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The effects of an emissions offsets scheme on Australian agriculture

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Abstract

The introduction of an offsets scheme is the key climate change mitigation policy for Australian agriculture. This paper presents an assessment, both qualitative and quantitative, of the long-run effects of an offsets scheme on Australian agriculture.

The uptake of agricultural technologies and practices that may generate offsets is likely to be significantly higher in the long run than in the short run. This paper focuses on the long-run uptake of mitigation technologies and practices under the assumption that relevant offset methodologies for agriculture will have been developed during the projection period to 2030.

The effects of the offsets scheme on Australian agriculture, as a whole, are projected to be positive by 2030. Costs per unit of production, adjusted for offset revenue, are projected to fall, production levels to increase and total emissions to fall, relative to the reference case.

However, the overall effects mask variances across agricultural industries and farms. The beef cattle and sheep meat industry is projected to experience the largest increase in production, while other, less emissions-intensive, industries are projected to experience smaller increases, or to decrease, as a result of the Carbon Pollution Reduction Scheme with offsets provisions.

The quantitative analysis is based on specific assumptions and should be viewed as indicative only.

Introduction

The past six months have seen significant changes in the Australian Government's climate change policies. Internationally, there has been some progress on climate change legislation in the United States and New Zealand, as well as agreement to the Copenhagen Accord. For Australian agricultural industries, the most significant development is the domestic offsets credit provisions for many agricultural practices proposed as part of the amendments to the government's climate change mitigation policy announced on 24 November 2009 (Australian Government 2009). Also, the Coalition's 'direct action' climate change policy, announced in February 2010 (Coalition 2010), includes programs that will encourage agricultural emissions reductions.

In the November 2009 amendments, the government made a policy commitment to exclude agriculture indefinitely from the Carbon Pollution Reduction Scheme (CPRS)[1], and to establish an offset market that complies with Australia's international climate change obligations and will provide credits for agricultural emissions abatement. The government also proposes to promote a voluntary market for offsets. Through these proposed changes to its CPRS policy, the government expects agriculture to contribute to Australia's unconditional target of a 5 per cent reduction in greenhouse gas emissions by 2020, relative to 2000 levels. The

1 It is also proposed that the government will work with industry to:

- monitor world's best practice in reducing agricultural emissions and consider a range of ways in which the agriculture sector can contribute to the transition to a low-pollution economy; and
- introduce voluntary emissions reporting trials in 2011 to allow the sector to better understand and manage its emissions.

economic outcomes for the agriculture sector will be determined by the opportunities arising from the domestic offsets schemes, and by changes in the competitiveness of the sector relative to international competitors.

The objective of this paper is to assess the opportunities for agriculture under the amended CPRS settings. The first part of this paper includes a review of international and domestic climate change policies, followed by an assessment of the performance of international offsets programs. The second part of this paper presents a qualitative and quantitative assessment of the possible long-run economic effects on Australian agriculture of an offsets scheme under the amended CPRS settings. As with all quantitative assessment, several simplifying assumptions were made in preparing this paper, including about a carbon price path, international policy settings and the availability and uptake of abatement technologies and practices to generate Kyoto compliant CPRS offsets within the agriculture sector.

International agriculture mitigation policy developments

In December 2009 at the Copenhagen Conference of the Parties (COP 15), countries agreed to provide the United Nations Framework Convention on Climate Change (UNFCCC) with non-binding emissions targets. Many countries, including Australia, have already announced their targets. While developed countries' proposed targets take the form of reduced emissions levels, some developing countries have elected to agree to an emissions intensity target (emissions per unit of GDP). Table 1 presents the targets proposed by some key countries.

1 Summary of proposed international greenhouse gas emissions targets for 2020 [a]

Country	Unit	Base year [b]	Reduction target (%)
Australia	Emissions	2000	–5 to –15 or –25
Canada	Emissions	2005	–17
United States	Emissions	2005	–17
EU	Emissions	1990	–20 to –30
Japan	Emissions	1990	–25
New Zealand	Emissions	1990	–10 to –20
Norway	Emissions	1990	–30 to –40
Russian Federation	Emissions	1990	–15 to –25
China	Emissions intensity	2005	–40 to –45
India	Emissions intensity	2005	–20 to –25

a The targets for Australia include land use, land use change and forestry (LULUCF) emissions. All other countries exclude LULUCF emissions. **b** Emissions levels (intensity) reduction targets are set relative to the base year emissions levels (intensity).
Source: UNFCCC website, ABARE calculations.

The Copenhagen Accord has focused on national targets and does not provide indications of the treatment of agricultural emissions; national policies are more informative in this regard. With regard to the treatment of agricultural emissions mitigation, proposed and/or current domestic climate change policies are relatively consistent across countries. All countries, with the exception of New Zealand, have excluded agriculture from direct emissions abatement obligations under their proposed/current climate change policies. Furthermore, there is a trend toward developed countries proposing offsets schemes to encourage emissions abatement from the agriculture sector. This trend is expected to accelerate over time as developing countries seek to also introduce agricultural offsets schemes to prevent any loss in competitiveness for their agricultural producers. The policy commitments made by major economies are discussed below.

