



Australian Government

Department of Climate Change, Energy,
the Environment and Water

DRAFT Greenhouse Gas Emissions Estimation and Reporting Guidelines for Agriculture, Fisheries and Forestry

Methodological Guidance

Appendix A1



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We acknowledge the Traditional Owners of Country throughout Australia and recognise their continuing connection to land, waters and culture. We pay our respects to their Elders past and present.

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A. APPENDIX

Default data tables for relevant calculations are taken from the latest Australian National Inventory Report Vol 1 and Vol 2. Where data is taken from other sources, references are provided with these datasets.

A.1 Enteric Fermentation and Manure Management

A.1.1 Beef – Feedlot

Table A.1.1.1: Beef feedlot cattle – Duration of stay (days)

Feedlot Type	Length of Stay
Domestic	1-80 days
Mid-fed	81-200 days
Long-fed	201+days

Table A.1.1.2: Beef feedlot cattle – Animal characteristics

Unit		2005-2009	2010-2014	2015-2019	2020-2023
Domestic					
Days on feed	days	70	70	70	75
Feed intake	kg DM/day	10.0	10.0	10.4	10.4
N retention	per cent of intake	21.1	20.4	20.4	20.4
Mid-fed					
Days on feed	days	115	115	120	150
Feed intake	kg DM/day	11.2	10.8	10.8	10.8
N retention	per cent of intake	12.5	12.7	12.7	12.7
Long-fed					
Days on feed	days	250	250	250	250
Feed intake	kg DM/day	9.0	8.5	8.2	8.2
N retention	per cent of intake	6.6	7.0	7.0	7.0

(a) Refer to the National Inventory Report Volume 2 if pre-2005 values required

Table A.1.1.3: Beef feedlot cattle – Diet properties

Nutrient analysis	Unit	2005-2009	2010-2014	2015-2019	2020-2023
Domestic					
Dry matter digestibility	fraction	0.81	0.81	0.81	0.81
Crude protein	fraction	0.14	0.14	0.14	0.14
NDF	per cent	23.0	22.0	22.0	22.0
Ether Extract	per cent	4.5	4.5	4.8	4.8
Mid-fed					
Dry matter digestibility	fraction	0.81	0.81	0.81	0.81
Crude protein	fraction	0.13	0.125	0.12	0.12
NDF	per cent	24.0	22.0	22.0	22.0
Ether Extract	per cent	5.0	5.0	5.0	5.0
Long-Fed					
Dry matter digestibility	fraction	0.81	0.81	0.81	0.81
Crude protein	fraction	0.13	0.125	0.12	0.12
NDF	per cent	24.0	24.0	24.0	24.0
Ether Extract	per cent	5.0	5.0	5.5	5.5

(a) Refer to the National Inventory Report Volume 2 if pre-2005 values required

Table A.1.1.4: Beef feedlot cattle – MCFs (fraction) (MCF_{imT})

Treatment stage T	MMS m	NSW	QLD	SA	VIC	WA
Primary	Dry lot (Feedpad)	0.01	0.03	0.01	0.01	0.01
Secondary	Solid Storage (Stockpile)	0.02	0.02	0.02	0.02	0.02
	Composting (Passive Windrow)	0.01	0.01	0.01	0.01	0.01
	Direct Application to soil	0	0	0	0	0
Tertiary	Uncovered anaerobic lagoon (Effluent pond)	0.75	0.77	0.75	0.75	0.77

Table A.1.1.5: Beef feedlot cattle – Nitrous oxide EFs (EF_{mT})

Treatment stage T	MMS m	EF_{mT} (kg N ₂ O-N/kg N)
Primary	Dry lot (Feedpad)	0.0054
Secondary	Solid Storage (Stockpile)	0.005
	Composting (Passive Windrow)	0.01
	Direct Application to soil	0
Tertiary	Uncovered anaerobic lagoon (Effluent Pond)	0

Table A.1.1.6: Beef feedlot cattle – Fraction of N volatilised by MMS ($FracGASM_{mT}$)

Treatment stage T	MMS m	$FracGASM_{mT}$ (kg NH ₃ -N + NO _x -N)/kg N
Primary	Dry lot (Feedpad)	0.6
Secondary	Solid Storage (Stockpile)	0.25
	Composting (Passive Windrow)	0.4
	Direct Application to soil	0
Tertiary	Uncovered anaerobic lagoon (Effluent pond)	0.35

A.1.2 Beef – Pasture

Table A.1.2.1: Beef pasture cattle – Liveweight (kg) (W_{jkl})

State	Region	Season	Bull <1	Bull >1	Cow <1	Cow 1-2	Cow >2	Steer <1	Steer >1
ACT/NSW	n/a	Spring	80	480	75	300	440	75	380
		Summer	170	520	160	360	470	160	420
		Autumn	240	550	220	390	490	220	450
		Winter	280	560	260	410	500	260	460
South Australia	n/a	Spring	250	800	220	400	500	230	420
		Summer	320	800	280	420	500	290	420
		Autumn	80	700	70	300	450	75	400
		Winter	160	700	140	350	450	150	400
Tasmania	n/a	Spring	105	700	85	300	490	90	480
		Summer	480	750	150	350	530	160	460
		Autumn	250	725	200	360	500	215	490
		Winter	260	700	210	380	460	230	470
Victoria	n/a	Spring	250	820	240	410	560	240	510
		Summer	280	850	260	440	550	270	520
		Autumn	100	700	95	300	450	95	410
		Winter	150	720	140	320	470	140	440
Western Australia	South West	Spring	340	800	260	420	550	300	480
		Summer	380	780	300	450	530	340	470
		Autumn	100	680	80	320	480	100	340
		Winter	190	700	150	330	490	170	360
	Pilbara	Spring	80	450	70	260	340	80	370
		Summer	150	500	140	310	360	150	400
		Autumn	230	550	220	330	380	230	420
		Winter	250	500	240	340	360	250	390
	Kimberl ey	Spring	220	500	180	300	320	210	340
		Summer	110	550	90	220	380	100	390
		Autumn	170	600	140	270	390	160	430
		Winter	200	550	150	280	350	190	400

Table A.1.2.2: Beef pasture cattle – Liveweight (kg) (W_{jkl}) for NT and QLD

State	Region	Season	Bull <1	Bull >1	Cow s <1	Cow s 1-2	Cow s 2-3	Cow s >3	Steer <1	Steer 1-2	Steer 2-3	Steer >3
Northern Territory	Alice Springs	Spring	220	706	208	323	415	467	223	371	493	585
		Summer	110	703	112	256	368	465	108	280	421	543
		Autumn	170	721	169	306	392	464	176	339	470	580
		Winter	200	727	211	338	432	492	222	377	498	590
	Barkly	Spring	220	620	227	319	398	452	216	334	NO	NO
		Summer	110	650	108	262	346	430	111	236	NO	NO
		Autumn	170	670	170	266	363	444	169	282	NO	NO
		Winter	200	660	225	307	398	452	214	326	NO	NO
	Northern	Spring	220	620	177	267	365	406	231	249	324	NO
		Summer	110	650	102	203	299	380	102	218	263	NO
		Autumn	170	670	173	250	336	414	175	243	304	NO
		Winter	200	660	202	272	365	390	208	260	337	NO
Queensland	High	Spring	260	705	215	302	416	519	234	455	551	660
		Summer	153	703	118	277	397	483	111	304	521	547
		Autumn	168	718	191	319	440	506	188	326	520	582
		Winter	235	722	207	352	470	514	209	421	512	605
	Moderate/High	Spring	230	674	217	344	357	467	242	370	550	620
		Summer	113	669	113	283	361	477	120	273	545	553
		Autumn	172	685	172	309	376	471	238	329	573	620
		Winter	241	692	208	344	364	484	260	350	567	620
	Moderate/Low	Spring	236	674	178	310	428	466	193	370	519	565
		Summer	120	669	112	250	390	448	115	273	433	556
		Autumn	125	685	140	277	407	455	141	296	445	593
		Winter	180	692	183	316	438	468	189	354	500	553
	Low	Spring	190	617	174	265	371	415	170	272	392	531
		Summer	119	591	140	205	310	405	133	218	315	445
		Autumn	175	610	163	232	351	427	146	242	320	471
		Winter	192	615	162	255	364	420	157	261	342	484

