research report

June 2011

Australian Farm Institute

The Impact of a Carbon Price on Australian Farm Businesses: Sheep production

A report prepared by The Australian Farm Institute with funding from Meat & Livestock Australia

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Australian Farm Institute Limited
Suite 73, 61 Marlborough Street
Surry Hills NSW 2010
AUSTRALIA
ABN 29 107 483 661
T: 61 2 9690 1388
F: 61 2 9699 7270
E: info@farminstitute.org.au
W: www.farminstitute.org.au

Disclaimer

Meat & Livestock Australia
Level 1, 165 Walker Street
North Sydney NSW 2060
T: 61 2 9463 9333
F: 61 2 9463 9393
E: info@mla.com.au
W: www.mla.com.au

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The impact of a carbon price on Australian farm businesses:

Sheep production

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Summary

Farm level modelling was carried out of the impact of an economy-wide carbon price on the costs and profitability of a farm representing a national average (Australia) sheep farm, and average sheep farms in NSW and Western Australia. Three carbon price scenarios were examined, one of which commenced at \$20/t CO_2-e, and the other two of which utilised emission prices modelled by the Australian Treasury associated with national emission reduction targets of either 5% or 15% by the year 2020.

Five years after the introduction of a carbon price, the three sheep farms were projected to experience total annual business cost increases of between 2.0% and 5.5% compared to a business-as-usual scenario, amounting to between \$3,992 and \$12,971 in additional annual costs per farm, depending on the carbon price and the farm under investigation. The increased costs included both on-farm costs, and also additional processor costs which were assumed to be fully passed on to the farm businesses. No attempt was made to estimate or include additional processing costs associated with wool processing, because the majority of wool is processed offshore. The increases in business costs (in the absence of the potential for farm businesses to increase sheepmeat or wool prices) would result in a reduction in net farm income of between 10.4% and 30.9% relative to the business-as-usual scenario in year 5.

The modelling does not incorporate any assumptions about dynamic changes (over and above normal productivity growth) by farm business managers in response to the additional costs, and as such provides a projection of the potential challenge these policies will pose for farm businesses, rather than attempting to predict future outcomes. Nevertheless, the results highlight that the proposed carbon policy represents a major challenge for Australian sheep producers, irrespective of whether the Australian agriculture sector is included in a carbon price mechanism and farm businesses are required to pay for farm-level emissions.

Introduction

The Australian Government has proposed to introduce a policy that will impose a price on greenhouse gas emissions produced by some Australian businesses from 1 July, 2012. The details of this policy are still to be finalised, although it has been announced that the carbon price mechanism will initially be a fixed carbon price specified by the Government, which will continue for 3-5 years before transitioning into a market-based emissions trading scheme similar to the previously announced Carbon Pollution Reduction Scheme (CPRS).

The Government has announced that direct emissions from agricultural activities will not incur a cost under the proposed carbon scheme for the foreseeable future, although the possibility of imposing a cost on agricultural emissions at some future time has not been ruled out, and has been proposed by a number of prominent persons and groups involved in advising on carbon policy.

While agricultural emissions will not incur a direct cost under the proposed carbon price mechanism, major emitters such as electricity generators will have a cost imposed on their greenhouse emissions, and other major sources of emission such as fossil fuels are also likely to be included in the scheme. This will mean that the proposed carbon price mechanism will increase the price of energy, and hence the cost of farm inputs that involve the use of energy in their production or delivery.

Generally speaking, the price that Australian farmers receive for the agricultural commodities they produce is set in the international marketplace, in which Australian farmers are price-takers. This means farmers are not able to increase the prices they receive, and that any additional costs incurred by Australian farm business have a direct impact on farm profitability. Even in the absence of a direct cost being imposed on agricultural emissions, the implementation of a carbon price mechanism in Australia will have a negative impact on farm profitability. The scale of the adverse impact will vary depending on a range of factors, including the degree of reliance of different farm business and their related sectors on energy and energy-related farm inputs.

The aim of the research reported here is to gain an understanding of the potential impact of the proposed carbon price mechanism on the profitability of sheep farms in Australia.

Methodology

In order to project the impact of the proposed carbon price mechanism on Australian farm businesses, financial models were developed of typical farm businesses, based on data available from ABARES farm surveys. The methodology utilised has been described in a previous research report (Keogh and Thompson, 2008). In summary, a set of 'normal' assumptions (including rates of farm productivity growth) was applied to the relevant ABARE farm financial data in order to project trends in farm costs and farm revenue into the future under a "business as usual" scenario.

The impact of a carbon price mechanism on farm businesses was then estimated using formulae that create a link between the price of carbon, the impact of that carbon price on fuel and electricity costs, and the impact of changes in fuel and electricity costs on the cost of farm business inputs, including upstream and downstream sectors. The responsiveness of farm input costs to a change in energy prices was calculated on the basis of the significance of energy as an input to the goods or services being utilised by the farm business. This enabled the impact of the carbon price mechanism on farm inputs costs and farm profitability to be calculated based on projected future changes in the price of carbon. Projected farm costs and farm profitability under a carbon price mechanism could then be compared with the business-as-usual scenario in the absence of a carbon price mechanism, in order to estimate the impact of the policy on future farm profitability.

Previous research by ABARE (Tulloh et.al. 2009) has identified that post-farm transport and processing costs will also be impacted by a carbon price, and given the international exposure of Australia's farm commodity and food sectors, it is also anticipated that these additional costs will be passed back to farmers in the form of higher processing costs and/or lower farm commodity prices. These additional post-farm costs identified by ABARE have been incorporated in this analysis. The following Table identifies these estimated costs, which have been converted to 2009-10 dollars. In the ABARE research, these costs were associated with a carbon price of $26.05 ($2009-10). For the purposes of this research, available data was used to calculate the size of these additional costs if fuel emissions were excluded from a carbon price, and the methodology employed in this calculation is detailed later in the report. It should be noted that no attempt has been made to estimate or incorporate wool processing costs, as most wool is processed offshore.

Table 1: Post-farm processor cost increases arising from a carbon price.

Sector	Units	Additional cost ($2007/8)	Additional cost ($2009/10)	Additional costs, No-fuel scenario [a]
Beef processing	$/head	$7.60	$7.96	$1.59
Sheep processing	$/head	$0.72	$0.75	$0.15
Grain processing	$/tonne	$2.34	$2.45	$0.61
Dairy processing	$/litre	$0.005	$0.00524	$0.0021

a For details of the calculation associated with these numbers see the explanation of the no-fuel scenario below.

Model farm businesses

The ABARES Agsurf database (ABARES, 2011) was accessed to extract farm financial data for three 'average' sheep farms, one located in NSW, another in WA, and one which represents a national average (Australia). These farms represent an average of the sheep farms included in ABARES farm surveys for these states and nationally, where ABARES defines a 'sheep farm' as farms engaged mainly in producing sheepmeat and/or wool.

