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Australian Bureau of Agricultural and Resource Economics and Sciences

Reference case projections of Australian agricultural activity and greenhouse gas emissions: 2007–08 to 2029–30

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ABARES report to client for the Department of Climate Change and Energy Efficiency

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Summary

- The Department of Climate Change and Energy Efficiency (DCCEE) requested that the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) provide estimates of agricultural greenhouse gas emissions from 2007–08 to 2029–30. Agricultural emission estimates are derived using the ABARES 2010 reference case projections of agricultural activity in Australia, in conjunction with emission coefficients provided by DCCEE.
- In responding to this request, commodity analysts within ABARES updated their suite of short and medium-term projections for Australian agricultural commodities. The analysts' views are incorporated in these projections to 2014–15. Beyond 2014–15, analysts' views are used as input to the TRANSPLANT model. The model is forward looking, and is used to project agricultural activity variables for Australia over time.
- From 2008–09 to 2029–30, the beef cattle herd is projected to increase by an average of 1.17 per cent a year, the size of the sheep flock by 0.62 per cent, the dairy herd by 0.05 per cent, the pig herd by 1.0 per cent, and the poultry flock by 0.71 per cent.
- Australia's broadacre cropping area is projected to increase to 2029–30. Increases in area and yields are expected to result in production increases over the period. Rice area and production are projected to recover from the lows recorded in recent years. However, water availability will remain a critical issue. Demand for sugar is expected to continue to grow steadily, but supply may be limited by urban encroachment and competition for land use from horticultural crops over the longer term.
- Australia's agricultural emissions were estimated at 73.1 million tonnes of carbon dioxide equivalent (Mt CO_2–e) in 2008–09. Reference case emissions are projected to reach 80.3 Mt CO_2–e in 2019–20 and 89.1 Mt CO_2–e in 2029–30.
- In comparing these projections with those made previously by ABARE, it should be recognised that agricultural activity is affected by farmer responses to changing market price expectations, relative returns from alternative farm enterprises, longer term climatic conditions and short-term seasonal conditions. Changes in projected emissions over time will largely reflect the first three factors, with short-term changes in emissions largely stemming from seasonal variability.
- There is little difference in the emission projections for agriculture as a whole between the ABARE 2008 report *Reference case projections of Australian agricultural activity levels and greenhouse gas emissions: 2005–06 to 2019–20* and this report. Reference case agricultural emissions in this report are projected to be about 0.6 per cent higher than those projected in the 2008 report in 2019–20. The difference is primarily attributed to an upward revision in projected beef cattle herd numbers, partially offset by a downward revision of projected dairy herd size and sheep flock numbers.
- A sensitivity analysis revealed that a temporary deterioration of seasonal conditions could have a significant effect on agricultural emissions. Emissions are projected to fall during a drought period, before returning gradually to reference case levels as livestock numbers are restored.

1 Developing the agricultural activity projections

Objective

The purpose of this report is to describe the 2010 ABARES reference case projections of agricultural activity in Australia for the period 2007–08 to 2029–30. In this report, the first two years (2007–08 and 2008–09) are actual outcomes, included for the purpose of later comparison, with projections beginning from 2009–10. The projections are used in the report to derive activity related to greenhouse gas emission estimates from agriculture using emission coefficients provided by the Department of Climate Change and Energy Efficiency (DCCEE). Agricultural production volumes, and therefore emissions, are highly variable because of climate and market volatility, among other factors. This report incorporates sensitivity analysis among several factors, including drought, productivity, export demand and changes in costs, to assess potential variability.

More detailed data have been provided to DCCEE in spreadsheet form. The spreadsheets provide state-level projections of agricultural activity and emissions.

The projections in this report update the ABARE 2008 reference case projections provided to the then Department of Climate Change in November 2008. The 2010 reference case projections incorporate assumptions of macroeconomic and market conditions that Australian agriculture would face to 2029–30 in the absence of any new emissions abatement technologies, without consideration of the Murray–Darling Basin Plan, and assuming a return to long-term average seasonal conditions over the projection period following recent droughts.

Modelling approach

A hybrid approach was used in developing the reference case activity projections. This involved integrating commodity analysts' views into the ABARE-developed model used for the projections, TRANSPLANT. The model is forward looking, and is used to project agricultural activity variables for Australia over time using key economic rules (see Thorpe and Klijn 2002 for documentation). Demand and supply shifters were set in the reference case of the model to fully reflect the commodity analysts' views of the national outlook for agricultural commodities. Integrating the analysts' views in the model ensures consistency across the analysts' projections and with economic theory.