US

The United States Congress is considering two climate mitigation Bills. The Bill passed by the House (Markey-Waxman Bill) and the one being considered by the Senate (Kerry-Boxer Bill) both propose emissions trading schemes that exclude agricultural emissions. The agriculture sector would have the opportunity to participate in the scheme through the generation of offsets. Offsets may be generated domestically or internationally in developing countries.

China

China has set emissions intensity reduction targets for 2020 of between 40 and 45 per cent per unit of GDP compared to 2005 levels (table 1). It is expected that a domestic carbon trading market will be operational during 2010 (Chinese Government 2009b). Five million dollars have been invested into projects designed to aid agricultural industries in adapting to climate change.

India

India plans to cut carbon intensity by up to 25 per cent in 2020 relative to its 2005 levels (table 1). In the agriculture sector, improvements in cultivation practices have been encouraged in order to decrease nitrous oxide emissions (Government of India 2009).

EU

The European Union (EU) established its emissions trading scheme (ETS) in 2005 and aims to reduce emissions by 20 to 30 per cent by 2020 and by 60 to 80 per cent by 2050 in comparison to 1990 levels. Currently, the EU scheme does not cover agriculture. The highest share of emissions in the agriculture sector comes from livestock and this will be an area for future mitigation policy. Strong incentives to preserve carbon stocks in agricultural soils are also expected to be established (Commission of the European Communities 2009).

Brazil

Brazil's Minister for Agriculture has announced that the agricultural industry will be required to decrease emissions by between 4.9 and 6.1 per cent below 2005 levels by 2020. The Brazilian Government has accorded A$66.5 billion in agricultural loans to assist farmers, with provision for an additional A$6.1 billion for future loans. The beef industry in particular is held accountable for deforestation problems in the Amazon, accounting for 75 per cent of Brazil's carbon emissions. The government hopes to rectify this situation through educating farmers about fertilisers and grass choices and promoting tree plantation (Colitt 2009).

Canada

Canada has set a target to reduce emissions by 17 per cent from 2005 levels by 2020 and by 60 to 70 per cent by 2050. Canada plans to develop a cap and trade system that aligns with the United States model (Canadian Government 2009). Although agricultural production is responsible for about 10 per cent of Canada's greenhouse gas emissions, the Canadian scheme excludes agricultural emissions. Beneficial management practices have been encouraged to reduce emissions in the agriculture sector, such as appropriate fertiliser management, low emissions intensity irrigation practices and proper grazing management.

New Zealand

The New Zealand Government has passed an Act to establish an emissions trading scheme, which will commence in 2010. The agriculture sector will be covered from 2015, with the point of policy obligation initially placed with processors. In the future, as practical issues such as the ability to accurately verify emissions are resolved, the government may move the point of policy obligation to farms. Agriculture sector participants will receive free permits on an output intensity basis. Free permits will be provided for 90 per cent of emissions required by each firm, based on the industry average emissions intensity. The rate of assistance provided to the agriculture sector will decline by 1.3 per cent a year from 2016 (Ministry for the Environment, NZ 2009).

Current domestic agriculture mitigation policies

The Carbon Pollution Reduction Scheme (CPRS) is scheduled to commence in July 2011. In November 2009, the government announced amendments to the CPRS policy (Australian Government 2009). A key amendment is to exclude agricultural emissions indefinitely from the CPRS. However, the government has committed to introducing agricultural offset schemes alongside the CPRS to allow agriculture to contribute to meeting the overall national emissions abatement commitment (DCC 2009). A Productivity Commission review in 2015 will assess whether the agriculture sector is at world's best practice mitigation and will examine potential measures to achieve further emissions reductions in the sector.

The amended CPRS settings allow for the generation of offsets credits from the agriculture sector (see table 2; amendments relating to non-agricultural industries are outlined in box 1). There are three provisions within the amended CPRS settings that will directly affect agriculture:

- Kyoto compliant CPRS offsets
- voluntary market offsets
- CPRS opt-in.

Emission reductions that are counted toward Australia's international commitments (that is, Kyoto compliant CPRS offsets) would be eligible for offset credits under the proposed CPRS amendments. Emission reductions that do not contribute to meeting Australia's international commitments may, nevertheless, generate offsets (henceforth, non-CPRS voluntary offsets) to be sold into voluntary markets. Furthermore, the agriculture sector may generate CPRS credits via reforestation, forest regrowth and increased soil carbon on deforested land (henceforth, CPRS opt-in). Stands of trees that meet the Kyoto Protocol requirements for a forest (with greater than 20 per cent crown cover, height of 2 metres or more, area of greater than 0.2 hectares and on land clear of forest since 31 December 1989) will have the option of generating CPRS credits.

To help facilitate the creation of the voluntary market, the government has released a National Carbon Offset Standard (NCOS). The NCOS will cover abatement from activities that do not comply with Australia's Kyoto Protocol commitments, including Article 3.4 activities, such as agricultural soils. The NCOS methodologies will be assessed by the same expert panel that will assess methodologies for Kyoto compliant CPRS offsets. This will allow for the transition of methodologies from the NCOS to the CPRS as international carbon accounting rules evolve.