Itemised annual farm financial data (in 2009-10 dollars) was obtained for the five years from 2006 – 2010 and averaged to provide 'typical' farm financial data for each of the three farms. Some characteristics of each of the farms are displayed in Tables 2 and 3 below.

ABARES data provides an estimate of the number of sheep sold each year for the three model farms. The data outlined in Table 1 above applies to domestic processing; however sheep exported live from Australia will not be subject to these additional costs.

To incorporate this, live export percentages were obtained from Meat & Livestock Australia (MLA) at a national level, and for NSW and WA, and applied to the number of sheep sold. That is, if 100 sheep are sold each year according to ABARES data, and MLA data indicates 5% of sheep from farms located in that region are exported live from Australia, the adjusted number of sheep sold and processed domestically will be 95. The processor costs outlined above in Table 1 are applied to the adjusted number of sheep sold.

The live export percentage is assumed to apply only to the primary enterprise activity of the model farm, in this case sheep meat and wool production. Despite all three model sheep farms having some beef cattle present according to ABARES data, the number of sheep sold is the only farm data adjusted to account for live exports. This is because it's likely the small number of cattle sold each year would be sold locally and processed domestically.

The farm production information was utilised together with the FarmGAS farm greenhouse emissions calculator to calculate annual greenhouse emissions arising from these farms. Data on nitrogen fertiliser use (an important source of greenhouse emissions in cropping) was not available, therefore an assumption was made that an average of 50 kilograms of Urea was applied per hectare for all crops except grain legumes. The greenhouse emission data enabled modelling of a scenario under which the farm businesses incurred a cost for farm emissions.

Table 2. Characteristics of the cropping enterprise for the three model sheep farms.

	Australia		W.A.		N.S.W.	
Crop	**Hectares**	**Yield (t/Ha)**	**Hectares**	**Yield (t/Ha)**	**Hectares**	**Yield (t/Ha)**
Canola	9.2	0.7	37	1.4	5.4	5.8
Lupins	4.4	0.9	16.2	1.2	2.2	3.6
Barley	23.8	1.7	51.4	2.2	12.8	2.5
Grain	7.6	1.05	18	1.2	3.6	3.8
Oats	17.8	1.4	36.6	1.89	18.2	2.4
Oilseeds	10.4	0.7	38.2	1.4	5.6	5.8
Sorghum	0.6	3.3	0	0	0	0
Wheat	56.4	1.5	132	1.7	70.2	6.4
Total cropping area (ha)	130		329		118	

Table 3: Production and greenhouse gas emission details for the three model sheep farms.

Cattle details	Australia	W.A.	N.S.W.
Bulls	1	1	1
Calves	13	15	15
Cows	23	23	27
Steers	8	2	11
Heifers	6	4	8
Total beef herd	50	45	62

Sheep details	Australia	W.A.	N.S.W.
Ewes	1,687	2,157	1,836
Lambs	684	786	664
Rams	37	58	34
Wethers	436	502	375
Total sheep flock	2,845	3,503	2,908
Live sheep exports	11%	39%	0%

Farm costs breakdown	Australia	W.A.	N.S.W.
Fuel	7%	7%	8%
Freight	3%	4%	3%
Electricity	1%	1%	1%
Fertiliser	9%	15%	5%
Chemicals	4%	6%	3%

Total farm area (ha)	4775	7195	5263
Farm emissions	629.6t CO_2-e	859.2t CO_2-e	854.07t CO_2-e

Scenarios examined

Three carbon price series were used in the analysis, to provide a picture of the impact of different carbon prices. The three price series used were as follows;

- **LOW –** the carbon price commenced at $20/t CO_2-e in the 2013 year (2012-13) and increased at an average of 4% per annum.
- **MEDIUM –** the carbon price utilised the Australian Government Treasury modelling (Australian Treasury, 2008) of a carbon price series that would be required to reduce national emissions by 5% by 2020 (updated to 2010 dollars). This price series commences at approximately $28/t CO_2-e and increases by an average of 4.4% per annum.
- **HIGH -** the carbon price utilised the Australian Government Treasury modelling of a carbon price series that would be required to reduce national emissions by 15% by 2020 (updated to 2010 dollars). This price series commences at approximately $39/t CO_2-e and increases by an average of 4.3% per annum.

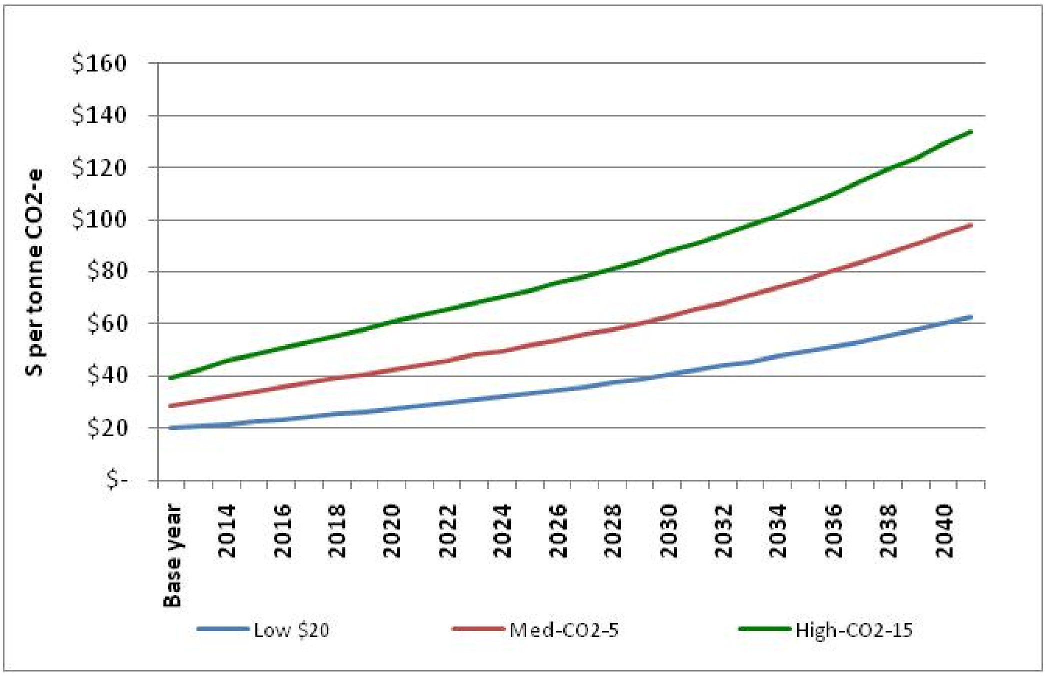

Figure 1: Carbon price series utilized in modelling.

The modelling provided an opportunity to project the impact of three different carbon prices on farm input costs and farm profitability over an extended period of time, assuming historical rates of farm productivity growth are maintained into the future. The modelling also provided an opportunity to examine the potential implications for farm businesses if agricultural emissions incurred a carbon price at some future time (**Agriculture Covered**). In this scenario, it was assumed that agricultural emissions incur a carbon price after five years, commencing with the carbon price being applied to 10% of farm emissions, increasing by 1.5% per annum. This broadly reflects the coverage of agricultural emissions included in the CPRS proposal, and is also similar to the coverage of agricultural emissions included in the New Zealand ETS.