In developing the 2010 reference case projections commodity analysts within ABARES updated their short and medium-term projections for Australian agricultural commodities published on a quarterly basis in *Australian commodities*. In these projections, the analysts' views are incorporated to 2014–15. These projections were prepared in November 2010 and reflect the bureau's assessment of industry production at that time. For updated short-term assessments taking into account developments since November 2010, please refer to the latest editions of the *Australian crop report* and *Australian commodities*. The analysts' forecasts of national livestock numbers and crop areas, real prices, output and exports were imposed in a complete and consistent fashion on TRANSPLANT using a unique set of demand and supply shifters. Key supply productivity shifters are presented as yield changes in the reference case. The analysts' views of the domestic and export demand outlook are important demand shifters in the model. Beyond 2014–15, analysts' views of key drivers of production are used as input to the TRANSPLANT model.

Key activity variables

Key activity levels in the model include livestock numbers for grazing beef cattle, dairy cattle, sheep and intensively farmed pigs, poultry and feedlot beef by state. In this report, these numbers were calibrated to the analysts' forecasts of activity. The main supply-side links in the model are from land and feed competition. Livestock types compete with each other for feed, and with crops for land. There are six cropping sectors: wheat; coarse grains; oilseeds and pulses; rice; sugar; and other crops, including wine grapes and cotton.

The model includes a simple livestock dynamic for each broadacre livestock type in every state. If a higher real price of beef cattle is expected tomorrow then, consistent with rational behaviour, slaughter rates are reduced today to build up stock for tomorrow. A broad-brush approach is used to model this livestock dynamic in terms of net growth in livestock numbers. While the model approach takes no direct account of the age and sex composition of the herd, the analysts do take account of flock and herd composition in formulating their forecasts over the short to medium term. In the model, compositional changes are partly reflected in changes in the net reproduction rate and changes in the carcass weight. In the model, the saleyard price of beef cattle reflects the meat carcass value and the beef price reflects competition between domestic and export demand.

Supply and demand shifters

To drive the model, it is necessary to specify supply and demand shifters over time. For livestock, typical supply productivity shifters over time include changes in carcass weights; changes in yields from any joint products (wool and sheep meat, dairy products and beef, eggs and chicken meat); and changes in land use per unit of output. A change in output per hectare is the key supply shifter for crops.

To drive the demand side of the model, it is typically necessary to specify how demand will shift over time with changes in real gross domestic product (GDP) in Australia and the rest of the world, changes in tastes, and changes in the relative price of substitutes.

The ABARES macroeconomic assumptions for Australia are consistent with the *Mid-Year Economic and Fiscal Outlook* (Australian Government 2010). Real GDP in Australia is assumed to grow by 3.25 per cent in 2010–11 and 3.75 per cent in 2011–12, returning to 3.0 per cent in 2012–13 and beyond. Economic growth for the rest of world is assumed to average 4.3 per cent in 2010–11 and 3.7 per cent in 2011–12, before recovering to around 4.0 per cent in 2012–13 and beyond.

2 Reference case livestock activity

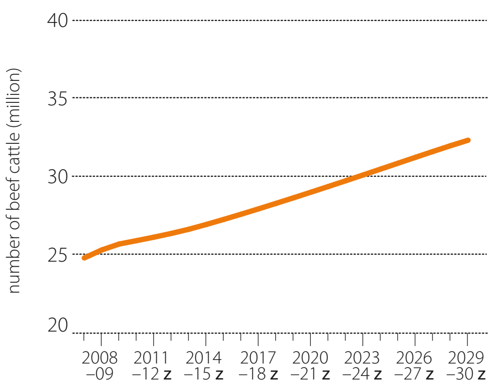
Good growing conditions since the second half of 2009–10 have improved prospects for Australian agricultural industries. Time paths of the size of the total national beef herd and sheep flock toward 2029–30 are given in figures a and b.

Beef cattle

In drought years, slaughterings are typically high as producers turn off more stock in response to lower feed availability and higher costs of supplementary feeding. When seasonal conditions improve, there is often a period of herd rebuilding, in which slaughterings fall as producers retain cows and heifers. These variations in slaughterings and production are not reflected in the average annual growth rates presented in table 1, because interseasonal fluctuations are smoothed out.

A lack of pasture and higher cost of supplementary feed associated with drought led to a fall in beef cattle numbers in the year to June 2007. The drought and herd rebuilding effects are incorporated in the short to medium-term projections.

a National beef herd



z Projected.