2 Agricultural offsets options under the amended CPRS settings (announced in November 2009)

	Kyoto compliant CPRS offsets	Non-CPRS voluntary offsets	CPRS opt-in
Activities	Subject to the development of robust methodologies, emissions reductions associated with (from 1 July 2011): • livestock • manure management • fertiliser use • savanna burning • burning of agricultural residues • rice cultivation • avoided deforestation.	Subject to the development of robust methodologies, emissions reductions associated with: • agricultural soils (grazing and cropland management), including biosequestration through soil carbon and biochar • enhanced forest management • non-forest revegetation and vegetation management.	Regrowth forests on deforested land (legally cleared between 1990 and 31 December 2008). Reforestation (sequestration from Kyoto forests from 1 July 2010 will be credited). Soil carbon only on deforested land (credited from 2013; from land legally cleared between 1990 and 31 December 2008).

In order for Kyoto compliant CPRS offsets to be generated, relevant methodologies need to be developed and approved. No decision has been made on which abatement technologies will be incorporated into offset methodologies. This decision will be made on advice from the Domestic Offsets Integrity Committee.

Subject to compliance with the design of the market and methodological decisions about crediting abatement activities, Kyoto compliant CPRS offsets are more likely to be generated because they are likely to provide higher returns in terms of farmers receiving a higher price per offset unit. Known technologies and practices that may be used, subject to the development of robust methodologies, to generate Kyoto compliant CPRS offsets include:

- improved timing of fertiliser application (split application)
- improved fertiliser quality (slow release or nitrification inhibitors)
- improved placement of nitrogen fertiliser
- improved fertiliser management on pasture
- improved water management in rice cultivation
- use of rice varieties with reduced methane production
- improved livestock management
- improved feed quality
- implementation of effluent/methane capture systems in intensive livestock operations
- improved savanna burning practices.

Many of these technologies and practices are not likely to be implemented on a large scale in Australia because they are too costly, or apply only to small-scale activities or may not be judged to be 'additional' in the sense that their uptake is not induced by the policy in question. In particular, improved livestock management and methane capture systems are currently too expensive to implement, even with the additional income from an offsets scheme (EPA Queensland 2008). Improved savanna burning, fertiliser improvements (other than nitrogen inhibitors) and improved pasture management are the most likely to be implemented on a large scale.

There are also a range of non-CPRS voluntary offset activities recognised under the NCOS that focus on the sequestration of carbon dioxide in soils (other than on deforested land). Soil carbon levels and sequestration vary across management practices, as well as climate and soil types (Grace et al. 2004). There is a high degree of uncertainty surrounding the 'potential' volume of soil sequestration available in Australia. Furthermore, it is difficult to ensure the permanence of soil carbon sequestration. Current technologies that may be used, subject to the development of robust methodologies, to generate non-CPRS voluntary offsets include:

- increased use of no-till farming
- elimination of bare fallows/use of cover crops/improvement of vegetative fallows
- application of biochar
- introduction of pasture species with deeper roots
- reduction of degradation from overgrazing (rotational grazing)
- conversion of cropland to perennial grass vegetation.

The nature of the offset market is likely to change significantly over time. In 2012, for example, the agricultural offset market is likely to be small, chiefly due to issues surrounding the development of robust methodologies for agriculture (as discussed below). In the longer run, many of these problems will have been addressed, and technology will also have improved. Therefore, it is reasonable to expect that the uptake of mitigation technology induced by the proposed offsets schemes will be significant in the long run.

Box 1: Key features of the proposed CPRS (as of November 2009)

Timing: expected to begin on 1 July 2011.

Greenhouse gas emissions coverage: all greenhouse gases included under the Kyoto Protocol (carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, hydrofluorocarbons and perfluorocarbons).

Sectoral coverage: stationary energy, transport, fugitive emissions, industrial processes and waste sectors will be covered from 2011, while forestry will be included on a voluntary opt-in basis. Agriculture is excluded indefinitely from the scheme.

General emissions threshold (entities with facility emissions above this level are subject to scheme obligations): 25 000 tonnes of carbon dioxide equivalent (CO_2-e) a year.

Scope of coverage: approximately 75 per cent of Australia's emissions. Around 1000 entities will initially be subject to mandatory obligations under the scheme.

Emissions trajectory: to be consistent with Australia reducing its emissions by between 5 and 15 or 25 per cent below 2000 levels by 2020 and to 60 per cent below 2000 levels by 2050. Australia has submitted these 2020 targets to the Copenhagen Accord.

Emissions price: Fixed at $10 a tonne of CO_2-e in 2011–12 and to be determined by market forces from 2012–13 onwards, subject to a maximum price cap. The price cap (which will set the maximum cost of compliance under the scheme) will be around A$46/t CO_2-e in 2012–13 and will rise by 5 per cent in real terms each year until it ceases operation after the 2015–16 compliance year.

Assistance for Emission Intensive Trade Exposed (EITE) Sectors: Assistance will be provided to eligible entities through the allocation of free permits at the start of each period (based on an individual entity's previous year's level of production) to cover an agreed and declining proportion of emissions including those associated with direct emissions covered by the scheme and scheme related cost increases for electricity, steam and those associated with the extraction and production of natural gas and its derivatives when used as a feedstock. Eligibility will be decided at an activity level (for example, aluminium smelting) based on all entities conducting an activity. To be eligible for assistance an activity must be:

- **trade exposed**—have a trade share (ratio of value of imports and exports to the value of domestic production) greater than 10 per cent in any of the years between 2004–05 and 2007–08; or have a demonstrated lack of capacity to pass through costs due to the potential for international competition
- **emissions intensive**—highest level of assistance (94.5 per cent support in 2011) if emissions exceed 2000 tonnes CO_2-e/$million revenue (or 6000 tonnes CO_2-e emissions/$million value added) on average; lower assistance (66 per cent support in 2011) if emissions are in the range of 1000–1999 tonnes CO_2-e/$million revenue (or 3000 to 5999 tonnes CO_2-e/$million value added). Estimates of emissions intensity will be based on data over the period 2004–05 to 2008–09.