A final scenario that was also able to be analysed utilising the modelling employed here was one under which a carbon price is implemented in the economy, with no cost imposed on emissions arising from fuel. This scenario – **No Fuel –** utilised the same carbon price series detailed previously. For on-farm input costs, all linkages between changes in the price of fuel and farm input costs were removed. For off-farm costs specifically related to the processing sector, ABARE data (Tulloh et al 2009) in combination with data from a number of other sources was used to calculate the proportion of processor input costs that were not fuel related costs, and this was used to estimate cost increases for processors under a carbon price which excluded fuel. The methodology associated with the calculation is explained below.

Results

Agriculture as an uncovered sector

It should be noted that the following discussion relates to projected changes from the business-as-usual scenario under which no carbon cost mechanism is implemented in the Australian economy. As such, the projections being discussed are relative rather than absolute changes. Tables 4, 5 and 6 below display changes in farm input costs and farm cash income (gross farm cash revenue minus farm cash costs) arising from the impact of the carbon price, assuming agriculture remains an uncovered sector, under the three different carbon prices under consideration.

Table 4: Projected change in farm business costs and farm cash income for the Australian average sheep farm.

Change in total costs and cash income (agriculture uncovered)							
Carbon price scenario		**Year 5**	**Year 10**	**Year 15**	**Year 20**	**Year 25**	**Year 30**
	Carbon Price	$ 23.40	$ 28.47	$ 34.63	$ 42.14	$ 51.27	$ 62.37
	Cost - Processor ($)	$ 1,314	$ 1,599	$ 1,946	$ 2,367	$ 2,880	$ 3,504
Low $20	Cost - farm ($)	$ 2,678	$ 3,241	$ 3,923	$ 4,746	$ 5,739	$ 6,936
	Cost Total ($)	**$ 3,992**	**$ 4,840**	**$ 5,868**	**$ 7,113**	**$ 8,619**	**$ 10,440**
	Cost change (%)	2.0%	2.5%	3.0%	3.7%	4.4%	5.4%
	Income change (%)	-10.4%	-10.9%	-11.5%	-12.3%	-13.2%	-14.4%
	Carbon Price	$ 35.78	$ 44.34	$ 53.61	$ 65.53	$ 80.35	$ 97.83
	Cost - Processor ($)	$ 2,010	$ 2,491	$ 3,011	$ 3,681	$ 4,514	$ 5,496
Med-CO2-5	Cost - farm ($)	$ 4,079	$ 5,018	$ 6,023	$ 7,306	$ 8,881	$ 10,716
	Cost Total ($)	**$ 6,089**	**$ 7,509**	**$ 9,035**	**$ 10,987**	**$ 13,395**	**$ 16,211**
	Cost change (%)	3.1%	3.9%	4.6%	5.6%	6.9%	8.3%
	Income change (%)	-15.9%	-16.9%	-17.7%	-19.0%	-20.6%	-22.3%
	Carbon Price	$ 50.83	$ 62.98	$ 75.60	$ 91.00	$ 110.11	$ 134.07
	Cost - Processor ($)	$ 2,855	$ 3,538	$ 4,247	$ 5,112	$ 6,185	$ 7,532
High-CO2-15	Cost - farm ($)	$ 5,776	$ 7,087	$ 8,433	$ 10,056	$ 12,045	$ 14,503
	Cost Total ($)	**$ 8,631**	**$ 10,625**	**$ 12,680**	**$ 15,168**	**$ 18,230**	**$ 22,034**
	Cost change (%)	4.4%	5.5%	6.5%	7.8%	9.4%	11.3%
	Income change (%)	-22.6%	-23.9%	-24.9%	-26.2%	-28.0%	-30.3%

Table 5: Projected change in farm business costs and farm cash income, WA sheep farm.

Change in total costs and cash income (agriculture uncovered)							
Carbon price scenario		Year 5	Year 10	Year 15	Year 20	Year 25	Year 30
Low $20	Carbon Price	$ 23.40	$ 28.47	$ 34.63	$ 42.14	$ 51.27	$ 62.37
	Cost - Processor ($)	$ 1,999	$ 2,433	$ 2,960	$ 3,601	$ 4,381	$ 5,330
	Cost - farm ($)	$ 3,999	$ 4,841	$ 5,860	$ 7,091	$ 8,576	$ 10,367
	Cost Total ($)	**$ 5,998**	**$ 7,274**	**$ 8,820**	**$ 10,692**	**$ 12,957**	**$ 15,697**
	Cost change (%)	2.1%	2.5%	3.0%	3.7%	4.5%	5.4%
	Income change (%)	-12.6%	-12.4%	-12.5%	-12.8%	-13.4%	-14.1%
Med-CO2-5	Carbon Price	$ 35.78	$ 44.34	$ 53.61	$ 65.53	$ 80.35	$ 97.83
	Cost - Processor ($)	$ 3,057	$ 3,789	$ 4,581	$ 5,600	$ 6,866	$ 8,360
	Cost - farm ($)	$ 6,093	$ 7,496	$ 9,000	$ 10,918	$ 13,274	$ 16,017
	Cost Total ($)	**$ 9,150**	**$ 11,286**	**$ 13,581**	**$ 16,518**	**$ 20,140**	**$ 24,377**
	Cost change (%)	3.1%	3.9%	4.7%	5.7%	6.9%	8.4%
	Income change (%)	-19.2%	-19.2%	-19.2%	-19.8%	-20.8%	-21.9%
High-CO2-15	Carbon Price	$ 50.83	$ 62.98	$ 75.60	$ 91.00	$ 110.11	$ 134.07
	Cost - Processor ($)	$ 4,343	$ 5,382	$ 6,461	$ 7,777	$ 9,409	$ 11,457
	Cost - farm ($)	$ 8,627	$ 10,588	$ 12,601	$ 15,028	$ 18,001	$ 21,673
	Cost Total ($)	**$ 12,971**	**$ 15,970**	**$ 19,061**	**$ 22,805**	**$ 27,410**	**$ 33,130**
	Cost change (%)	4.5%	5.5%	6.6%	7.8%	9.4%	11.4%
	Income change (%)	-27.3%	-27.1%	-26.9%	-27.3%	-28.2%	-29.7%

Table 6: Projected change in farm business costs and farm cash income, NSW sheep farm.