Seasonal conditions improved in northern Australia in 2008–09 and across both northern and south-eastern Australia in 2009–10. The greater availability of on-farm pasture and fodder supplies have allowed graziers to rebuild their beef herds, resulting in reduced cattle turn-off and lower slaughter rates. Overall, Australia's beef cattle numbers have been increasing since 2007–08. Assuming favourable seasonable conditions, the Australian beef cattle herd is projected to approach 27 million head by the end of 2014–15 (figure a).

From 2008–09 to 2014–15, beef production is projected to increase, reflecting increased slaughterings. Further increases in beef production are forecast to 2019–20 and 2029–30 as cattle numbers, slaughterings and carcass weights continue to increase, reflecting a return to favourable seasonal conditions and the trend toward increased feedlotting.

Competition in Australia's key export markets is expected to increase over the medium to long term, with the United States regaining market share in Japan and the Republic of Korea, after US beef was blocked from entering those countries in the wake of a bovine spongiform encephalopathy outbreak in late 2003. Exports of Australian beef to other emerging markets (particularly South-East Asia, the Middle East and the Russian Federation) are expected to continue to increase over the long term, reflecting growing demand in those regions. The moderate long-term expansion in the domestic beef herd is consistent with long-run profit-making opportunities for the industry.

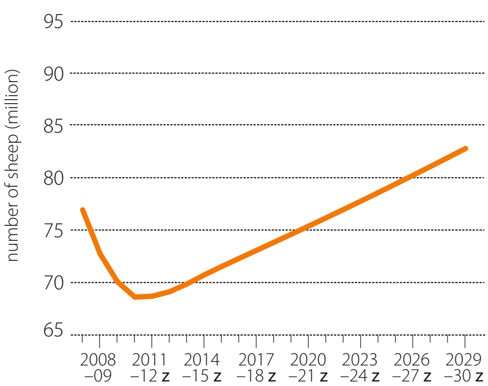
Overall, from 2008–09 to 2029–30, beef production is projected to increase at an annual average rate of 1.57 per cent. This reflects an annual average increase of 1.32 per cent in slaughterings and 0.25 per cent in carcass weights. Over the period, the size of the herd is projected to increase by an average of 1.17 per cent a year.

Sheep

The decline in the profitability of wool relative to sheep meat is expected to continue over the medium term before conditions stabilise in the long term.

Since the collapse of wool prices in 1990–91, slaughterings of wethers previously held for wool production led to higher sheep slaughter rates, despite a continuous decline in the size of the adult sheep flock. From 1990–91 to 2009–10, lamb slaughter increased on average by around 1 per cent a year, while sheep slaughterings fell by an average of 2.6 per cent a year, reflecting an increasing emphasis on lamb production within sheep enterprises.

b National sheep flock



z Projected.

Wool production fell at a faster rate than the sheep flock between 1990–91 and 2009–10. In addition to several years of unfavourable seasonal conditions, this reflected the shift in composition of the flock toward meat breeds, and the number of sheep shorn fell. Wool production is forecast to stabilise in 2010–11, as the long-term decline in sheep numbers slows and wool cut per head increases because of favourable seasonal conditions.

Favourable seasonal conditions since 2009–10 have improved pasture growth and fodder production, encouraging producers to increase breeding numbers to maintain or increase future lamb production. Hence, sheep slaughter and lamb slaughter are both forecast to fall in the short term (figure b). Over the medium term, lamb slaughter is expected to increase as a result of continued emphasis on lamb production. This growth is expected to be partially offset by incentives to hold stock for flock rebuilding.