The rates of assistance will decline each year by a carbon productivity contribution of 1.3 per cent to ensure that EITE sectors make a contribution to the national improvement in carbon productivity.

Desirable features of an offsets scheme: a critical review

It is important for Australia's international commitments that the CPRS is internationally recognised as an environmentally effective scheme (DCC 2008a). By extension, it is important that any offsets scheme that provides for offset credits under the CPRS is equally effective and meets international standards. Consequently, an offsets scheme must meet the internationally accepted principles of:

- additionality
- permanence
- verifiability and measurability
- independent audit
- registration.

Additionality

The additionality principle requires that an offset must be induced solely by the offsets scheme—the action that created the offset must not have occurred in the 'business as usual' case where there is no offsets scheme. Furthermore, an offset should not be credited if the action that created the offset is required to be undertaken because of regulatory requirements. In other words, the creation of the offsets scheme must drive the decision to undertake the abatement action. This interpretation is sometimes referred to as 'economic additionality'. If an offsets credit is awarded to a non-additional project the environmental integrity of the scheme is compromised as an offset has been created despite the fact that no new abatement (in the business-as-usual sense) has been undertaken. As the offset may be traded and used to discharge obligations under the CPRS, the awarding of offsets to non-additional projects is akin to loosening the emissions cap under the CPRS. The Australian Government has stated that additionality will be a requirement of any domestic offsets scheme.

Permanence

If any emissions abatement is non-permanent then it only represents a temporary reduction in emissions. Temporary reductions in emissions do not, in the long run, reduce global CO_2-e concentrations and, therefore, should not be included in an environmentally sound offsets scheme. While permanence cannot be guaranteed for many agricultural offsets, it is good practice to approve only less risky projects and require that projects hold insurance against unexpected events that may cause the carbon reduction to be reversed.

Verifiability and measurability

Verifiability can also be difficult for agricultural offset programs. Generally, the number of offsets credited to a given project is calculated by subtracting the actual emissions from an estimate of baseline emissions. Because the baseline emissions estimate is a counter-factual—it never actually occurs and, hence, cannot be measured directly—it needs to be modelled or estimated. This reduces the certainty concerning whether the correct number of offsets have been issued. It is essential that a credible and internationally recognised methodology for calculating baseline emissions is developed and adhered to.

It is tempting to assume that an agricultural offsets scheme would involve significantly lower measurement and administration costs than including agriculture directly in the CPRS. However, both methodologies involve significant measurement and administration costs. A methodology will be needed for measuring the baseline for each type of project that is allowed to generate offsets, and emissions from all projects will need to be monitored. The measurement costs will depend heavily on the final design of the offsets scheme.

Lessons from existing offsets schemes

The Kyoto Protocol has included two offset programs—the Joint Implementation (JI) and Clean Development Mechanism (CDM) programs—as a part of the protocol's flexibility mechanisms to reduce global greenhouse gas emissions. Under the Kyoto rules, JI projects must occur in Annex B countries (industrialised countries and economies in transition), while CDM projects must occur in developing countries. In practice, CDM occurs in a more diverse range of countries and is the larger of the two schemes by a factor of 10 (Wara and Victor 2008). Among the growing number of international methodologies being prepared for the CDM offsets, currently only five methodologies have been developed for agriculture (UNFCCC 2009). The difficulties associated with agricultural offsets are further highlighted by the fact that only 123 (or about 5 per cent) of CDM-registered projects relate to agricultural methodologies.

Kollmuss et al. (2008) identify and analyse 24 current or proposed offsets schemes and standards. Many of these schemes focus on the energy and energy efficiency sectors, and are not directly applicable to agriculture. Those that do include agricultural offsets generally include only a specified and limited number of agricultural offsets, such as methane management and/or soil carbon improvements from no-till agricultural practices.

Thus, while there is some international precedent for agricultural offsets, the scope of the proposed Australian scheme is unprecedented. Australia will need to develop methodologies that are relevant to its unique climate and agricultural characteristics.

CDM and the additionality principle

It is claimed that the test for additionality in the CDM has, at least in practice, been compromised to such an extent that many non-additional projects have been included in the CDM (see, for example, Schneider 2009). Schneider (2009) provides a critical review of the CDM project assessment process and concludes that 'these results seriously question the way in which the additionality of CDM projects is assessed in practice. For a considerable number of projects, additionality seems unlikely or questionable'.

The biggest failure of the CDM process is chiefly institutional in nature. One of the key issues identified by Schneider (2009) is that projects that were admitted through the barrier criterion (that there was some non-financial barrier preventing their implementation) failed to explain how the CDM helped the project to overcome the barrier. For CDM projects in developing countries, lack of access to a liquid capital market is often cited as a barrier. As the barrier criterion is also to be used in the Australian offsets scheme, it is important that this issue be addressed in the domestic setting (Australian Senate 2009).