Change in total costs and cash income (agriculture uncovered)							
Carbon price scenario		Year 5	Year 10	Year 15	Year 20	Year 25	Year 30
Low $20	Carbon Price	$ 23.40	$ 28.47	$ 34.63	$ 42.14	$ 51.27	$ 62.37
	Cost - Processor ($)	$ 2,457	$ 2,989	$ 3,637	$ 4,425	$ 5,383	$ 6,550
	Cost - farm ($)	$ 2,771	$ 3,355	$ 4,060	$ 4,912	$ 5,941	$ 7,180
	Cost Total ($)	**$ 5,228**	**$ 6,344**	**$ 7,697**	**$ 9,337**	**$ 11,324**	**$ 13,730**
	Cost change (%)	2.6%	3.1%	3.8%	4.6%	5.5%	6.7%
	Income change (%)	-14.3%	-14.8%	-15.6%	-16.7%	-17.9%	-19.4%
Med-CO2-5	Carbon Price	$ 35.78	$ 44.34	$ 53.61	$ 65.53	$ 80.35	$ 97.83
	Cost - Processor ($)	$ 3,757	$ 4,656	$ 5,629	$ 6,881	$ 8,437	$ 10,273
	Cost - farm ($)	$ 4,222	$ 5,194	$ 6,235	$ 7,563	$ 9,195	$ 11,096
	Cost Total ($)	**$ 7,979**	**$ 9,850**	**$ 11,864**	**$ 14,444**	**$ 17,632**	**$ 21,370**
	Cost change (%)	3.9%	4.8%	5.8%	7.1%	8.6%	10.4%
	Income change (%)	-21.8%	-23.0%	-24.1%	-25.8%	-27.9%	-30.3%
High-CO2-15	Carbon Price	$ 50.83	$ 62.98	$ 75.60	$ 91.00	$ 110.11	$ 134.07
	Cost - Processor ($)	$ 5,337	$ 6,614	$ 7,939	$ 9,556	$ 11,562	$ 14,079
	Cost - farm ($)	$ 5,978	$ 7,336	$ 8,730	$ 10,412	$ 12,474	$ 15,023
	Cost Total ($)	**$ 11,315**	**$ 13,949**	**$ 16,669**	**$ 19,968**	**$ 24,036**	**$ 29,102**
	Cost change (%)	5.5%	6.8%	8.1%	9.8%	11.7%	14.2%
	Income change (%)	-30.9%	-32.6%	-33.9%	-35.7%	-38.1%	-41.2%

For all three farms, the impact of the carbon price, even at relatively low levels, is quite significant. It is interesting to note that on a dollar basis, the WA farm incurs the greatest increase in input costs. However on a percentage basis, the NSW farm experiences the highest increase in input costs of all three farms, partly because the NSW farm is the smallest of all the model farms and has higher processing costs. The NSW farm sells 46% of the farm flock each year, whereas the WA sheep farm sells 29% of total sheep and the Australian average farm sells 40% of total sheep numbers each year.

The impact of a carbon price on farm businesses can also be expressed in terms of the changes in farm cash income (gross farm cash revenue minus farm cash costs) as the price of carbon changes. Farm cash income is an important measure for a farm business, as it reflects the cash surplus generated each year that is available for owner/operators expenses and/or to retire debt.

The projections in these tables highlight that the ‘bottom-line’ impact of increases in farm input costs are significant when considered from a perspective of the effect on farm profitability, with a 2.6% increase in farm input costs for the NSW farm, for example, projected to result in a 14.3% reduction in farm cash income. As the costs increase, farm cash income falls in response, and by year 30 farm input costs for the NSW farm are projected to rise by 6.7% resulting in a projected 19.4% fall in farm cash income.

In relative terms the impact of the carbon price on farm profitability is projected to be greatest for the NSW farm. This is partly because the NSW farm has the lowest overall productivity rate of all three model farms. The NSW farm is highly reliant on income from sheep and wool sales, which in combination make up 68% of farm revenue and only 11% of revenue is generated from the cropping enterprise. In comparison, the WA farm obtains 53% of farm revenue from sheep and wool sales, and 30% from the cropping enterprise. The historical productivity rates associated with cropping (1.5% pa) are higher than for wool and sheep production (0.3% pa). Over time the higher overall farm productivity rate for the WA farm allows the farm to better absorb the increase in input costs. This is despite the fact that in the base year (prior to the imposition of the carbon price) the NSW farm was generating $1.15 of revenue per dollar of input, compared with $1.13 for the WA farm. This highlights the importance of future productivity growth to enable farms to maintain profitability despite the introduction of a carbon price.

The above results are expressed in terms of changes from the business-as-usual scenario, under which no carbon price is introduced into the economy, and both the sheep and grains industries maintains historical productivity growth rates. In all cases, the imposition of a price on carbon slows the rate of growth in future farm cash income, (in $2009-10 terms) but nominal farm cash income continues to grow under all scenarios, as Figures 2, 3 and 4 (below) highlight.

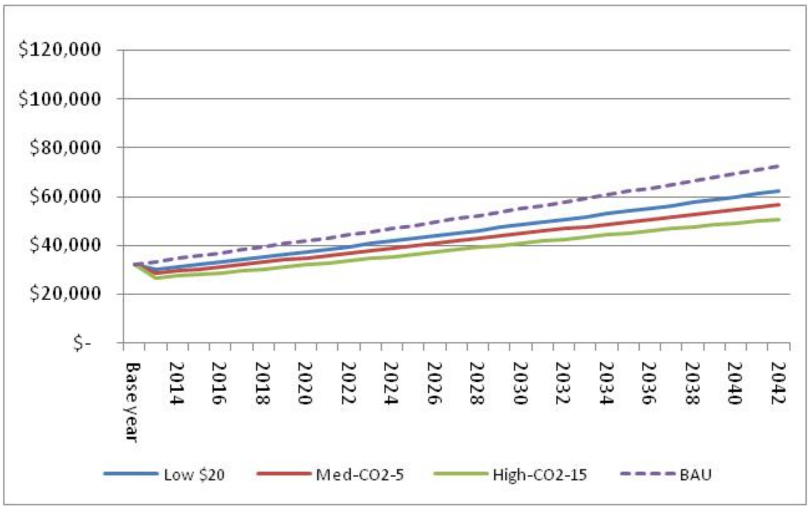

Figure 2: Projected future farm cash income under different carbon price scenarios, Australian average sheep farm.

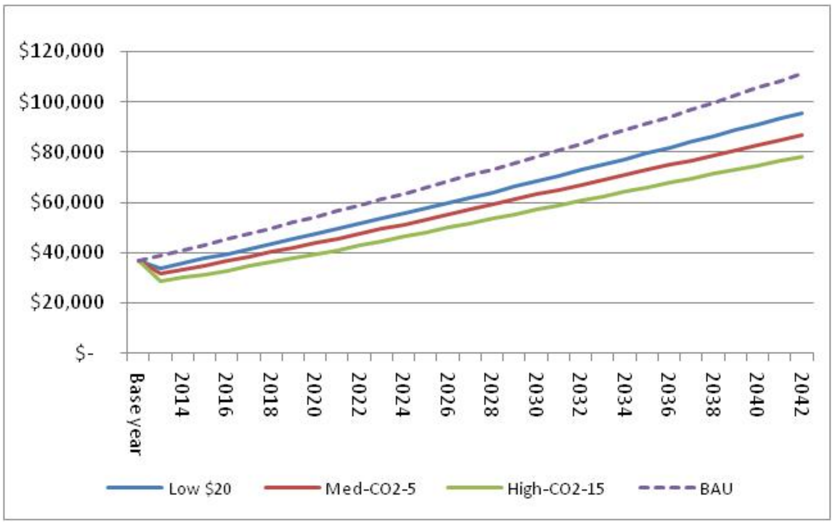

Figure 3: Projected future farm cash income under different carbon price scenarios, WA sheep farm.