Table A.1.2.3: Beef pasture cattle – Liveweight gain (kg) (LWG_{ijkl})

State	Region	Season	Bull	Bull	Cow	Cow	Cow	Steer	Steer
			<1	>1	<1	1-2	>2	<1	>1
ACT/NSW	n/a	Spring	0.5	0.2	0.5	0.4	0.3	0.5	0.4
		Summer	1.0	0.4	0.9	0.7	0.3	0.9	0.4
		Autumn	0.8	0.3	0.7	0.3	0.2	0.7	0.3
		Winter	0.4	0.1	0.4	0.2	0.1	0.4	0.1
South Australia	n/a	Spring	0.99	1.1	0.88	0.55	0.55	0.88	0.22
		Summer	0.77	0.0	0.66	0.22	0.0	0.66	0.0
		Autumn	0.9	-1.1	0.7	0.22	-0.55	0.8	-0.22
		Winter	0.88	0.0	0.77	0.55	0.0	0.82	0.0
Tasmania	n/a	Spring	1.0	0.50	1.0	1.0	-0.44	1.0	0.5
		Summer	0.82	0.55	0.71	0.55	0.99	0.77	0.5
		Autumn	0.77	0.50	0.55	0.11	-0.33	0.6	0.33
		Winter	0.11	-0.27	0.11	0.22	-0.44	0.16	-0.22
Victoria	n/a	Spring	1.10	1.10	1.10	0.99	0.99	1.10	0.77
		Summer	0.33	0.33	0.22	0.33	-0.10	0.33	0.11
		Autumn	0.50	0.20	0.55	0.44	0.20	0.55	0.20
		Winter	0.55	0.22	0.49	0.22	0.22	0.49	0.33
Western Australia	n/a	Spring	1.64	1.10	1.21	0.99	0.66	1.42	1.10
		Summer	0.44	-0.22	0.44	0.33	-0.22	0.44	-0.11
		Autumn	0.60	0.00	0.60	0.22	-0.55	0.60	0.00
		Winter	0.99	0.22	0.77	0.11	0.11	0.77	0.44
	Pilbara	Spring	0.70	-0.55	0.70	0.22	-0.22	0.70	-0.22
		Summer	0.77	0.55	0.77	0.66	0.55	0.77	0.33
		Autumn	0.88	0.55	0.88	0.22	0.22	0.88	0.22
		Winter	0.22	-0.55	0.22	0.11	-0.22	0.22	-0.33
	Kimberley	Spring	0.22	-0.55	0.33	0.22	-0.33	0.22	-0.55
		Summer	0.80	0.55	0.70	0.44	0.66	0.80	0.55
		Autumn	0.66	0.55	0.55	0.55	0.11	0.66	0.55
		Winter	0.33	-0.55	0.11	0.11	-0.44	0.33	-0.55

Table A.1.2.4: Beef pasture cattle – Liveweight gain (kg) (LWG_{ijkl}) for NT and QLD

State	Region	Season	Bull	Bull	Cow	Cow	Cow	Cow	Steer	Steer	Steer	Steer
			<1	>1	<1	1-2	2-3	>3	<1	1-2	2-3	>3
Northern Territory	Alice Springs	Spring	0.22	-0.23	0.25	0.17	0.18	-0.28	0.32	0.24	0.25	-0.05
		Summer	0.66	0.20	0.62	0.54	0.38	0.27	0.75	0.64	0.55	0.48
		Autumn	0.49	0.13	0.54	0.45	0.35	0.15	0.63	0.54	0.42	0.26
		Winter	0.27	-0.80	0.22	0.09	0.12	0.02	0.25	0.18	0.12	0.03
	Barkly	Spring	0.22	-0.44	0.20	0.21	0.18	0.01	0.12	0.09	NO	NO
		Summer	0.66	0.22	0.68	0.22	0.24	0.25	0.64	0.37	NO	NO
		Autumn	0.49	0.05	0.64	0.25	0.29	0.12	0.57	0.49	NO	NO
		Winter	0.27	-0.27	0.31	0.29	0.19	0.04	0.26	0.28	NO	NO
	Northern	Spring	0.22	-0.44	0.00	0.15	0.08	0.17	0.06	0.02	-0.14	NO
		Summer	0.66	0.22	0.79	0.40	0.38	0.27	0.80	0.16	0.30	NO
		Autumn	0.49	0.05	0.55	0.38	0.36	0.06	0.58	0.23	0.40	NO
		Winter	0.27	-0.27	0.02	0.09	0.16	-0.04	0.21	0.03	0.11	NO
Queensland	High	Spring	0.27	-0.19	0.38	0.25	0.07	0.05	0.52	0.55	0.19	0.60
		Summer	0.16	0.16	0.80	0.57	0.76	0.49	0.84	0.51	0.36	0.17
		Autumn	0.45	0.10	0.49	0.41	0.40	0.17	0.54	0.64	-0.05	0.32
		Winter	0.51	-0.07	0.13	-0.09	-0.13	0.07	0.25	0.71	0.17	0.43
	Moderate / High	Spring	-0.12	-0.19	0.41	0.09	0.41	-0.19	0.07	1.07	-0.08	0.00
		Summer	0.65	0.19	0.65	0.51	0.18	0.63	1.30	0.48	1.12	0.38
		Autumn	0.70	0.13	0.52	0.34	0.02	0.04	0.77	0.42	0.12	0.74
		Winter	0.32	-0.06	0.25	0.19	-0.10	-0.02	0.02	0.23	-0.13	0.00
	Moderate / Low	Spring	0.62	-0.19	0.37	0.41	0.06	-0.02	0.47	0.44	0.30	0.13
		Summer	0.05	0.19	0.31	0.54	0.53	0.15	0.28	0.57	0.42	0.40
		Autumn	0.33	0.13	0.39	0.36	0.26	0.11	0.40	0.44	0.37	-0.01
		Winter	0.61	-0.06	0.21	0.18	0.12	0.06	0.29	0.41	0.41	-0.15
	Low	Spring	-0.20	0.02	0.24	0.30	0.23	-0.05	0.34	0.30	0.57	0.52
		Summer	0.62	0.21	0.25	0.32	0.47	0.31	0.14	0.40	0.26	0.43
		Autumn	0.40	0.13	0.12	0.27	0.30	0.08	0.13	0.24	0.15	0.21
		Winter	0.08	0.04	0.06	0.18	0.11	-0.07	0.13	0.16	0.40	0.33

Table A.1.2.5: Beef pasture cattle – Dry matter digestibility of feed intake (fraction) (DMD_j)