It is suggested that internationally accepted principles are not currently working to effectively deliver real abatement under the CDM. It is claimed that the CDM has been subverted by trying to achieve too much at once (Wara and Victor 2008). For example, the CDM has been variously attributed with delivering low-cost emissions permits for the developed world, providing developing nations with funds to help tackle climate change and providing legitimate emissions reductions (Wara and Victor 2008). Wara and Victor contend that the CDM cannot achieve all of these goals simultaneously, and that additionality may have been compromised somewhat in the pursuit of the other goals. The proposed Australian legislation indicates that Australian offset methodologies 'must meet internationally accepted principles which are designed to deliver real abatement' (Australian Senate 2009). In order to ensure additionality, it may be necessary to develop clearer and more effective guidelines for the Australian scheme than have been used for the CDM projects.

Other international offsets schemes

Kollmuss et al. (2008) identify three key areas in which many of the offsets schemes are criticised: additionality, high compliance costs and low liquidity. However, it is unlikely that a scheme would be able to address all three of the criticisms at once. Strong regulatory mechanisms are required in order to ensure additionality. These regulatory mechanisms tend to increase compliance costs and reduce market liquidity.

On the methodology of CPRS offsets

The development of robust methodologies for crediting CPRS offsets is critical to creating conditions suitable for farmers' participation in CPRS-eligible offset activities. As already mentioned, these methodologies should comply with internationally agreed principles. Timeframes for resolving methodological issues are likely to be different for different mitigation options, and are a matter of ongoing research. The design of the offset markets and the decisions on methodologies and standards will influence the range, and the rate of uptake, of CPRS-eligible offsets.

Implications of offsets for Australian agriculture and the CPRS: a qualitative assessment

The Australian offsets schemes are proposed as a mechanism for encouraging agricultural abatement without imposing any cost burden on primary producers. In practical terms, an offsets scheme for agriculture will move the cost burden for emissions mitigation away from agriculture; with farmers being paid for any rules-compliant emissions reductions.

An offsets program provides the potential for agricultural producers to earn additional income via carbon sequestration or reduction activities. Producers receive a CPRS credit for every tonne of CPRS-compliant CO_2-e emissions that are reduced or sequestered, relative to a pre-determined baseline. Non-CPRS compliant offsets will be rewarded with a voluntary offset market credit. These credits may then be sold at the prevailing market rates.

Supply response and the rebound effect

The introduction of an agricultural offsets scheme improves the returns to agriculture. Improved returns from agriculture are likely to attract additional investments to the sector inducing an increase in the supply of agricultural goods. The increase in supply may result in an increase in emissions relative to a situation where there was no enhanced supply response. However, it is likely that improvements in the emissions intensity of agricultural production, despite any enhanced supply response, will cause total emissions to be lower than without offsets.

The supply response is likely to be more pronounced over the long run than in the short run. In the short run, the uptake of offsets-generating mitigation activities in agriculture is expected to be lower and, therefore, the supply response effect (in absolute terms) will also be smaller. Accordingly, the quantitative assessment of supply response in this paper was done for the year 2030 (see the section on indicative effects of the CPRS *with* offsets on Australian agriculture).

Furthermore, as a result of the offsets scheme, agricultural production is likely, over time, to shift toward industries that receive a higher proportion of offsets. Currently, the livestock industries in Australia have a limited potential to generate offsets. However, in the long run, it is likely that the more emissions intensive red meat and dairy industries will be able to generate the greatest proportion of offsets and, therefore, increase their share of agricultural production at the expense of lower emissions-intensive agricultural industries. This long-run shift in production toward higher emissions intensive industries may further limit overall emissions abatement in agriculture.

The agricultural supply response discussed here is akin to the rebound effect often identified in the case of energy efficiency improvements. Currently, the rebound effect is taken into account in a haphazard manner (if at all) within existing international offsets programs, such as the CDM, and only for energy efficiency projects (Hayashi and Michaelowa 2007). While it is possible to account for the rebound effect when determining project methodologies, it is difficult to quantify the rebound effect in practice.

CPRS compliant and voluntary offsets: a two-track approach

The proposed Australian offsets scheme involves a two-track approach. Kyoto compliant CPRS offsets will be eligible for discharging CPRS liabilities, while non-CPRS voluntary offsets will not be eligible for discharging CPRS liabilities. Non-CPRS voluntary offsets may be sold into voluntary schemes or, potentially, into international markets.

The critical difference between Kyoto compliant CPRS offsets and non-CPRS offsets will be the prices at which they can be sold. Kyoto compliant CPRS offsets, by definition, will be worth the same as a CPRS permit. The value of non-CPRS offsets will be determined by the relative supply and demand in the voluntary offsets market. It is likely that, at least initially, the voluntary market will be relatively small. Unless an international market is found, domestic demand may not be sufficient to induce significant investments in generating non-CPRS offsets.

Nonetheless, there will be some demand for voluntary offsets. Companies that have publicly committed to reducing their emissions or becoming 'carbon neutral' often consider the cost of offsets to be a reputational or branding cost. Many companies that have made such pledges are service-oriented firms, and are therefore unlikely to be directly covered under the CPRS. This affords them the option of purchasing cheaper, voluntary offsets. However, firms in this category will be small emitters (otherwise they would be covered entities under the CPRS). Overall, the demand for voluntary offsets is likely to be small when compared with the potential for agriculture to generate voluntary offsets.