1 Reference case livestock activity

		2007–08	2008–09	2009–10 z	2014–15 z	2019–20 z	2029–30 z	average annual growth rate 2008–09 to 2014–15 z	2014–15 to 2019–20 z	2019–20 to 2029–30 z	2008–09 to 2029–30 z
beef cattle								%	%	%	%
herd size	000 hd	24784	25294	25674	26927	28632	32313	1.05	1.24	1.22	1.17
slaughterings	000 hd	8793	8702	9387	9592	10132	11461	1.63	1.10	1.24	1.32
meat production	kt	2154	2148	2359	2387	2560	2982	1.78	1.40	1.54	1.57
meat yield a	kg/hd	245	247	251	249	253	260	0.14	0.30	0.29	0.25
dairy cattle											
herd size	000 hd	2537	2612	2530	2551	2575	2638	-0.40	0.19	0.24	0.05
milk production	ML	9223	9388	9016	9790	10389	11755	0.70	1.19	1.24	1.08
milk yield b	L/hd	3635	3594	3564	3839	4034	4456	1.10	1.00	1.00	1.03
sheep											
flock size	000 hd	76938	72740	70053	70724	74615	82816	-0.47	1.08	1.05	0.62
slaughterings	000 hd	32828	32049	31009	32514	34517	38312	0.24	1.20	1.05	0.85
meat production	kt	694	658	662	677	722	810	0.46	1.30	1.15	0.99
wool production	kt	459	420	382	397	430	501	-0.93	1.58	1.55	0.84
meat yield a	kg/hd	21.1	20.5	21.3	20.8	20.9	21.1	0.22	0.10	0.10	0.14
wool yield c	kg/hd	6.0	5.8	5.5	5.6	5.8	6.1	-0.46	0.50	0.50	0.22
pigs											
herd size	000 hd	2412	2302	2287	2417	2547	2838	0.82	1.05	1.09	1.00
slaughterings	000 hd	5217	4522	4606	4708	4947	5509	0.67	0.99	1.08	0.94
meat production	kt	377	324	334	341	360	405	0.87	1.10	1.18	1.07
meat yield a	kg/hd	72.3	71.6	72.6	72.5	72.8	73.6	0.19	0.10	0.10	0.13
poultry											
flock size	000 hd	88629	95409	90010	102454	105119	110630	1.19	0.51	0.51	0.71
slaughterings	000 hd	473551	488562	453615	524472	542304	570598	1.19	0.67	0.51	0.74
meat production	kt	835	866	870	1031	1093	1209	2.94	1.17	1.01	1.60
meat yield a	kg/hd	1.8	1.8	1.9	2.0	2.0	2.1	1.73	0.50	0.50	0.85

a meat yield calculated as production divided by slaughterings b milk yield calculated as total dairy herd size, including non-milk producing cattle, divided by milk production c wool yield calculated as production divided by flock size z ABARES projection with 2008-09 as the base year.

Toward 2014–15, the size of the sheep flock is projected to increase gradually, reflecting a fall in slaughter rates as producers begin to rebuild flocks. Overall slaughter rates and meat production are expected to remain largely unchanged over this period. The sheep flock is projected to return to around 70 million head by 2014–15.

The sheep flock is expected to increase moderately over the long term, reflecting producer responses to increased profitability of sheet meat focused enterprises in particular. Overall, the size of the sheep flock is projected to increase by 0.3 per cent a year from 2007–08 to 2029–30. This reflects the aggregate effect of the decline in the size of the sheep flock from 2007–08 to 2010–11, and the projected increase in the size of the sheep flock over the remainder of the outlook period. Projections for livestock activity are summarised in table 1.

Dairy cattle

Australian milk production has been significantly affected by drought over the past few years. The effects of drought—particularly lower water allocations for irrigation-dependent dairy farms—and higher feed costs resulted in lower milk production in 2009–10. Since 2000–01, milk output has decreased by an average of 1.6 per cent a year, while milk yield per cow increased by around 1.3 per cent a year. However, Australian milk output is forecast to recover in 2010–11 (table 1), in line with a significant improvement in seasonal conditions and stronger global demand for dairy products.

Over the medium to long term, growth in global demand for dairy products (in line with rising incomes, particularly in developing countries in Asia) will be the major driver of growth in Australian dairy production and exports. Under the assumption of long-term average seasonal conditions, the dairy herd is projected to expand by an average of 0.05 per cent a year between 2008–09 and 2029–30, limited by the movement of suitable land to more profitable uses. During the same period, milk output is projected to grow by an average of 1.08 per cent a year, underpinned by yield growth.

Pigs

Australia's pig meat industry is forecast to grow slowly over the short to medium term, to supply mainly fresh meat for domestic consumption. The majority of Australian pig meat imports are from Canada, the United States and Denmark, where producers have greater access to relatively low-cost energy-intensive feed grains (such as corn) and possibly better genetics. Producers in these countries are expected to remain price-competitive in the Australian processed pig meat market over the medium term.

Between 2008–09 and 2029–30, the Australian pig herd is projected to increase by an average of 1 per cent a year (table 1), reflecting growth in domestic demand for fresh pig meat and continued relatively low feed costs. In line with the increase in the pig herd, slaughterings are also projected to increase. From 2008–09 to 2029–30, pig meat production is projected to increase by an average of 1.07 per cent a year.

Poultry

Australia's mainly domestically oriented poultry production is expected to expand over the projection period. Consumption of poultry meat in Australia is projected to continue increasing, reflecting lower prices of poultry meat relative to other meats. Poultry meat production is projected to increase by an average of 1.6 per cent a year from 2008–09 to 2029–30 (table 1). The growth reflects expected increases in slaughterings and slaughter weights, mostly arising from improving bird genetics and associated feed-use efficiency. The poultry flock is projected to be larger in 2029–30, increasing by an average of 0.71 per cent a year from 2008–09, again underpinned by growth in the domestic demand for poultry meat.