State	Region	Season			
		Spring	Summer	Autumn	Winter
ACT/NSW	n/a	0.55	0.65	0.60	0.50
NT	n/a	0.55	0.61	0.57	0.54
QLD	n/a	0.53	0.57	0.55	0.51
SA	n/a	0.70	0.55	0.55	0.75
TAS	n/a	0.75	0.60	0.70	0.75
VIC	n/a	0.80	0.55	0.60	0.76
WA	South West	0.80	0.58	0.50	0.75
	Pilbara	0.40	0.65	0.55	0.45
	Kimberley	0.40	0.65	0.55	0.45

Table A.1.2.6: Beef pasture cattle – Crude protein content of feed intake (fraction) (CP_j)

State	Region	Season			
		Spring	Summer	Autumn	Winter
ACT/NSW	n/a	0.07	0.13	0.1	0.06
NT	n/a	0.058	0.092	0.075	0.053
QLD	n/a	0.072	0.099	0.078	0.059
SA	n/a	0.16	0.07	0.09	0.2
TAS	n/a	0.2	0.1	0.16	0.2
VIC	n/a	0.25	0.07	0.1	0.21
WA	South West	0.2	0.09	0.06	0.2
	Pilbara	0.04	0.12	0.09	0.06
	Kimberley	0.04	0.12	0.09	0.06

Table A.1.2.7: Beef pasture cattle – Feed intake adjustment and milk production (kg/head/day)

Breed	Season	Feed adjustment ($MC_{jk=1,3,6}$)	Milk intake / production ($DMP_{jk=5}$)
Hereford or Shorthorn breeds	Spring	1.3	6
	Summer	1.1	4
	Autumn	0	0
	Winter	0	0
Northern Brahman cross breed	Spring	0	0
	Summer	1.3	4
	Autumn	1.1	3
	Winter	0	0

Table A.1.2.8: Beef pasture cattle – Standard reference weights (kg) (SRW_k)

State	Bulls <1	Bulls >1	Cows <1	Cows 1-2	Cows >2	Steer <1	Steer >1
ACT/NSW	700	700	500	500	500	600	600
Northern Territory	770	770	550	550	550	660	660
Queensland	770	770	550	550	550	660	660
South Australia	770	770	550	550	550	660	660
Tasmania	770	770	550	550	550	660	660
Victoria	770	770	550	550	550	660	660
Western Australia	770	770	550	550	550	660	660

Table A.1.2.9: Beef pasture cattle – Fraction of manure to each manure management system (fraction) (MMS_m)

State	Region	MMS_m (%)	
		Pasture, range and paddock	Uncovered Anaerobic lagoon
ACT	n/a	99.192	0.808
NSW	n/a	99.452	0.548
SA	n/a	99.759	0.241
TAS	n/a	99.122	0.878
VIC	n/a	98.894	1.106
WA	South West	99.622	0.378
	Pilbara	99.999	0.001
	Kimberley	99.999	0.001
NT	Alice Springs	99.999	0.001
	Barkly	99.994	0.006
	Northern	99.999	0.001
QLD	High	99.773	0.227
	Moderate/High	99.898	0.102
	Moderate/Low	99.979	0.021
	Low	99.977	0.023

Table A.1.2.10: Beef pasture cattle – Methane conversion factor per region (fraction) (MCF_{im})

State	Region	MCF_{im}	
		Pasture, range and paddock	Uncovered Anaerobic lagoon
ACT	n/a	0.0047	0.71
NSW	n/a		0.75
SA	n/a		0.74
TAS	n/a		0.7
VIC	n/a		0.74
WA	South West		0.76
	Pilbara		0.76
	Kimberley		0.76
NT	Alice Springs		0.8
	Barkly		0.8
	Northern		0.8
QLD	High		0.78
	Moderate/High		0.78
	Moderate/Low		0.78
	Low	0.78	

A.1.3 Dairy

Table A.1.3.1: Dairy cattle – Liveweight (kg) – Cows and Heifers (W_i)

Breed	Milking Cows	Heifers >1	Heifers <1 (weaned)	Reference
Medium Friesian	550	380	155	Dairy Australia [1]
Large Friesian	600	415	170	
Holstein-Friesian	650	450	185	
Friesian crossbred	500	350	145	
Jersey	400	275	115	
Jersey crossbred	450	315	130	
Ayrshire	540	375	150	
Guernsey	480	335	140	
Brown Swiss	600	415	170	
Illawarra/Aussie Red	550	375	150	

Table A.1.3.2: Dairy cattle – Liveweight (kg) – Bulls (W_i)

Breed	Bulls >1	Bulls <1 (weaned)
All breeds	600	225

Table A.1.3.3: Dairy cattle – Liveweight gain (kg) (LWG_i)

Milking Cows	Heifers >1	Heifers <1 (weaned)	Bulls >1	Bulls <1 (weaned)
0.016	0.6	0.57	0.1	0.8

Table A.1.3.4: Dairy cattle – Reference weights (kg) (WR_i)

Milking Cows	Heifers >1	Heifers <1 (weaned)	Bulls >1	Bulls <1 (weaned)
590	590	590	770	770

Table A.1.3.5: Dairy cattle – Data for pre-weaned calves

	CH ₄ production	Volatile solids (VS _{j=3,5})	Nitrogen Excreted (NPW _{j=3,5})
	(kg/day)		
Heifers<1	0.0176	0.2685	0.0137
Bulls<1	0.0204	0.3003	0.0092

Table A.1.3.6: Dairy cattle – Dairy cattle – MCFs (fraction) (MCF_{jm})

MMS m	ACT	NSW	NT	QLD	SA	TAS	VIC	WA
Pasture	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
Anaerobic lagoon	0.72	0.76	0.8	0.78	0.74	0.69	0.73	0.76
Daily spread - Sump and dispersal systems	0.005	0.005	0.01	0.005	0.005	0.001	0.005	0.005
Daily spread - Drains to paddocks (a)	0.15	0.18	0.50	0.24	0.17	0.13	0.17	0.18
Solid Storage	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Direct Application to soil	0	0	0	0	0	0	0	0

(a) MCF based on liquid slurry without natural crust

Table A.1.3.7: Dairy cattle – Nitrous oxide EFs and fraction of N volatilised by MMS

MMS m	EF _m (kg N ₂ O-N/kg N excreted)	FracGASM _m (kg N ₂ O-N/kg N excreted)
M=14 Pasture	0	0
M=1 Anaerobic lagoon	0	0.35
M=2 Daily Spread – Sump and Dispersal	0	0.07
M=3 Daily Spread – Drains to Paddock	0	0.2
M=3 Solid Storage	0.005	0.3

Table A.1.3.8: Dairy cattle – Methane production for pre-weaned heifer and bull calves (kg CH₄/head/day) (MPW_{ENTERIC,j=3,5})

Animal Class j	MPW _{ENTERIC}
Heifers < 1 year	0.0176
Bulls < 1 year	0.0204

Table A.1.3.9: Dairy cattle – Increased metabolic rate when producing milk (kg DM/head/day) (MR_j)

Animal Class j	MR _j
Milking cows, and house cows	1.1
All other cattle classes	1.0

Table A.1.3.10: Dairy cattle – Fraction of volatile solids voided to each manure management system (fraction) (MMS_{jm})

Area	Annual fraction of time spent per area		
	Pasture	Milking Shed	Feedpad
System 1: Grazed Only	0.89	0.11	0
System 2: On feedpad for <10 hr/day for <3 months/year	0.79	0.11	0.10
System 3: Pasture-grazed 3-9 months/year	0.534	0.11	0.356
System 4: Zero grazing	0	0.11	0.89

Table A.1.3.11: Dairy cattle – EF for nitrous oxide per MMS (kg N₂O-N/kg N) (EF_m)