Demand for voluntary offsets may also be generated by environmental groups or companies, such as airlines, that sell offsets to consumers of high emissions intensity services. However, it is likely that, given a choice, consumers in these categories may prefer more expensive Kyoto compliant offsets. The demand for those offsets is driven by environmentally conscious consumers and citizens who may be, if given a choice, willing to pay a premium for the higher environmental security provided by Kyoto compliant offsets. Second, the market is driven by perceived environmental altruism, where it is assumed by firms that a consumer feels happier knowing that they have contributed to the environment. In these situations, higher payments can lead to a greater degree of happiness, thus increasing the relative demand for Kyoto compliant offsets.

Interactions between CPRS opt-in credits and agricultural offsets

The CPRS includes an opt-in credit scheme for rules-compliant forest sinks. Providing offsets for forest sinks, but not for agricultural emissions abatement, would give forestry a competitive advantage over agricultural activities while both are competing for land. There was considerable public debate on this issue.

Providing offsets credits to agriculture as well as forestry might be expected to limit land use change out of agriculture. The extent of the potential reduction in land moving out of agriculture will depend on the availability of abatement technologies and practices and, more importantly, their uptake by farmers. Offsets credits will allow agriculture to be more competitive with forestry than if it were included directly in the CPRS as a covered sector. Furthermore, with an offsets scheme, agriculture will be in a stronger competitive position than if it were excluded from emissions trading entirely because farmers will be able to earn income from carbon offsets. The extent of this benefit will be determined by, among other things, the cost-competitiveness of abatement technologies and practices.

It should be noted that activities under the CPRS opt-in will be credited for net carbon sequestration, whereas under the CPRS offsets agricultural activities will receive credits for reductions in emissions. The extent of the competitive advantage that agriculture would gain from the proposed offsets scheme will depend on the type and quantity of the offsets that will be generated in agriculture. Providing agriculture with access to emissions offsets could potentially reduce the amount of land being converted to forestry activities in Australia, although it is not clear by how much.

Implications of access to international offsets

Australia's CPRS provides for the unlimited imports of international offsets, such as CDM offsets (Certified Emissions Reductions). The availability of international offsets will influence the price of CPRS permits and hence the domestic offsets market and domestic abatement outcomes.

If the international permit price is lower than the domestic permit price before the two markets are integrated, allowing unlimited access to international permits will lower the domestic permit price to equal the international price (adjusted for any transaction costs differential). In a competitive market, the volume of imported international permits will exactly match the reduced supply of domestic offsets. However, if enough domestically produced offsets were available at the international price, there should be no import of international permits because of higher perceived risks and transaction costs associated with internationally sourced offsets.

Indicative effects of the CPRS with offsets on Australian agriculture: a quantitative assessment

This section contains a quantitative assessment of the potential impacts of implementing the CPRS *with* offsets scheme using ABARE's Global Trade and Environment Model (GTEM).

Policy scenarios

Two policy scenarios were modelled:

- CPRS *with* offsets
- CPRS *without* offsets.

The two scenarios are identical except that the CPRS *with* offsets scenario allowed for credits for CPRS-compliant Australian agricultural offsets whereas in the counterfactual CPRS *without* offsets scenario Australian agricultural offsets were not credited. In both scenarios, agriculture was exempted from emissions liabilities. Comparing the results for the CPRS *with* offsets scenario with those of the counterfactual CPRS *without* offsets scenario, the effects of the agricultural offsets scheme were approximated.

In order to determine the effect of including CPRS compliant offsets on Australian agriculture, both policy scenarios were run in a CPRS-5 policy environment in which Australia is assumed to meet its unconditional target of a 5 per cent reduction in greenhouse gas emissions by 2020, relative to 2000 levels. Offset opportunities arising from the voluntary market were not modelled. Changes other than offsets negotiated between the government and the Coalition in November 2009 were not included, but are not expected to significantly affect the results for agriculture. No climate change impacts were accounted for explicitly in policy scenarios in this analysis.

The key modelling assumptions for the two policy scenarios are summarised in table 3.

3 Policy scenario settings

	CPRS *with* offsets scenario	CPRS *without* offsets scenario
Domestic agriculture policy	Agriculture is exempted from emissions liabilities. Agriculture has the opportunity to earn CPRS offsets credits for emissions reductions.	Agriculture is exempted from emissions liabilities. Agriculture cannot earn credits for offsets.
Other domestic policy settings	The pre-November 2009 government CPRS settings are used. These include the CPRS start date of 2011, a fixed $10 carbon price in 2011 and full trading in 2012.	
International policy settings	All countries implement domestic emissions trading schemes and face the same world carbon price, with developed countries beginning abatement prior to developing countries. All countries provide an offsets scheme for their agriculture industries.	
Carbon price	The carbon price for all countries, once they enter the scheme, is set equivalent to Treasury world carbon price estimates as published in Australian Government (2008).	
Forestry sequestration and land use change	Some agricultural land is converted to forestry use at the rate assumed in Ford et al. (2009).	
EITE assistance	All countries implement the same EITE assistance as Australia. Australia's EITE assistance is modelled as per government policy, with high-intensity industries receiving 94.5 per cent assistance and medium-intensity industries receiving 66 per cent assistance at the start of the scheme (declining over time).	