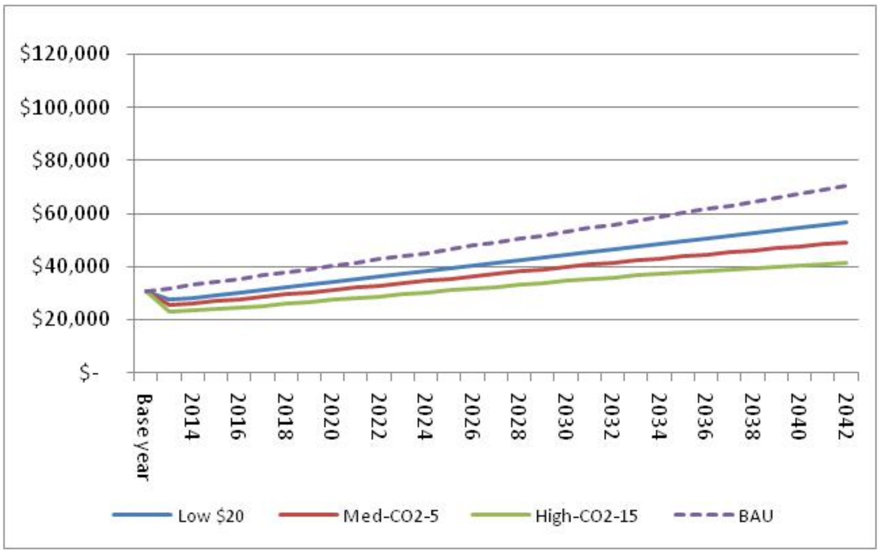

Figure 4: Projected future farm cash income under different carbon price scenarios, NSW sheep farm.

The analysis provided an opportunity to develop a "carbon price/farm cost" curve for each of the farms, which provides a picture of how farm input costs are projected to increase as carbon prices increase. These results are displayed in Figures 5, 6 and 7 below.

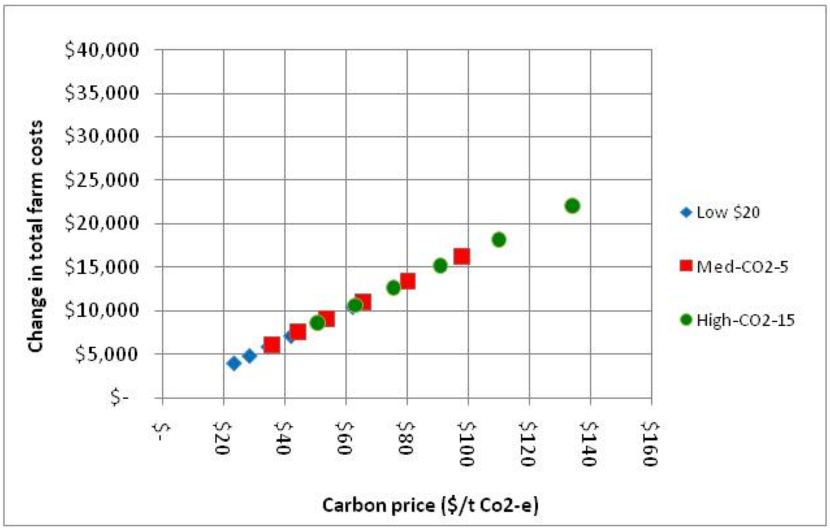

Figure 5: Relationship between carbon price and overall cost increases for the Australian average sheep farm.

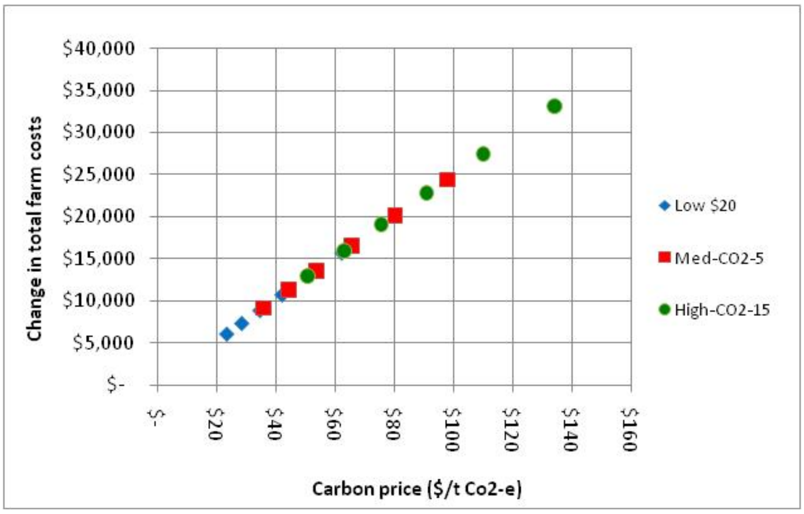

Figure 6: Relationship between carbon price and overall cost increases for the WA sheep farm.

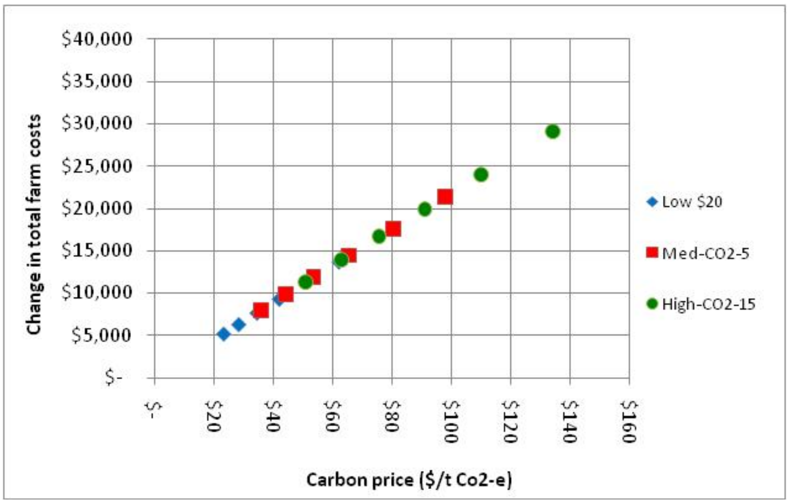

Figure 7: Relationship between carbon price and overall cost increases for the NSW sheep farm.

At a carbon price of approximately $20 per tonne CO_2-e, the additional costs are approximately $1.20 per head of sheep for the Australian average sheep farm, approximately $1.46 per head of sheep for the WA farm, and $1.54 per head of sheep for the NSW farm. The variation in these figures arises partly from the different levels of reliance each of these farms has on non-sheep enterprises.