MMS m	EF _m
m=14 Pasture	0
m=1 Anaerobic Lagoon	0
m=2 Daily Spread: Sump and dispersal	0
m=3 Daily Spread: Drains to paddocks	0
m=4 Solid Storage	0.005

A.1.4 Sheep

Table A.1.4.1: Sheep – Liveweight (kg) (W_{jk})

State	Season	Rams	Wethers	Sheep > 1			Sheep < 1
				Maiden Ewes (intended for breeding)	Breeding Ewes	Other Ewes	Lambs & Hoggets
ACT/NSW	Spring	75	62	44	54	56	20
	Summer	75	55	42	49	51	27
	Autumn	69	55	43	50	50	32
	Winter	69	55	45	50	51	34
Queensland	Spring	58	50	35	40	45	20
	Summer	61	55	40	45	50	25
	Autumn	63	55	40	45	50	20
	Winter	60	50	35	42	48	25
South Australia	Spring	80	70	52	55	55	40
	Summer	70	65	52	55	55	45
	Autumn	70	60	52	55	55	20
	Winter	70	60	52	55	55	30
Tasmania	Spring	90	55	45	50	50	14
	Summer	90	55	45	50	50	24
	Autumn	75	50	45	50	50	36
	Winter	75	45	50	55	50	42
Victoria	Spring	70	60	50	55	50	22
	Summer	65	55	45	50	50	28
	Autumn	65	52	43	48	50	33
	Winter	60	50	40	45	50	35
Western Australia	Spring	75	60	50	55	55	30
	Summer	65	55	45	50	50	30
	Autumn	65	48	40	45	45	10
	Winter	65	48	45	50	50	20

Table A.1.4.2: Sheep – Dry matter digestibility of feed intake (fraction) (DMD_{jk})

State	Season	Sheep > 1				Sheep < 1	
		Rams	Wethers	Maiden Ewes (intended for breeding)	Breeding Ewes	Other Ewes	Lambs & Hoggets
ACT/NSW	Spring	0.75	0.75	0.75	0.75	0.75	0.75
	Summer	0.61	0.61	0.61	0.61	0.61	0.61
	Autumn	0.64	0.64	0.64	0.64	0.64	0.64
	Winter	0.72	0.72	0.72	0.72	0.72	0.72
Queensland	Spring	0.51	0.51	0.51	0.51	0.51	0.51
	Summer	0.55	0.55	0.55	0.55	0.55	0.55
	Autumn	0.59	0.59	0.59	0.59	0.59	0.59
	Winter	0.58	0.58	0.58	0.58	0.58	0.58
South Australia	Spring	0.70	0.70	0.70	0.70	0.70	0.70
	Summer	0.55	0.55	0.55	0.55	0.55	0.55
	Autumn	0.55	0.55	0.55	0.55	0.55	0.55
	Winter	0.75	0.75	0.75	0.75	0.75	0.75
Tasmania	Spring	0.75	0.75	0.75	0.75	0.75	0.75
	Summer	0.55	0.55	0.55	0.55	0.55	0.55
	Autumn	0.67	0.67	0.67	0.67	0.67	0.67
	Winter	0.70	0.70	0.70	0.70	0.70	0.70
Victoria	Spring	0.70	0.70	0.70	0.70	0.70	0.70
	Summer	0.55	0.55	0.55	0.55	0.55	0.55
	Autumn	0.65	0.65	0.65	0.65	0.65	0.65
	Winter	0.60	0.60	0.60	0.60	0.60	0.60
Western Australia	Spring	0.73	0.73	0.73	0.73	0.73	0.73
	Summer	0.55	0.55	0.55	0.55	0.55	0.55
	Autumn	0.50	0.50	0.70	0.70	0.50	0.70
	Winter	0.76	0.76	0.76	0.76	0.76	0.76

Table A.1.4.3: Sheep – Feed availability (t/ha) (DMA_{jk})

State	Season	Rams	Wethers	Sheep > 1			Sheep < 1
				Maiden Ewes (intended for breeding)	Breeding Ewes	Other Ewes	Lambs & Hoggets
ACT/NSW	Spring	2.9	2.9	2.9	2.9	2.9	2.9
	Summer	2.5	2.5	2.5	2.5	2.5	2.5
	Autumn	1.6	1.6	1.6	1.6	1.6	1.6
	Winter	1.7	1.7	1.7	1.7	1.7	1.7
Queensland	Spring	1.5	1.5	1.5	1.5	1.5	1.5
	Summer	2.0	2.0	2.0	2.0	2.0	2.0
	Autumn	2.2	2.2	2.2	2.2	2.2	2.2
	Winter	1.7	1.7	1.7	1.7	1.7	1.7
South Australia	Spring	4.0	4.0	4.0	4.0	4.0	4.0
	Summer	2.5	2.5	2.5	2.5	2.5	2.5
	Autumn	0.7	0.7	0.7	0.7	0.7	0.7
	Winter	0.9	0.9	0.9	0.9	0.9	0.9
Tasmania	Spring	2.5	2.5	2.5	2.5	2.5	2.5
	Summer	2.5	2.5	2.5	2.5	2.5	2.5
	Autumn	1.3	1.3	1.3	1.3	1.3	1.3
	Winter	0.8	0.8	0.8	0.8	0.8	0.8
Victoria	Spring	3.2	3.2	3.2	3.2	3.2	3.2
	Summer	3.0	3.0	3.0	3.0	3.0	3.0
	Autumn	1.8	1.8	1.8	1.8	1.8	1.8
	Winter	1.0	1.0	1.0	1.0	1.0	1.0
Western Australia	Spring	3.5	3.5	3.5	3.5	3.5	3.5
	Summer	1.5	1.5	1.5	1.5	1.5	1.5
	Autumn	0.7	0.7	0.7	0.7	0.7	0.7
	Winter	1.2	1.2	1.2	1.2	1.2	1.2

Table A.1.4.4: Sheep – Crude protein content of feed intake (fraction) (CP_{jk})

State	Season	Rams	Wethers	Sheep > 1			Sheep < 1
				Maiden Ewes (intended for breeding)	Breeding Ewes	Other Ewes	Lambs & Hoggets
ACT/NSW	Spring	0.20	0.20	0.20	0.20	0.20	0.20
	Summer	0.10	0.10	0.10	0.10	0.10	0.10
	Autumn	0.12	0.12	0.12	0.12	0.12	0.12
	Winter	0.18	0.18	0.18	0.18	0.18	0.18
Queensland	Spring	0.08	0.08	0.08	0.08	0.08	0.08
	Summer	0.10	0.10	0.10	0.10	0.10	0.10
	Autumn	0.09	0.09	0.09	0.09	0.09	0.09
	Winter	0.07	0.07	0.07	0.07	0.07	0.07
South Australia	Spring	0.16	0.16	0.16	0.16	0.16	0.16
	Summer	0.07	0.07	0.07	0.07	0.07	0.07
	Autumn	0.09	0.09	0.09	0.09	0.09	0.09
	Winter	0.20	0.20	0.20	0.20	0.20	0.20
Tasmania	Spring	0.20	0.20	0.20	0.20	0.20	0.20
	Summer	0.07	0.07	0.07	0.07	0.07	0.07
	Autumn	0.14	0.14	0.14	0.14	0.14	0.14
	Winter	0.16	0.16	0.16	0.16	0.16	0.16
Victoria	Spring	0.16	0.16	0.16	0.16	0.16	0.16
	Summer	0.07	0.07	0.07	0.07	0.07	0.07
	Autumn	0.13	0.13	0.13	0.13	0.13	0.13
	Winter	0.10	0.10	0.10	0.10	0.10	0.10
Western Australia	Spring	0.18	0.18	0.18	0.18	0.18	0.18
	Summer	0.06	0.06	0.06	0.06	0.06	0.06
	Autumn	0.06	0.06	0.16	0.16	0.06	0.16
	Winter	0.21	0.21	0.21	0.21	0.21	0.21