Carbon prices and emissions

The CPRS-5 global carbon price pathway from *Australia's Low Pollution Future: The Economics of Climate Change Mitigation* (Australian Government 2008) was used in simulating the two policy scenarios, with the exception that a A$10 carbon price was applied in 2011. Given the differences between the two scenarios, the emissions pathways under the two scenarios may not necessarily be the same but are not expected to be significantly different.

International settings

The international settings in both scenarios are identical and are taken from the *Australia's Low Pollution Future* report (Australian Government 2008). Countries were assumed to progressively engage in emissions trading, with the timing of engagement with the world carbon market based on Treasury's assumptions, and all countries provide the opportunity for agriculture to earn offsets once they enter the global trading scheme.

Exogenous accounting for land use change

GTEM, as is the case with most general equilibrium models, does not currently have the capability to model land use change between agriculture and forestry endogenously. ABARE is currently working toward implementing a theoretical framework for the treatment of land use change and forestry in dynamic general equilibrium models (Pant 2010). Thus, land use change estimates for the CPRS taken from previous studies (Lawson et al. 2008) were used in the model. Although land use is expected to differ somewhat between the two policy scenarios considered, the same land use change estimates were used in both scenarios.

The key features of GTEM are outlined in box 2. For this paper, the modelling framework has been enhanced by incorporating agricultural offsets and explicitly accounting for the cost of adopting abatement technologies and practices. These improvements are discussed below.

Modelling offsets

As ABARE does not have sufficiently detailed data and information about voluntary offsets, it is not possible to calibrate emissions intensity response curves (or marginal abatement cost functions) for voluntary offsets in GTEM. As a result, the GTEM simulations reported in this paper include only Kyoto compliant CPRS offsets. Consequently, the results provided here may underestimate actual offset potential. As more data becomes available on voluntary abatement options, such as soil carbon and biochar, ABARE may undertake a comprehensive modelling of agricultural offsets.

The number of offsets generated by each industry is derived from the emissions intensity response curves (also known as non-combustion emissions response functions; for details, see Ford et al. 2009). Given currently available and soon to be available technologies, the greater relative potential for reducing emissions in cropping compared with livestock is reflected in the emissions intensity response curves. However, in absolute terms, the potential to reduce emissions in livestock is greater. Offset credits are then provided to agricultural sectors based on the emissions offsets generated and the prevailing market price of carbon. The offset revenue provides additional incentives to agricultural sectors to undertake the abatement activities as well as increase their output levels.

Furthermore, it is assumed that the required offsets methodologies have been developed by 2030. No transaction costs or market barriers associated with the implementation of offsets methodologies are considered.

Accounting for the cost of abatement technologies and practices

Previous GTEM modelling has not explicitly accounted for the cost of adopting abatement technologies and practices (see, for example, Ford et al. 2009). That is, abatement costs have not been included in the accounting framework of the model. An attempt has been made in this paper to allow for the cost of abatement while providing credits for carbon offsets. The emissions intensity response curves, derived from the abatement potential outlined in the *Australia's Low Pollution Future* report (Australian Government 2008), were used to estimate the costs of abatements. Payments to the agriculture sectors for offset credits, discussed above, were adjusted for these costs.

Box 2: GTEM economic framework

GTEM (Pant 2007) is a recursively dynamic general equilibrium model of the world economy developed by ABARE to address policy issues with long-term global dimensions, such as climate change mitigation. The advantage of using a global general equilibrium model is that it captures interactions within and across sectors and countries that are particularly important when analysing trade-exposed sectors such as agriculture.

The version of GTEM used in this paper is largely consistent with the version used in the Australian Government (2008) modelling report. However, a number of additional model developments have been undertaken to improve the analysis of the agriculture sector. These are described here (also, see text for details on offsets modelling and explicit accounting for abatement costs).

For the analysis in this paper, the agriculture and food processing sectors of GTEM were expanded from three broad industries (livestock, crops and food processing) to seven agriculture industries (grains, rice, other crops, beef cattle and sheep meat, other animals, dairy cattle, and wool) and three food processing industries (meat, milk and other food). Furthermore, within the meat and food processing industries, substitution was enabled among inputs in response to relative price changes.

The key components of the new GTEM broad industries are: 'grains': wheat, corn, barley and other cereals; 'other crops': oil seeds, vegetables, fruit, sugar cane, cotton; 'beef cattle and sheep meat': beef cattle, sheep, goats, horses; 'other animals': poultry and pigs; 'wool': wool and other animal materials used in textiles; and 'dairy cattle': dairy cattle.

In addition, various land types and switching possibilities between them across agricultural activities were modelled, reflecting agronomic conditions and differences in returns to various land types. In this analysis, some agricultural land is assumed to be converted to forestry use in response to changes in relative profitability associated with the introduction of an emissions price. The conversion of agricultural land to forestry differs across agriculture industries. The majority of agricultural land converted to forestry is from the grazing industries. The introduction of an agricultural offsets scheme is expected to influence the amount of afforestation and reforestation in Australia. However, due to lack of details on the relevant policies, the extent of this influence could not be modelled.