3 Reference case crop activity

Projections for crop activity are summarised in table 2. In 2008–09 and 2009–10, better seasonal conditions followed a period of severe drought in 2006–07 and 2007–08. Winter crop production in 2008–09 increased by 35 per cent from 2007–08.

In addition to wheat, coarse grains and oilseeds and pulses, other cropping industries in the TRANSPLANT model include rice and sugar cane, while a residual 'other crops' category includes cotton and wine grapes. These are intensive cropping industries in the TRANSPLANT model with specialised land and climatic characteristics. A lack of irrigation water severely affected the amount of land planted to cotton and rice in Australia in 2007–08. Water availability has improved markedly from 2007–08 and the area planted to rice is forecast to improve significantly in 2010–11 after falling to a low of 2000 hectares in 2007–08 and recovering to 19 000 hectares in 2009–10. The area planted to cotton was 63 000 hectares in 2007–08, nearly 60 per cent less than a year earlier. This area increased to 211 000 hectares by 2009–10 and is forecast to rise significantly in 2010–11. Meanwhile, the area planted to sugar cane has been increasing since 2008–09, while production has remained relatively steady. This reflects slightly lower yields resulting from the adverse effects of cyclones and sugar cane smut in recent years.

Over the longer term to 2029–30, broadacre cropping area is projected to increase. Improved productivity is expected to result in yield increases over the period. Wheat production is projected to increase by an average of 1.28 per cent a year, coarse grains are projected to increase by 0.66 per cent a year and oilseeds and pulses are projected to increase by 1.94 per cent a year, relative to 2008–09.

Rice area and production are projected to recover over the projection period, but not to the levels observed in the early 2000s when production was consistently above one million tonnes. Water availability will be a critical factor for determining rice production over the projection period.

Sugar cane production in Australia is limited to a narrow coastal strip that extends from northern New South Wales through to Far North Queensland, and there is limited potential for expansion. While domestic and export demand for sugar is expected to increase, the area of sugar cane harvested is projected to grow steadily, but may be limited by urban encroachment and competition for land use from horticultural crops over the longer term. Steady improvements in cane and sugar yields are projected throughout the period to 2029–30.

2 Reference case cropping activity

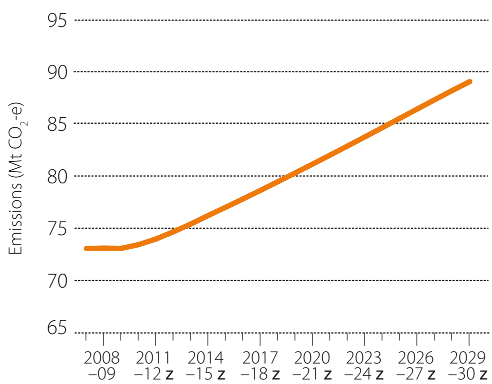
		2007–08	2008–09	2009–10 z	2014–15 z	2019–20 z	2029–30 z	average annual growth rate 2008–09 to 2014–15 z	2014–15 to 2019–20 z	2019–20 to 2029–30 z	2008–09 to 2029–30 z
								%	%	%	%
wheat											
production	kt	13569	21420	21656	24895	25902	27993	2.54	0.80	0.78	1.28
land use	000 ha	12578	13530	13788	13860	14347	15346	0.40	0.69	0.68	0.60
yield	t/ha	1.1	1.6	1.6	1.8	1.8	1.8	2.13	0.10	0.10	0.68
coarse grains											
production	kt	13289	12586	11442	12877	13385	14443	0.38	0.78	0.76	0.66
land use	000 ha	7510	7039	6196	6484	6704	7155	-1.36	0.67	0.65	0.08
yield	t/ha	1.8	1.8	1.8	2.0	2.0	2.0	1.76	0.11	0.11	0.58
oilseeds and pulses											
production	kt	2620	3401	3466	4552	4725	5089	4.97	0.75	0.74	1.94
land use	000 ha	2707	3024	2600	3155	3259	3475	0.71	0.65	0.64	0.67
yield	t/ha	1.0	1.1	1.3	1.4	1.4	1.5	4.23	0.10	0.10	1.26
rice											
production	kt	18	65	207	471	564	724	39.02	3.69	2.53	12.15
land use	000 ha	2.2	8.0	19.0	43.0	51.3	65.2	32.42	3.58	2.43	10.52
yield	t/ha	8.2	8.2	10.9	10.9	11.0	11.1	4.98	0.10	0.10	1.47
sugar cane											
production	kt	32621	30284	31457	36344	37281	39266	3.09	0.51	0.52	1.24
land use	000 ha	381	367	391	413	421	439	1.98	0.41	0.42	0.86
yield	t/ha	86	83	80	88	88	89	1.09	0.10	0.10	0.38
other crops											
production	kt	1970	2013	2167	2766	3040	3611	5.44	1.91	1.74	2.82
land use	000 ha	229	321	369	503	549	623	7.74	1.77	1.28	3.20
yield	t/ha	8.6	6.3	5.9	5.5	5.5	5.8	-2.14	0.13	0.45	-0.37