Table A.1.4.5: Sheep – Liveweight gain (kg) (LWG_{jk})

State	Season	Rams	Wethers	Sheep > 1			Sheep < 1
				Maiden Ewes (intended for breeding)	Breeding Ewes	Other Ewes	Lambs & Hoggets
ACT/NSW	Spring	0.07	0.08	0.07	0.04	0.05	0.16
	Summer	0	-0.08	0.00	-0.05	-0.05	0.08
	Autumn	-0.07	0.00	0.00	0.01	-0.01	0.05
	Winter	0.00	0.00	0.02	0.00	0.01	0.04
Queensland	Spring	-0.02	0.00	0.00	-0.02	-0.03	0.20
	Summer	0.03	0.05	0.05	0.05	0.05	0.05
	Autumn	0.02	0.00	0.00	0.00	0.00	0.20
	Winter	-0.03	-0.05	-0.05	-0.03	-0.02	0.05
South Australia	Spring	0.11	0.11	0.00	0.00	0.00	0.11
	Summer	-0.10	-0.10	0.00	0.00	0.00	0.05
	Autumn	0.00	-0.10	0.00	0.00	0.00	0.16
	Winter	0.00	0.00	0.00	0.00	0.00	0.16
Tasmania	Spring	0.16	0.11	0.03	-0.02	0.00	0.15
	Summer	0.00	0.00	0.00	0.00	0.00	0.11
	Autumn	-0.20	-0.10	0.00	0.00	0.00	0.13
	Winter	0	-0.10	0.5	0.02	0.00	0.07
Victoria	Spring	0.11	0.11	0.16	0.11	0.00	0.15
	Summer	-0.05	-0.05	-0.05	-0.05	0.00	0.07
	Autumn	0.00	-0.03	-0.02	-0.02	0.00	0.05
	Winter	-0.05	-0.02	-0.03	-0.03	0.00	0.02
Western Australia	Spring	0.11	0.13	0.05	0.05	0.05	0.11
	Summer	-0.11	-0.05	-0.05	-0.05	-0.05	0.00
	Autumn	0.00	-0.08	0.11	-0.05	-0.05	0.11
	Winter	0.00	0.00	0.05	0.05	0.05	0.11

Table A.1.4.6: Sheep – Standard reference weights (kg) (SRW_k)

State	Sheep > 1				Sheep < 1	
	Rams	Wethers	Maiden Ewes (intended for breeding)	Breeding Ewes	Other Ewes	Lambs & Hoggets
ACT/NSW	78	62	57	57	57	60
Queensland	70	60	50	50	50	55
South Australia	84	72	60	60	60	66
Tasmania	77	66	55	55	55	60
Victoria	70	60	50	50	50	55
Western Australia	84	72	60	60	60	66

Table A.1.4.7: Sheep – Fraction of waste in each manure management system (fraction) (MMS_m)

State	MMS _m (%)	
	Pasture, range and paddock	Uncovered Anaerobic lagoon
ACT	99.25	0.75
NSW	99.55	0.45
QLD	99.91	0.09
SA	99.74	0.26
TAS	99.50	0.50
VIC	99.17	0.83
WA	99.59	0.41

Table A.1.4.8: Sheep – Methane conversion factor per region (fraction) (MCF_{im})

State	MCF _{im}	
	Pasture, range and paddock	Uncovered Anaerobic lagoon
ACT	0.0047	0.72
NSW		0.75
QLD		0.78
SA		0.74
TAS		0.69
VIC		0.73
WA		0.76

A.1.5 Other Livestock

Table A.1.5.1 : Other Livestock – Enteric fermentation emission factor for each other livestock type (kg CH₄/head/year (M_j))

Other Livestock Type	M_j
Buffalo	68
Goats	5
Deer	20
Camels	46
Alpacas	8
Horses	18
Mules/asses	10
Emus/ostriches	5

Table A.1.5.2: Other Livestock – Volatile solids produced by each other livestock type (kg VS/head/day) (VS_j)

Other Livestock Type	VS_j
Buffalo	2.73
Goats	0.34
Deer	0.91
Camels	2.73
Alpacas	0.34
Horses	2.73
Mules/asses	0.91
Emus/ostriches	0.34

Table A.1.5.3: Other Livestock – Nitrogen excreted per livestock type (kg N₂O/head/year) (NE_j)

Other Livestock Type j	NE _j
Buffalo	39.5
Goats	7.0
Deer	13.2
Camels	39.5
Alpacas	7.0
Horses	39.5
Mules/asses	13.2
Emus/ostriches	7.0

Table A.1.5.4: Other Livestock – Average Liveweights (W_{co}) (kg)

Other Livestock Type j	Average Liveweight	Average Liveweight
Buffalo	336	-
Goats	33	28kg – low productivity systems 50kg – high productivity systems
Deer	120	
Camels	217	570
Alpacas	-	65
Horses	377	550
Mules/asses	130	245
Emus/ostriches	120	
Reference	IPCC 2019, Table 10A.5 [2]	IPCC 2019, Table 10.10 [2]

Table A.1.5.5: Other Livestock – Fraction of waste in each manure management system (fraction) (MMS_m)

State	MMS_m (%)	
	Pasture, range and paddock	Uncovered Anaerobic lagoon
ACT	99.66	0.34
NSW	99.66	0.34
NT	99.66	0.34
QLD	99.66	0.34
SA	99.66	0.34
TAS	99.66	0.34
VIC	99.66	0.34
WA	99.66	0.34

Table A.1.5.6: Other Livestock – Methane conversion factor per region (fraction) (MCF_{im})

State	MCF_{im}	
	Pasture, range and paddock	Uncovered Anaerobic lagoon
ACT	0.0047	0.71
NSW		0.75
NT		0.80
QLD		0.78
SA		0.74
TAS		0.70
VIC		0.74
WA		0.76

A.1.6 Swine

Table A.1.6.1: Swine – Intake and manure characteristics derived from PigBal

Swine Characteristic		2005-2009	2010-2014	2015-2019	2020-2024
Breeder herd					
Feed Intake (ingested as-fed) (I_i)					
Boars	kg/hd/day	2.58	2.62	2.62	2.62
Sows	kg/hd/day	2.30	2.30	2.30	2.30
Gilts	kg/hd/day	2.50	2.50	2.50	2.50
Volatile solids (VS_j)					
Boars	kg/hd/day	0.40	0.40	0.40	0.40
Sows	kg/hd/day	0.43	0.46	0.46	0.46
Gilts	kg/hd/day	0.51	0.55	0.55	0.55
Nitrogen in waste (NW_j)					
Boars	kg/hd/day	0.048	0.046	0.046	0.046
Sows	kg/hd/day	0.053	0.049	0.049	0.049
Gilts	kg/hd/day	0.054	0.046	0.046	0.046
Slaughter pig herd					
Feed intake (I _i)	kg/hd/day	1.65	1.71	1.71	1.71
Volatile solids (VS _j)	kg/hd/day	0.36	0.39	0.39	0.39
Nitrogen in waste (NW _j)	kg/hd/year	14.2	11.4	11.4	11.4
Reference	PigBal 5 [3]				