Agriculture as an covered sector

The Australian Government has stated that agricultural emissions will not attract a liability under a carbon price mechanism for the 'foreseeable future', and this might lead to the conclusion that the sector therefore does not need to consider the implications of a carbon cost being imposed on farm emissions. However, it is pertinent to note that the New Zealand emissions trading scheme which has already commenced includes a proposal to impose a cost on at least some farm emissions from 2015, by making downstream processors and input suppliers liable for emissions that are generated on farm. This, in combination with the fact that agriculture sector emissions will become more prominent in future in the national inventory as other sectors emissions decline (and therefore more likely to attract the attention of policymakers) suggests that it is prudent to also examine the implications for farm businesses of a liability for a proportion of direct farm emissions.

A scenario was therefore modelled under which a carbon price mechanism was introduced in the economy such that a carbon price trajectory equivalent to the Treasury modelling of the CPRS-5 scenario was experienced. The agriculture sector, from year five, was then assumed to be required to pay a carbon price for 10% of farm emissions (in accordance with the 'Emissions-Intensive Trade Exposed' sector proposal included with the CPRS), with the level of liability increasing by 1.5% per annum from year 6. This would mean that a farm business would be liable to pay a cost for 10% of estimated farm emissions in year 5, 11.5% in year six and so on. Figures 8, 9 and 10 (below) show projected changes in farm cash income for the Australian average, WA and NSW model sheep farms under this scenario, comparing the results with the projected income under a carbon pricing mechanism with carbon prices equivalent to the CPRS-5 Treasury carbon price series.

The resulting projections indicate that the imposition of a cost for farm emissions from year 5, even at an initial 10% level, would result in a significant additional decrease in farm cash incomes for all three model farms. The impact would be relatively greater for the smaller NSW farm, again largely due to the lower productivity rate of the NSW farm. This means that even a small increase in input costs has a marked impact on overall farm profitability.

It should be noted that this impact is projected to occur under a model whereby it is assumed historical sheep industry productivity growth of 0.3% per annum is able to be maintained for the duration of the period under investigation. This perhaps under-estimates future productivity growth rates, and if the modelling incorporated a higher rate of long-term productivity growth, the negative impact on farm income would be less than indicated in this modelling.

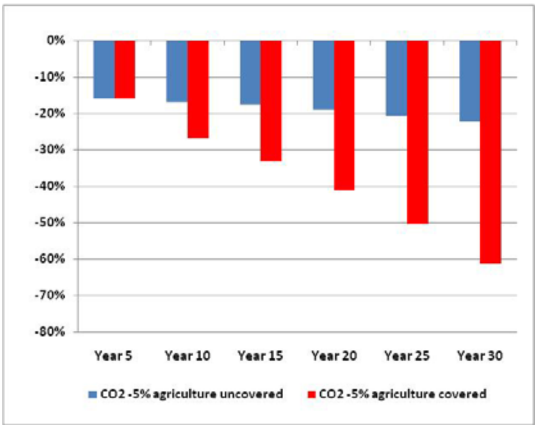

Figure 8: Change in farm cash income for an Australian average sheep farm under a scenario where agriculture becomes a covered sector after 5 years, and incurs a liability for 10% of emissions, escalating by 1.5% per annum.

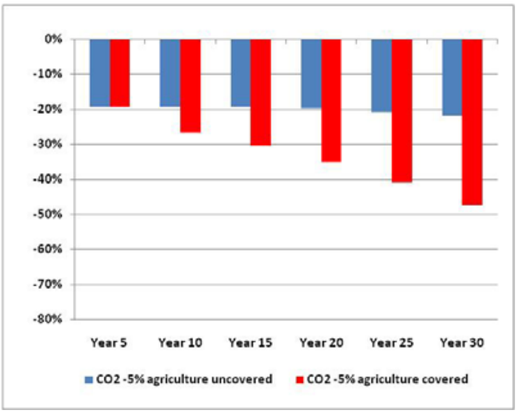

Figure 9: Change in farm cash income for a W.A. average sheep farm under a scenario where agriculture becomes a covered sector after 5 years, and incurs a liability for 10% of emissions, escalating by 1.5% per annum.

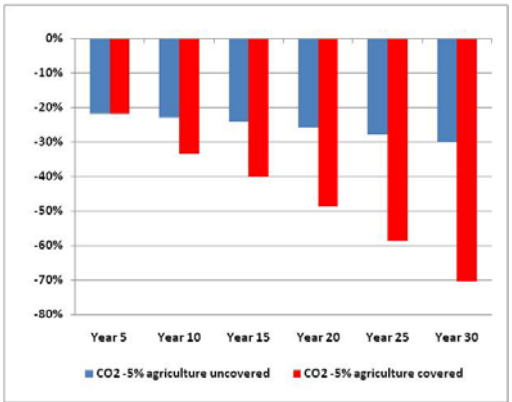

Figure 10: Change in farm cash income for NSW average sheep farm under a scenario where agriculture becomes a covered sector after 5 years, and incurs a liability for 10% of emissions, escalating by 1.5% per annum.

No fuel scenario

A carbon price policy scenario that has been the subject of some discussion is one under which no carbon price is implemented for emissions arising from liquid fuel, and under which agricultural emissions are excluded from a carbon price. The scenario modelled here attempts to provide an estimate of the impact of such a policy for Australian farm businesses.

For farm-sector costs detailed in the models developed for this analysis, it is a relatively straightforward process to remove any linkage between the carbon price and fuel-related farm input costs such as fuel and freight, in order to calculate the direct impact of a 'no-fuel' carbon policy on farm businesses.

However, for the post farm processing sector, calculating the impact of a carbon price that excludes fuel is much less straightforward, because of the limited availability of relevant data. The approach used in this analysis was to use the increased processor costs identified by ABARE (Tulloh et. al, 2009) as a starting point, and then to discount those to account for the fact that fuel emissions would not incur a cost under the carbon policy. To do this requires identification of the significance of fuel and fuel-related inputs in the total input costs of processors. It is also important to recognise that many processing facilities produce direct emissions in excess of the previously announced threshold level for participation in a carbon scheme (25,000 tonnes CO_2-e per annum) and it is assumed that this same threshold will be applied to a future carbon scheme, and that processors will therefore incur a direct liability for these factory emissions, irrespective of the inclusion or exclusion of fuel.

The potential impact of a carbon scheme on meat, milk and grain processors is assumed to depend on two main variables, which are;

1. The total amount of electricity inputs utilised by the processor and key input providers, and
2. The direct emissions produced by the processor, for which it is likely that a carbon price will be applied.

ABS Input/Output tables, (ABS, 2010) (Table 7 below) provide a breakup of the energy and energy-related inputs used by relevant agricultural processing sectors in Australia. The table indicates that fuel and transport costs dominate the energy-related costs of these sectors, with dairy processors seemingly less reliant on fuel (and therefore more reliant on electricity) than either of the other two sectors.