a meat yield calculated as production divided by slaughterings **b** milk yield calculated as total dairy herd size, including non-milk producing cattle, divided by milk production **c** wool yield calculated as production divided by flock size **z** ABARES projection with 2008-09 as the base year.

4 Reference case emissions from agriculture

The emission projections are based on ABARES projections of agricultural activity and emissions coefficients supplied by the DCCEE. ABARES inserts the agricultural activity variables into DCCEE's Master Workbook calculator of emissions. The workbook contains emission coefficients by agricultural activity in each Australian state and territory. These are applied to the activity variables to obtain the emission estimates in carbon dioxide equivalent (CO_2–e) in the workbook.

C Total emissions from agricultural activities (Mt CO_2–e)



z Projected.

In Australia, the most important agricultural emissions are methane gas derived from food digestion by ruminant livestock (cattle and sheep). The number of livestock is the critical activity variable for calculating these emissions in the workbook. For crops, area planted is the activity variable used to determine methane emissions from rice growing, while for other cropping the area planted is important in determining emissions from agricultural soil disturbances and from nitrogen fertiliser use. Agricultural production is the activity variable required to estimate emissions from the burning of agricultural residues such as from sugar cane crops.

The 2010 DCCEE Master Workbook was used to generate the reference case emissions from agricultural activities (table 3). The projected time path of total emissions is presented in figure c. The differences between the 2019–20 agricultural emissions projections in the ABARE 2008 report and this report are also tabulated. These differences incorporate minor revisions since 2008 of the DCCEE emissions coefficients used to derive greenhouse gas emission estimates from agricultural activity.

3 Reference case emissions from agricultural activities

	Levels (Mt CO_2–e)					average annual growth rate				per cent change from 2008 report
	2008–09	2009–10 z	2014–15 z	2019–20 z	2029–30 z	2008–09 to 2014–15 z	2014–15 to 2019–20 z	2019–20 to 2029–30 z	2008–09 to 2029–30 z	2019–20 z
					%	%	%	%	%	
total agriculture	73.1	73.1	76.2	80.3	89.1	0.70	1.05	1.04	0.95	0.6
enteric fermentation	55.7	55.7	57.8	61.0	68.0	0.61	1.10	1.09	0.96	0.0
beef cattle	38.7	39.3	41.2	43.8	49.5	1.05	1.24	1.22	1.17	7.2
dairy cattle	6.3	6.1	6.1	6.2	6.3	-0.40	0.19	0.24	0.05	-15.8
sheep	10.7	10.3	10.4	10.9	12.1	-0.47	1.08	1.05	0.62	-12.9
pigs	0.1	0.1	0.1	0.1	0.1	0.82	1.05	1.09	1.00	8.0
other	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.0
manure management	3.2	3.2	3.4	3.6	3.9	1.06	0.97	0.94	0.98	5.5
beef cattle	1.0	1.0	1.1	1.2	1.3	1.38	1.48	1.30	1.37	23.2
dairy cattle	0.5	0.5	0.5	0.5	0.5	-0.40	0.19	0.24	0.05	-16.8
sheep	0.0	0.0	0.0	0.0	0.0	-0.47	1.08	1.05	0.62	-11.7
pigs	1.1	1.1	1.2	1.3	1.4	0.82	1.05	1.09	1.00	7.8
poultry	0.6	0.6	0.6	0.7	0.7	2.16	0.51	0.51	0.98	-4.0
other	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.0
crops	14.2	14.2	15.0	15.7	17.1	0.99	0.88	0.85	0.90	2.0
rice cultivation	0.0	0.1	0.2	0.3	0.3	35.33	3.58	2.43	11.21	-13.7
agricultural soils a	13.8	13.7	14.4	15.0	16.3	0.71	0.83	0.82	0.79	1.9
field burning of agricultural residues	0.3	0.4	0.4	0.4	0.5	3.51	0.97	0.90	1.66	21.3

a The composition of agricultural soils includes nitrogen excreted on pasture land, direct soil emissions from synthetic fertiliser, animal waste applied to soils, nitrogen-fixing crops, crop residue cultivation of histosols, and indirect soil emissions from atmospheric deposition and nitrogen leaching and runoff **z** ABARES projection with 2008-09 as the base year.