(a) Refer to the National Inventory Report Volume 2 if pre-2005 values required

Table A.1.6.2: Swine – Fraction of N volatilised by MMS ((kg NH₃-N + NO_x-N)/kgN) (FracGASM_{mT})

MMS m	FracGASM _{mT}
Outdoor (Dry lot)	0.3
Deep litter	0.125
Stockpile (Solid storage)	0.2
Effluent pond (Uncovered anaerobic lagoon)	0.55
Anaerobic digester / Covered lagoon	0
Short HRT tank storage < 1 month (pit storage)	0.25

Table A.1.6.3: Swine – Nitrous oxide EFs by MMS (kgN₂O-N/kgN) (EF_{mT})

MMS m	EF _{mT}
Outdoor (Dry lot)	0.02
Deep litter	0.01
Stockpile (Solid storage)	0.005
Effluent pond (Uncovered anaerobic lagoon)	0
Anaerobic digester / Covered lagoon	0
Short HRT tank storage < 1 month (pit storage)	0.002

Table A.1.6.4: Swine – MCFs (fraction) (MCF_{im})

MMS m	NSW	QLD/NT	SA	TAS	VIC	WA
Outdoor (Dry lot)	0.01	0.03	0.01	0.01	0.01	0.01
Deep litter	0.04	0.04	0.04	0.04	0.04	0.04
Stockpile (Solid storage)	0.02	0.02	0.02	0.02	0.02	0.02
Effluent pond (Uncovered anaerobic lagoon)	0.75	0.78	0.75	0.70	0.74	0.76
Anaerobic digester / Covered lagoon	0.1	0.1	0.1	0.1	0.1	0.1
Short HRT tank storage < 1 month (pit storage)	0.03	0.03	0.03	0.03	0.03	0.03
Direct Application to soil	0	0	0	0	0	0

Table A.1.6.5: Swine – Average liveweight (inventory defaults) (kg) (W_{co})

Livestock Type j	Average Liveweight (kg)
Sows	188
Boars	206
Gilts	125
Slaughter pigs	39
Slaughter pigs at turnoff	97

Table A.1.6.6: Swine – Liveweight and age ranges (PigBal) (kg) (W_{co})

Livestock Type j	Liveweight range (kg/pig)		Age range (weeks)	
	Entry	Exit	Entry	Exit
Gilt	100	160	22	30
Boar	100	300	22	128
Dry Sow	145	200	n/a	n/a
Lactating Sow	145	200	n/a	n/a
Sucker	1.4	7	0	3.5
Weaner	7	35	3.5	10
Porker	35	60	10	14
Grower	60	85	14	18
Finisher	85	110	18	22
Heavy finisher	110	130	22	26
Reference	PigBal 5 [3]			

A.1.7 Poultry

Table A.1.7.1: Poultry - Diet properties

Nutrient analysis	Units	Layers	Meat chicken growers	Meat chicken breeder	Meat other
Dry matter intake (I_{jk})	(kgDM/head/day)	0.086	0.093	0.103	0.093
Dry matter digestibility (DMD_{jk})	fraction	0.80	0.80	0.80	0.80
Crude protein (CP_j)	fraction	0.19	0.23	0.19	0.23
Nitrogen retention rate (NR_{jk})	per cent	0.35	0.47	0.32	0.47
Manure ash (A)	per cent	0.18	0.15	0.18	0.15

Table A.1.7.2: Poultry – Fraction of N volatilised by MMS ((kg NH₃-N + NO_x-N)/kgN) ($FracGASM_{mT}$)

MMS m	$FracGASM_{mT}$	
Poultry manure with litter (housing)	0.3	
Poultry manure without litter (housing)	Belt manure removal	0.05
	Manure stored in house under cages or slat	0.4
Solid storage (stockpile)	0.2	
Composting (passive windrow)	0.2	
Direct processing	0	
Anaerobic digester / covered pond	0	

Table A.1.7.3: Poultry – Nitrous oxide EFs by MMS (kgN₂O-N/kgN) (EF_{mT})

MMS m	EF_{mT}
Poultry manure with litter (housing)	0.001
Poultry manure without litter (housing)	0.001
Pasture range and paddock (free range)	0.02
Solid storage (stockpile)	0.005
Composting (passive windrow)	0.01
Direct processing	0
Anaerobic digester / covered pond	0

Table A.1.7.4: Poultry – MCFs (fraction) (MCF_{im})

MMS m	All states	NSW/ACT	QLD/NT	VIC	SA	WA	TAS
Poultry manure with litter	0.015	n/a					
Poultry manure without litter	0.015	n/a					
Pasture range and paddock ^(a)	n/a	0.01	0.03	0.01	0.01	0.01	0.01
Solid storage	0.02	n/a					
Composting (passive windrow)	n/a	0.01	0.01	0.01	0.01	0.01	0.005
Anaerobic digester / Covered pond	0.1	n/a					
Direct processing into pelletized fertiliser	0	n/a					
Direct application to soil	0	n/a					

(a) Applies MCF for drylot

Table A.1.7.5: Poultry - Liveweights (W_{co}) (kg)

Livestock Class j	Average Liveweight (kg)
Chicken	1.3
Hen >=1 yr	2
Pullets	1.4
Broilers	1.2
Reference	IPCC 2019 [2]

A.1.8 Manure management

Table A.1.8.1: Manure Management – Methane conversion factor per temperature zone (fraction) (MCF_{im})

Temperature		MCF by manure management system ^(a)											
Zone	MAT (°C)	Uncovered anaerobic lagoon	Covered lagoon	Liquid Slurry (without natural crust)	Daily spread ^(b)	Composting (passive windrow)	Solid Storage	Pit Storage <1 month	Deep Litter	Poultry Manure (with/without litter)	Direct processing into pelletized fertiliser	Direct application to soil	Pasture, Range and Paddock ^{(c)(d)}
Cool	≤10	0.66	0.1	0.1	0.001	0.005	0.02	0.03	0.04	0.015	0	0	0.0047
	11	0.68		0.11									
	12	0.7		0.13									
	13	0.71		0.14									
	14	0.73		0.15									
Temperate	15	0.74		0.17	0.005	0.01							
	16	0.75		0.18									
	17	0.76		0.2									
	18	0.77		0.22									
	19	0.77		0.24									
	20	0.78		0.26									
	21	0.78		0.29									
	22	0.78		0.31									
	23	0.79		0.34									
	24	0.79		0.37									
Warm	25	0.79	0.41	0.01	0.015								
	26	0.79	0.44										
	27	0.8	0.48										
	≥28	0.8	0.5										
Source		IPCC 2006	NIR	IPCC 2006	IPCC	IPCC 2006	NIR	NIR	NIR	IPCC 2006	NIR	NIR	IPCC 2019

- (a) Drylot MCF is state based - 0.02 (NT) or 0.01 (Other States) - source NIR
- (b) Dairy daily spread – drains to paddock should apply liquid slurry MCFs – source NIR
- (c) Dairy pasture range and paddock is state based - 0.03 (QLD, NT) or 0.01 (Other States) – source NIR
- (d) Poultry and Swine pasture range and paddock should apply the drylot MCFs – source NIR