The amount of direct greenhouse emissions produced by the various processing sectors is not available, although some information can be obtained from published data associated with the National Greenhouse and Energy Reporting Scheme (NGERS), which lists reporting companies and various categories of emissions they produce. (NGERS, 2009). There has also been some research carried out into emissions associated with red meat processing (The CIE, 2009). Based on that data and assuming an emission price of \$25/t CO_2-e, direct emission costs of approximately \$45 million would be added to the costs incurred by meat processors nationally, and this portion of the added costs would not change if fuel was excluded from coverage. The same data is not as readily available for other processors, but it is assumed that similar 'direct' emission costs would apply to processors in other sectors under any carbon price policy.

Table 7: Energy and energy-related inputs utilized by agricultural processors.

Supply sector	User sector ($ millions)		
	Meat and Meat product Manufacturing	Dairy Product Manufacturing	Grain Mill and Cereal Product Manufacturing
Oil and gas extraction	$ 27	$ 60	$ 4
Petroleum and Coal Product Manufacturing	$ 11	$ 23	$ 16
Electricity Generation	$ 67	$ 92	$ 28
Electricity Transmission, Distribution, On Selling and Electricity Market	$ 55	$ 77	$ 23
Gas Supply	$ 2	$ 35	$ 6
Road Transport	$ 1,546	$ 375	$ 298
Rail Transport	$ 21	$ 12	$ 36
Total (Energy related)	**$ 1,730**	**$ 673**	**$ 411**
Fuel related	**$ 1,606**	**$ 470**	**$ 355**
Electricity related	**$ 124**	**$ 203**	**$ 56**
Fuel related (%)	**93%**	**70%**	**86%**
Non-fuel (Electricity/gas) %	**7%**	**30%**	**14%**

Based on the above and on consideration of factors such as pass-through rates of fuel costs into transport costs, the fact that many processors will incur a cost for their factory emissions and not receive any concessional treatment, and that there will likely be indirect cost increases passed on to processors by input suppliers, it is assumed that the removal of fuel emissions from coverage under a carbon price policy will substantially reduce the additional costs faced by processors. For the purpose of this modelling it is assumed that additional meat processor costs under a 'no-fuel' scenario would be only 20% of the additional costs estimated by ABARE (Tulloh et. al 2009) under a scenario where fuel was included, and for dairy and grain processors the additional costs would only be 40% and 25% respectively of the additional costs estimated by ABARE under a scenario where fuel emissions are included.

The resulting 'no-fuel carbon scheme' cost estimates are displayed in Table 1. These unit costs were then multiplied by farm outputs (tonnes of grain, numbers of livestock sold etc.), to estimate processor costs incurred by the farm business, assuming that 100% of processor costs are passed on to the farm business. This is considered realistic, given the export-dependent nature of the sheep industry and the relative concentration of the sheep processing sector. It should be noted that these estimates represent little more than a 'best guess' in the absence of the detailed plant-by-plant data that would be required to estimate these costs more accurately.

Modelling was carried out of the projected impacts of such a policy, assuming that all other factors (including the carbon price) remained the same as in earlier modelling. The results are displayed in Tables 8, 9 and 10 below.

Table 8: Projected change in farm business costs and farm cash income, No-fuel scenario, Australian average sheep farm.

Change in total costs and cash income (agriculture uncovered)							
Carbon price scenario		Year 5	Year 10	Year 15	Year 20	Year 25	Year 30
Low $20	Carbon Price	$ 23.40	$ 28.47	$ 34.63	$ 42.14	$ 51.27	$ 62.37
	Cost - Processor ($)	$ 282	$ 344	$ 418	$ 508	$ 619	$ 753
	Cost - farm ($)	$ 789	$ 949	$ 1,140	$ 1,370	$ 1,646	$ 1,974
	Cost Total ($)	**$ 1,071**	**$ 1,292**	**$ 1,558**	**$ 1,879**	**$ 2,264**	**$ 2,727**
	Cost change (%)	0.5%	0.7%	0.8%	1.0%	1.2%	1.4%
	Income change (%)	-2.8%	-2.9%	-3.1%	-3.2%	-3.5%	-3.7%
Med-CO2-5	Carbon Price	$ 35.78	$ 44.34	$ 53.61	$ 65.53	$ 80.35	$ 97.83
	Cost - Processor ($)	$ 432	$ 535	$ 647	$ 791	$ 970	$ 1,181
	Cost - farm ($)	$ 1,196	$ 1,457	$ 1,735	$ 2,087	$ 2,515	$ 3,008
	Cost Total ($)	**$ 1,627**	**$ 1,992**	**$ 2,382**	**$ 2,878**	**$ 3,484**	**$ 4,189**
	Cost change (%)	0.8%	1.0%	1.2%	1.5%	1.8%	2.1%
	Income change (%)	-4.3%	-4.5%	-4.7%	-5.0%	-5.4%	-5.8%
High-CO2-15	Carbon Price	$ 50.83	$ 62.98	$ 75.60	$ 91.00	$ 110.11	$ 134.07
	Cost - Processor ($)	$ 613	$ 760	$ 912	$ 1,098	$ 1,329	$ 1,618
	Cost - farm ($)	$ 1,687	$ 2,047	$ 2,413	$ 2,851	$ 3,384	$ 4,036
	Cost Total ($)	**$ 2,300**	**$ 2,807**	**$ 3,326**	**$ 3,949**	**$ 4,712**	**$ 5,654**
	Cost change (%)	1.2%	1.4%	1.7%	2.0%	2.4%	2.9%
	Income change (%)	-6.0%	-6.3%	-6.5%	-6.8%	-7.2%	-7.8%

Table 9: Projected change in farm business costs and farm cash income, No-fuel scenario, WA sheep farm.

Change in total costs and cash income (agriculture uncovered)							
Carbon price scenario		Year 5	Year 10	Year 15	Year 20	Year 25	Year 30
Low $20	Carbon Price	$ 23.40	$ 28.47	$ 34.63	$ 42.14	$ 51.27	$ 62.37
	Cost - Processor ($)	$ 458	$ 558	$ 678	$ 825	$ 1,004	$ 1,222
	Cost - farm ($)	$ 773	$ 926	$ 1,110	$ 1,329	$ 1,589	$ 1,899
	Cost Total ($)	**$ 1,231**	**$ 1,484**	**$ 1,788**	**$ 2,154**	**$ 2,593**	**$ 3,120**
	Cost change (%)	0.4%	0.5%	0.6%	0.7%	0.9%	1.1%
	Income change (%)	-2.6%	-2.5%	-2.5%	-2.6%	-2.7%	-2.8%
Med-CO2-5	Carbon Price	$ 35.78	$ 44.34	$ 53.61	$ 65.53	$ 80.35	$ 97.83
	Cost - Processor ($)	$ 701	$ 869	$ 1,050	$ 1,283	$ 1,574	$ 1,916
	Cost - farm ($)	$ 1,168	$ 1,417	$ 1,680	$ 2,011	$ 2,410	$ 2,867
	Cost Total ($)	**$ 1,869**	**$ 2,286**	**$ 2,730**	**$ 3,294**	**$ 3,983**	**$ 4,783**
	Cost change (%)	0.6%	0.8%	0.9%	1.1%	1.4%	1.6%
	Income change (%)	-3.9%	-3.9%	-3.9%	-3.9%	-4.1%	-4.3%
High-CO2-15	Carbon Price	$ 50.83	$ 62.98	$ 75.60	$ 91.00	$ 110.11	$ 134.07
	Cost - Processor ($)	$ 996	$ 1,234	$ 1,481	$ 1,782	$ 2,157	$ 2,626
	Cost - farm ($)	$ 1,645	$ 1,984	$ 2,327	$ 2,734	$ 3,224	$ 3,821
	Cost Total ($)	**$ 2,641**	**$ 3,218**	**$ 3,807**	**$ 4,516**	**$ 5,381**	**$ 6,447**
	Cost change (%)	0.9%	1.1%	1.3%	1.6%	1.9%	2.2%
	Income change (%)	-5.6%	-5.5%	-5.4%	-5.4%	-5.5%	-5.8%