Comparison with ABARE 2008 projections

There are only minor differences in the emission projections for agriculture as a whole between the ABARE 2008 report and this report. In 2019–20, reference case agricultural emissions in this report are projected to be about 0.6 per cent higher than those projected in the 2008 report. This difference is primarily attributed to an upward revision of projected beef cattle herd numbers, partially offset by a downward revision of dairy herd size and sheep flock numbers. In this report, agricultural emissions are projected to grow by an average of 0.95 per cent a year between 2008–09 and 2019–20.

Beef cattle are responsible for the largest share of enteric emissions by livestock industries. In 2019–20, beef cattle account for 72 per cent of enteric emissions projected in this report. This result is higher than the ABARE 2008 report, where beef cattle are projected to account for 67 per cent of enteric emissions in 2019–20. In addition to higher projected beef cattle herd numbers, the increasing importance of beef cattle emissions in Australia's total agricultural emissions is also due to a downward revision of emissions from other agricultural industries, including dairy, sheep and rice.

Projections for dairy and sheep emissions have been revised downward in this report, compared with ABARE 2008. Dairy emissions projections for 2019–20 in this report are around 16 per cent lower than the ABARE 2008 projections, while emissions from sheep are 13 per cent lower. The dairy cattle herd numbers over the past few years have been lower than the ABARE 2008 projections, leading to downward revision of the projected dairy herd over the medium to longer term. The recognition of the increasing importance of meat production to the sheep industry has changed assumptions about industry dynamics and resulted in lower projected flock numbers relative to the ABARE 2008 report.

There is a significant difference between the projected emissions from the rice industry in the two reports. In this report, rice emissions projections for 2019–20 are around 14 per cent lower than the projection in the ABARE 2008 report. The outlook for the area planted to rice is lower than previously projected because of the likelihood that a drier climate, reduced water availability, and growth in water trade will favour higher-value crops than rice.

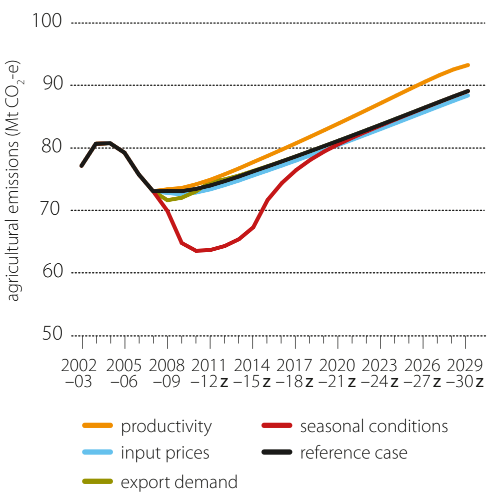
5 Sensitivity analysis

In addition to the reference case, four alternative scenarios were modelled to determine the sensitivity of the emissions projections to changes in seasonal conditions, industry productivity, export demand and input prices. Emissions projections to 2029–30 for all scenarios are shown in figure d.

Seasonal conditions

Australia's agricultural emissions fluctuate with seasonal conditions. In the past decade, Australia experienced significant droughts in 2002–03 and 2006–07. In those years, agricultural emissions fell as farmers reduced their livestock numbers. For example, beef cattle herd numbers in 2002–03 were 5.3 per cent below the average for the 10 years to 2009–10. Crop yields were also markedly lower in 2002–03. Wheat, barley and oilseed yields in 2002–03 were around 47 per cent lower than for the same 10-year average. Land planted to irrigated crops also decreased as farmers responded to reduced water allocations. Rice plantings were 47 000 hectares in 2002–03, some 34 per cent below the 10-year average to 2009–10.

d Sensitivity of Australia's agricultural emissions



z Projected.

For the sensitivity analysis, a severe five-year drought was modelled from 2009–10 to 2014–15, characterised by a 20 per cent reduction in stocking rates (number of livestock per hectare), a 20 per cent reduction in yields of dryland crops and perennial crops, and a 20 per cent reduction in land planted to cotton and rice. The model structure allows agricultural producers to fully anticipate the length and intensity of the drought. As a result, stock numbers fell prior to the start of the drought and began to recover prior to 2014–15. Obviously, such perfect foresight is not realistic, but this simplification is unlikely to significantly affect the cumulative emissions to 2029–30.