A.2 Fertiliser, Residues and Rice

A.2.1 Crop and Pasture Attributes

Table A.2.1.1: Crop attributes

Unit	fraction	fraction	kg dry weight/kg crop residue	fraction	kg N/kg DM	kg N/kg DM	fraction	fraction
Crop type c	Residue: Crop ratio R_{AGc}	Below-ground: above-ground residue ratio R_{BGc}	Dry matter content DM_c	Carbon fraction in dry matter CC_c	N content above-ground NC_{AGc}	N content below-ground NC_{BGc}	Fraction of residue remaining at time of burning S_c	Burning efficiency Z_c
Wheat	1.50	0.29	0.88	0.40	0.006	0.010	0.5	0.90
Barley	1.24	0.32	0.88	0.40	0.007	0.010	0.5	0.85
Maize	0.81	0.39	0.85	0.42	0.005	0.007	1.0	0.80
Oats	1.42	0.43	0.88	0.40	0.006	0.010	0.5	0.85
Rice	1.31	0.16	0.80	0.42	0.007	0.010	1.0	0.80
Sorghum	1.50	0.22	0.80	0.40	0.008	0.007	0.5	0.85
Triticale	1.50	0.42	0.88	0.40	0.006	0.010	0.5	0.85
Other cereals	1.46	0.36	0.88	0.40	0.006	0.010	0.5	0.85
Pulses	1.37	0.51	0.87	0.40	0.009	0.010	0.5	0.85
Tubers and roots	0.34	0.43	0.25	0.40	0.020	0.010	n/a	0.85
Peanuts	1.07	0.20	0.80	0.42	0.016	0.014	0.5	0.85
Sugar cane	0.25	0.45	0.20	0.40	0.005	0.007	1.0	0.80

Unit	fraction	fraction	kg dry weight/kg crop residue	fraction	kg N/kg DM	kg N/kg DM	fraction	fraction
Crop type c	Residue: Crop ratio R_{AGc}	Below-ground: above-ground residue ratio R_{BGc}	Dry matter content DM_c	Carbon fraction in dry matter CC_c	N content above-ground NC_{AGc}	N content below-ground NC_{BGc}	Fraction of residue remaining at time of burning S_c	Burning efficiency Z_c
Cotton	1.90	0.30	0.90	0.40	0.01	0.01	n/a	0.85
Hops	1.50	0.29	0.88	0.40	0.006	n/a	n/a	0.85
Oilseeds	2.08	0.33	0.96	0.40	0.009	0.010	0.5	0.85
Forage crops	1.34	0.37	0.88	0.40	0.006	0.010	n/a	0.85
Other annual crops	1.00	0.22	0.85	0.40	0.008	0.009	n/a	n/a
Other perennial crops	1.5	0.29	0.88	0.4	0.006	n/a	n/a	n/a

Table A.2.1.2: Crop attributes – Fraction removed (fraction) (FFOD_c)

Crop type c	State	Fraction removed FFOD_c
Rice	All states	0.06
Tubers and roots	All states	1
Cotton	All states	0
Hops	All states	0
Forage crops	All states	0.8
Sugar Cane	NSW	0
	QLD	0.03
	WA	0
All other crop types	NSW	0.05
	VIC	0.07
	QLD	0.04
	SA	0.09
	WA	0.11
	TAS	0.16
	NT	0.01
	ACT	0.00

Table A.2.1.3: Pasture attributes

Units	t dry matter/ha	fraction	kg N/kg dry matter	kg N/kg dry matter	fraction
Pasture type	Average Yield	N content			
	(t DM ha)	Below-ground: above-ground residue ratio	Above-ground	Below-ground	Fraction above ground residue removed
	Y_p	R_{BGp}	NC_{AGp}	NC_{BGp}	$FFOD_p$
Annual grass	4.41	0.4	0.015	0.012	0.8
Grass clover mixture	8.34	0.8	0.025	0.016	0.8
Lucerne	8.62	0.4	0.027	0.019	0.8
Other legume	5.62	0.4	0.027	0.022	0.8
Perennial pasture	8.35	0.8	0.015	0.012	0.8

Table A.2.1.4: Emission factor for organic fertiliser and crop residues returned to the soil (kg N₂O-N/kg N)

Climate zone	EF_{Ni} & EF_{N₂O,i}
Wet climate zone	0.006
Dry climate zones	0.005

A.2.2 Parameters relating to Fertiliser Use, Atmospheric Deposition and Leaching and Run-off

Table A.2.2.1: Nitrous oxide emission factors for inorganic fertiliser application (kg N₂O-N/kg N) (EF_{N2O})

These emission factors are used for both direct and atmospheric deposition emission estimation.

Production system j	EF _{N2O}
Irrigated pasture	0.0059
Irrigated crop	0.007
Non-irrigated pasture	0.0018
Non-irrigated crop (low rainfall)	0.0029
Non-irrigated crop (high rainfall)	0.008
Sugar	0.0199
Cotton	0.0053
Horticultural crops	0.0064
Aquaculture*	0.0026**
Rice (continuous flooding)	0.003
Rice (single and multiple drainage, or alternate wetting and drying)	0.005
Aquaculture	0.0026
Forestry**	0.0018

*For aquaculture, emissions related atmospheric deposition is assumed to be 0 and therefore EF_{N2O} = 0 is in aquaculture related atmospheric deposition calculations.

**non-irrigated pasture is assumed to be the most suitable production system for forestry plantations

Table A.2.2.2: Emission factor for urine and dung posited on pasture, range or paddock (kg N₂O-N/kg N) (EF_{PRP})

Climate Zone	EF _{PRP}
Wet climate zone	0.006
Dry climate zones	0.002

Table A.2.2.3: Fraction of nitrogen in common inorganic fertilisers (kgN/kg) ($FN_{\text{inorganic},f}$)

Fertiliser Type f	$FN_{\text{inorganic},f}$	References
Monoammonium phosphate (MAP)	0.10	Wood & Cowie [4]
Diammonium phosphate (DAP)	0.18	
Urea	0.46	
Sulphate of ammonia (SOA)	0.21	
Urea-ammonium nitrate (UAN)	0.32	
Ammonium nitrate (AN)	0.337	
Calcium ammonium nitrate (CAN)	0.27	
Ammonium Sulfate	0.21	Nadarajan & Sukumaran [5]
Calcium Nitrate	0.155	Lane, Finch & Samuel, [6]

Table A.2.2.4: Fraction of urea in common inorganic fertilisers (kg urea/kg) (FU_f)

Fertiliser Type f	FU_f	References
Monoammonium phosphate (MAP)	0	Wood & Cowie [4]
Diammonium phosphate (DAP)	0	
Urea	1	
Sulphate of ammonia (SOA)	0	
Urea-ammonium nitrate (UAN)	0.35	
Ammonium nitrate (AN)	0	
Calcium ammonium nitrate (CAN)	0	
Ammonium Sulfate	0	Nadarajan & Sukumaran [5]
Calcium Nitrate	0	Lane, Finch & Samuel, [6]

Table A.2.2.5: Fraction of nitrogen in organic fertiliser type f sourced from particular livestock manure (kg N/kg) ($FN_{organic,f}$)

Livestock source of organic fertiliser f	$FN_{organic,f}$
Dairy cattle	0.029
Beef cattle	0.023
Poultry	0.51
Swine	0.41
Sheep	0.033
Horses/Mules	0.013

Table A.2.2.6: Fraction of inorganic fertiliser f that volatilises as NH_3 and NO_x ((kg $NH_3-N + NO_x-N$)/kg N) ($FracGASF_f$)

Fertiliser type f	$FracGASF_f$
Urea-based fertilisers	0.15
Ammonium-based fertilisers	0.08
Nitrate-based fertilisers	0.01
Ammonium-nitrate based fertilisers	0.05
Other fertilisers	0.11

A.2.3 Scaling Factors for Rice Cultivation Emission Factor

Table A.2.3.1: Scaling factor based on the water regime employed during the growing season cultivation period (fraction) (SF_w)