Table 10: Projected change in farm business costs and farm cash income, No-fuel scenario, NSW sheep farm.

Change in total costs and cash income (agriculture uncovered)							
Carbon price scenario		Year 5	Year 10	Year 15	Year 20	Year 25	Year 30
Low $20	Carbon Price	$ 23.40	$ 28.47	$ 34.63	$ 42.14	$ 51.27	$ 62.37
	Cost - Processor ($)	$ 558	$ 679	$ 826	$ 1,005	$ 1,223	$ 1,488
	Cost - farm ($)	$ 921	$ 1,109	$ 1,335	$ 1,606	$ 1,931	$ 2,320
	Cost Total ($)	**$ 1,479**	**$ 1,788**	**$ 2,161**	**$ 2,611**	**$ 3,154**	**$ 3,807**
	Cost change (%)	0.7%	0.9%	1.1%	1.3%	1.5%	1.9%
	Income change (%)	-4.0%	-4.2%	-4.4%	-4.7%	-5.0%	-5.4%
Med-CO2-5	Carbon Price	$ 35.78	$ 44.34	$ 53.61	$ 65.53	$ 80.35	$ 97.83
	Cost - Processor ($)	$ 853	$ 1,058	$ 1,279	$ 1,563	$ 1,916	$ 2,333
	Cost - farm ($)	$ 1,398	$ 1,706	$ 2,035	$ 2,450	$ 2,957	$ 3,544
	Cost Total ($)	**$ 2,251**	**$ 2,764**	**$ 3,313**	**$ 4,013**	**$ 4,874**	**$ 5,877**
	Cost change (%)	1.1%	1.4%	1.6%	2.0%	2.4%	2.9%
	Income change (%)	-6.1%	-6.5%	-6.7%	-7.2%	-7.7%	-8.3%
High-CO2-15	Carbon Price	$ 50.83	$ 62.98	$ 75.60	$ 91.00	$ 110.11	$ 134.07
	Cost - Processor ($)	$ 1,212	$ 1,502	$ 1,803	$ 2,170	$ 2,626	$ 3,198
	Cost - farm ($)	$ 1,973	$ 2,399	$ 2,833	$ 3,353	$ 3,986	$ 4,765
	Cost Total ($)	**$ 3,186**	**$ 3,901**	**$ 4,636**	**$ 5,524**	**$ 6,612**	**$ 7,962**
	Cost change (%)	1.6%	1.9%	2.3%	2.7%	3.2%	3.9%
	Income change (%)	-8.7%	-9.1%	-9.4%	-9.9%	-10.5%	-11.3%

A comparison of these results with the results displayed in Tables 4, 5 and 6 shows that the projected cost impacts on sheep farms of a carbon policy that excluded fuel emissions would be considerably less, with projections of increased costs between 0.4% and 1.6% by year 5 (depending on the carbon price) which is projected to result in a reduction of farm cash income by between 2.6 and 8.7%, with the impact being greater on the NSW farm.

Under the highest carbon price scenario (High CO_2-15), farm cash income for the Australian average sheep farm is projected to fall by 30.3% (carbon price including fuel) and by 7.8% (carbon price excluding fuel) in year 30. For the WA farm, when fuel was included farm cash income was projected to fall by 29.7% and when fuel was excluded it was projected to fall by 5.8 % in year 30. From this analysis it seems that the WA farm benefits more from the exclusion of fuel than the Australian average farm. This is because the WA farm is more reliant on fuel-related input costs such as fertilizer, as shown in Table 3.

In the event the Australian Government remains committed to an emission reduction target by 2020 that reduces national emissions by either 5% or 15% and also decides to exclude fuel emissions from the carbon price, the carbon price that would be required to either emission reduction target would need to be considerably higher. No attempt has been made in this modelling to estimate how much higher the carbon price would need to be under the No-fuel scenario, in order for Australia to meet the emission-reduction targets that have been announced.

Conclusions

The scenarios modelled here and the assumptions underlying the modelling are as realistic as possible, but are still subject to a large degree of uncertainty at both a policy and also at a farm operation level. Faced with additional costs, farm business managers would respond in a variety of different ways that are not foreseeable or predictable, and technologies may emerge over time that enable adaptation to occur and the negative impacts of a carbon price on farm businesses to be reduced.

As outlined in the modelling, the impact of a carbon price on processor costs is potentially significant. The challenge of this cost for farm business managers is that there is very little which can be done to reduce it. There is little opportunity to change behavior to cope with this additional cost burden, as it is largely determined at the processor level and passed back to the producer at varying levels. The processor is assumed to pass back 100% of additional costs as a result of a carbon price in this modelling, so the results can be viewed as the upper level of the potential impact a carbon price will have on farm input costs.

It is clear that farm productivity rates have a significant impact on the ability of sheep farms to respond to and stay profitable when a carbon price is introduced. The different emission profiles of the model farms also indicate that emissions from nitrogen fertilizers only constitute a small amount of total emissions. The major source of emissions for these enterprises is methane emissions from enteric fermentation in sheep. The analysis shows that if agriculture was a covered sector and farm businesses were required to pay for farm emissions, farm cash income would fall significantly. This highlights that research and development to find a viable and cost-effective way to reduce enteric methane emissions in broadacre production systems is very important, particularly if agriculture is being considered as a covered sector in a future carbon price mechanism.

The exclusion of emissions from fuel would reduce the impact of a carbon price policy on Australian farm businesses by a very large amount in comparison with a policy that included fuel emissions (at the same carbon price), although no attempt has been made to estimate how much the carbon price would need to be increased under a ‘no-fuel’ scenario in order to achieve a specific future emission reduction target.

In conclusion, the introduction of a carbon policy in the Australian economy has the potential to have a significant negative impact on the profitability of sheep farm businesses in Australia, irrespective of whether or not agriculture sector emissions are included in the scheme.

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