The effect of the modelled drought on agricultural emissions is illustrated by the red line in figure d. Following the change in livestock numbers, emissions begin to fall prior to the drought. Emissions decline to their lowest point in 2010–11, before rebounding slightly in 2011–12 and returning to reference case levels after 2019–20. This return to the reference case can be explained by recovering crop and meat production.

Productivity

In the reference case, crop productivity is modelled as a 0.1 per cent a year increase in crop yields. Livestock productivity is generally modelled as an annual increase in carcass weights and other livestock product yields ranging from 0.1 per cent to 1.0 per cent (see table 1). To determine the effect of higher productivity on emissions, ABARES modelled a scenario in which agricultural productivity by 2029–30 is around 10 per cent higher than what is assumed in the reference case. A productivity improvement in this scenario is linked to an increase in emissions as technology changes are assumed not to affect emissions intensity of production.

Emissions under the higher productivity scenario are depicted by the orange line in figure d. Emissions under the assumption of greater productivity are higher, relative to the reference case. Over time, production increases and shifts toward livestock enterprises, with the result that as production and livestock numbers increase further from reference case levels, so do emissions. In 2019–20, projected emissions under the higher productivity scenario are 83.4 Mt CO_2–e, 2.5 Mt above the reference case. In 2029–30, projected emissions increase to 83.9 Mt CO_2–e, 4.16 Mt above the reference case.

Export demand

Approximately 55 per cent of Australia's agricultural emissions in 2009–10 were from beef cattle. With around 65 per cent of beef produced being exported, it is important to determine how agricultural emissions projections change as a result of a change in export demand. To model the sensitivity of Australia's emissions to a sudden fall in export demand (such as might happen in the case of disease outbreak in Australian beef cattle), a scenario depicting a 20 per cent drop in export demand for beef from 2009–10 to 2011–12 was modelled. As with the scenario depicting drought, Australian agricultural producers are assumed to fully anticipate the drop and subsequent rebound in demand.

The effect on total agricultural emissions of a 20 per cent drop in export demand is depicted by the green line in figure d. Beef cattle emissions are expected to fall during the outbreak period, as farmers destock to avoid the drop in prices that follows the sharp drop in export demand for beef. Australian producers begin to restock as they attempt to take advantage of the higher beef prices expected after export demand recovers in 2011–12. Under this scenario, beef herd numbers are projected to briefly increase above reference case levels in 2011–12, before trending back to the reference case shortly after.

Input prices

If farm input prices increase and all other market conditions remain the same, the profitability of agricultural production is likely to decrease, thereby reducing output, demand for farm inputs and emissions. In the past decade, fertiliser prices have more than doubled, and it is conceivable that agricultural input costs may be higher on a sustained basis in the future. To test the potential emissions effects of such a possibility, ABARES modelled a permanent 20 per cent increase in the real fertiliser price from 2009–10 to the end of the simulation period.

The increased fertiliser price scenario is depicted by the blue line in figure d. In the first year of the price increase, fertiliser application rates and land use are projected to decrease, causing fertiliser emissions to fall by 5.5 per cent and reducing total agricultural emissions by 0.7 per cent relative to the reference case. By 2029–30, fertiliser emissions are projected to remain 5.5 per cent below the reference case scenario. Consequently, total agricultural emissions in such a scenario are projected to be 0.8 per cent lower than for the reference case.

6 Conclusions

Australian agricultural greenhouse gas emissions are projected to increase by an average of around one per cent a year to 2029–30 under a reference case scenario. Most of this increase is driven by growth in livestock numbers associated with the expansion of meat production. Increases in emissions from cropping activities, including the application of fertiliser, also contribute, but to a lesser extent. Agricultural emissions are estimated to be 73.1 Mt CO_2–e in 2008–09, increasing to a projected 89.1 Mt CO_2–e by 2029–30.

There are minor differences between the emissions projections for agriculture provided in this report and those projected in the ABARE 2008 report. A slight upward revision of agricultural emissions is primarily attributed to an increase in the projected beef herd, partially offset by a downward revision of the dairy herd and sheep flock.

In the long run, agricultural emissions are unlikely to be significantly affected by a relatively short-term deterioration of seasonal conditions, improvements to productivity, temporary declines in beef exports or increases in input prices. However, in the short run, an incidence of drought is likely to significantly decrease agricultural emissions as farmers are forced to destock.

References

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