Cultivation method employed during growing season w		SF_w
Water regime type	Water regime sub-type	
Upland	Paddy rotation	0
	Fallow without flooding in previous year	0
Irrigated	Continuously flooded	1
	Single drainage period	0.71
	Multiple drainage periods	0.55
Rainfed and deep water	Regular rainfed	0.54
	Drought prone	0.16
	Deep water	0.06

Table A.2.3.2: Scaling factor based on the water regime employed in the pre-season before the growing period (fraction) (SF_p)

Water regime prior to cultivation period p	SF_p
Non flooded pre-season <180 days	1
Non flooded pre-season >180 days	0.89
Flooded pre-season >30 days	2.41
Non-flooded pre-season >365 days	0.59

Table A.2.3.3: Conversion factor for organic amendment i (fraction) ($CFOA_i$)

Organic amendment i	$CFOA_i$
Straw incorporated shortly (<30 days) before cultivation	1.00
Straw incorporated long (>30 days) before cultivation	0.19
Compost	0.17
Farm yard manure	0.21
Green manure	0.45

A.3 Scope 2 and 3

A.3.1 Purchased Goods and Services

Unless included in the tables below purchased goods and services emission factors are taken from the Australian Life Cycle Inventory Database Initiative Carbon Emissions Factors (AusLCI CEF).

Table A.3.1.1: Life-cycle emission factors for purchased feed (kg CO₂e/kg) (EF_j)

Feed Type j	EF _j	Reference
Whole Sardines	0.3	Blueshift [7]
Low Animal Protein Formulated Feed	2.2	
Squid	0.3	
Whole fish	0.3	
Custom Bait	0.08	

Table A.3.1.2: Life-cycle emission factors for purchased inorganic fertilisers (kg CO₂e/kg) (EF_f)

Fertiliser type f	EF _f	Reference
Ammonium nitrate (AN)	1.09	Wood & Cowie [4], Horticulture Australia Ltd [8]
Calcium ammonium nitrate (CAN)	0.88	
Diammonium phosphate (DAP)	1.00	
Monoammonium phosphate (MAP)	0.83	
Single Super Phosphate (SSP)	0.26	
Sulphate of ammonia (SOA)	0.75	
Urea	1.50	

Table A.3.1.3: Life-cycle emission factors for the production of components contained in inorganic fertilisers (kg CO₂e/kg component) (EF_c)

Component c	EF _c	Reference
N	3.25	Horticulture Australia Ltd [8]
P	0.9	
K	0.6	
S	0.3	

Table A.3.1.4: Life-cycle emission factors for the production of components contained in agrichemicals (kg CO₂e/kg) (EF_h)

Agrichemical type h	EF _h	Reference
Herbicide (paraquat, diquat, glyphosate)	33	Horticulture Australia Ltd [8]
Other herbicide	18.6	
Insecticide	18.9	
Fungicide	12.6	
Plant growth regulator	10.5	

Table A.3.1.5: Life-cycle emission factors for purchased packaging (kg CO₂e/kg) (EF_p)

Unit of packaging p	Unit weight (kg)	EF_p	Reference
1 tonne polypropylene bag (e.g. bags for seeds)	3.90	6.04	Australian Grains [9]
25 kg polypropylene bag (e.g. bags for seeds)	0.15	0.90	
20L high density polyethylene (HDPE) container (e.g. for chemicals)	1.40	3.41	
1000L intermediate bulk containers (e.g. for chemicals)	60.00	190.15	

A.4 Other

A.4.1 Parameters relating to Waste

Table A.4.1.1: Emission factors for wastes disposed of at different treatment facilities (t CO₂e/t) (EF_{wt})

Treatment type t	Waste type w	EF _{wt}	Reference
Landfill	Food waste (including animal carcasses, spoiled animal feed or crop)	2.1	Australian National Greenhouse Accounts Factors [10]
	Paper and cardboard	3.3	
	Green waste (including crop residues or prunnings)	1.6	
	Wood	0.7	
	Textiles	2.0	
	Sludge	0.4	
	Rubber and leather	3.3	
	Inert waste (including concrete, metal, plastic or glass)	0	
	Municipal solid waste	1.6	
	Commercial and industrial waste	1.3	
	Construction and demolition waste	0.2	
Incineration	Food waste, green waste, wood, sludge	0	Australian National Greenhouse Accounts Factors [10]
	Paper and cardboard	0.0169	
	Textiles	0.3667	
	Rubber and leather	0.4919	
	Inert Waste	0.1100	
	Municipal Solid Waste	0.0537	
	Industrial Waste	1.649	
Composting	All organic waste	0.046	Australian National Greenhouse Accounts Factors [10]
Anaerobic digestion	All organic waste	0.028	

Table A.4.1.2: Volume to mass conversion factor for various waste types (t/m^3) (VTM_w)

Waste type w	CF_w	Reference
Food waste (including animal carcasses, spoiled animal feed or crop)	0.50	Australian National Greenhouse Accounts Factors [10]
Paper and cardboard	0.09	
Green waste (including crop residues or prunings)	0.24	
Wood	0.15	
Textiles	0.14	
Sludge	0.72	
Rubber and leather	0.14	
Inert waste (including concrete, metal, plastic or glass)	0.42	
Municipal solid waste	0.36	
Commercial and industrial waste	0.33	
Construction and demolition waste	0.39	

Table A.4.1.3: Methane correction factor for treatment facility type t used to treat wastewater (fraction) ($CF_{ww,t}$)

Facility type t	$CF_{ww,t}$	Reference
Managed aerobic treatment	0	Australian National Greenhouse Accounts Factors [10]
Unmanaged aerobic treatment	0.3	
Anaerobic digester/reactor	0.8	
Shallow anaerobic lagoon (≤ 2 m)	0.2	
Deep anaerobic lagoon (> 2 m)	0.8	

Table A.4.1.4: Methane correction factor for treatment facility type t used to treat sludge (fraction) ($CF_{sludge,t}$)

Facility type t	$CF_{sludge,t}$	Reference
Managed aerobic treatment	0	Australian National Greenhouse Accounts Factors [10]
Unmanaged aerobic treatment	0.3	
Anaerobic digester/reactor	0.8	
Shallow anaerobic lagoon (≤ 2 m)	0.2	
Deep anaerobic lagoon (> 2 m)	0.8	

A.4.2 Parameters relating to Transport

Table A.4.2.1: Scope 1 and 3 emission factors (EF_{Trans}) and energy content factors ($EC_{Trans,q}$) for fuels used in off-road equipment and vessels

Transport type t	Fuel type q	$EC_{Trans,q}$	Scope 1 CO₂ $EF_{Tran,1,tgg}$	Scope 1 CH₄ $EF_{Tran,1,tgg}$	Scope 1 N₂O $EF_{Tran,1,tgg}$	Scope 3 $EF_{Trans,3,q}$
Units		GJ/kL	kg CO₂-e/GJ	kg CO₂-e/GJ	kg CO₂-e/GJ	kg CO₂-e/GJ
Vessel	Petrol	34.2	67.4	10.1	0.3	17.2
	Diesel	38.6	69.9	0.2	0.5	17.3
	Fuel Oil	39.7	73.6	0.2	0.5	18.0
Off-road Agriculture and forestry equipment	Diesel	38.6	69.9	0.3	0.5	17.3
Reference	Australian National Greenhouse Accounts Factors [10]					

A.4.3 Emission factors for Aquatic N₂O

Table A.4.3.1: Aquaculture – N₂O emissions from fish production (EF)

We are pending confirmation of emission factors for various aquatic systems. Please refer to Chapter 13 for additional details.

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