To quantitatively assess the effects of the CPRS on farm production and associated emissions, assumptions were made regarding farmers' ability to adjust their production practices and technologies in response to price changes. In GTEM, these are represented through the chosen input structure and assumed input mix possibilities. Under the two CPRS scenarios, relative prices of inputs, including land, capital, labour and energy, are expected to change. However, it is difficult to accurately quantify the responsiveness of farmers to price changes, in terms of changing input mix and technologies. If farmers' ability to adjust turns out to be significantly different from what was assumed in the modelling, actual agriculture production and emissions will differ from what has been reported in the paper.

The GTEM results presented here, as with any simulation modelling results, should only be taken as indicative projections of the potential impacts that can occur under the CPRS. This is because economic models are only an approximation or simplified version of the real world. Over time, this analysis can be improved as additional information and data become available.

The GTEM reference case scenario

The GTEM reference case results are used as a baseline with which to compare the results of the two policy scenarios. The GTEM reference case is a set of projections of economic growth, population, industry growth, productivity improvements and greenhouse gas emissions. It aims to reflect a world in which technological development and government policies progress along their expected pathways in the absence of any major regional or global climate change initiatives and without any significant technological breakthroughs. The CPRS is not implemented in the reference case and climate change impacts are not accounted for explicitly in the reference case (or in the CPRS scenario modelled in this paper).

GDP growth, population and economy-wide productivity improvements are consistent with those used in the Australian Government (2008) report. ABARE's Australian reference case projections of agricultural production and emissions are generally consistent with the most recent analysis by ABARE's agriculture analysts. The emission projections for the agriculture sector are lower than those contained in the Australian Government (2008) modelling report because of changes in assumptions about productivity, emission intensity and preferences for Australian agriculture exports.

The GTEM results for the policy scenarios are reported as deviations from the reference case. In this manner, the results presented below may be interpreted as being the difference between what occurs in the policies scenario and what would have occurred without the policies being implemented.

Modelling results

This section presents the potential effects of the CPRS and the Australian offsets scheme on agricultural production and emissions for the year 2030. The effects of establishing an agricultural offsets scheme are approximated by comparing the results of the CPRS *with* offsets scenario with those of the CPRS *without* offsets scenario.

Offsets credit adjusted production costs

Including an agricultural offsets scheme in the CPRS is projected to reduce per-unit agricultural production costs, once adjusted for offset credits, relative to the reference case. Production costs include costs of all inputs, including land, labour, capital, and costs associated with management practices that reduce emissions, less any income that may be earned from emissions offsets. As can be seen in table 4, the cost declines are projected to be largest in the beef cattle and sheep meat industry because it is most emissions intensive (defined as emissions per unit of production), meaning that the industry receives a larger offset payment as a proportion of the cost of production.

The projected fall, relative to the reference case, in overall costs of agriculture production under the CPRS *with* offsets scenario is driven mainly by revenue generated from selling offsets. This effect is somewhat dampened by an increase in land prices caused by assumed afforestation.

4 Change in agricultural offsets credit adjusted production costs, relative to reference case, 2030 (%)

	CPRS *with* offsets	CPRS *without* offsets	Impact of offsets scheme
Grains	–0.4	–0.9	0.5
Other crops	–1.0	–1.1	0.1
Beef cattle and sheep meat	–5.7	0.8	–6.5
Other animals	–1.8	–0.6	–1.2
Dairy cattle	–3.3	–0.5	–2.8
Wool	–2.9	0.2	–3.1

Source: ABARE GTEM estimates.

For high emissions intensive industries (beef cattle and sheep meat, other animals, dairy cattle and wool), the offsets revenue effect is projected to dominate, leading to a fall in costs of up to 6.5 per cent by 2030 relative to not having an offsets scheme. Under the CPRS *with* offsets scenario, livestock sectors are expected to gain a competitive advantage and attract more agricultural resources, consequently raising the cost of grains production. For low emissions intensive industries (in particular, grains) the resource reallocation effect is projected to dominate, as demonstrated by the 0.5 per cent projected increase in grain production costs, relative to the reference case.

Production

Including an agricultural offsets scheme in the CPRS is projected to increase total agricultural production by 0.8 per cent by 2030, relative to the reference case, but the effects vary across individual sectors (table 5). Relative to the reference case, Australia's overall agricultural production is projected to increase because of an increase in global demand in response to cheaper food prices, driven by the assumed exclusion of agriculture emissions liabilities and the global provision of offsets. The higher emissions intensive industries, such as beef cattle and sheep meat and dairy, experience the largest increases in production because they receive the greatest benefits from the offsets scheme. Each of these industries is projected to expand by 1 per cent or more in 2030, relative to the reference case. Grains production increases by an estimated 1.1 per cent, relative to the reference case, driven mainly by an increased demand for biomass energy production.

Under the CPRS *with* offsets scenario, wool production is projected to decline by about 1.7 per cent by 2030, relative to the reference case. In Australia, wool enterprises compete for broadacre land with beef cattle enterprises which expand their production levels.

To measure the impact of offsets, the CPRS *with* offsets scenario results are compared with those under the CPRS *without* offsets scenario. An agricultural offsets scheme is projected to increase total agricultural production by 1.1 per cent by 2030, relative to not having an offsets scheme, but the effects vary across individual sectors. The high emissions intensive broadacre industries gain the most from the introduction of an offsets scheme and increase their production accordingly. The only industry that is projected to experience a decline in production levels, relative to not having an offsets scheme, is the grains industry. There is a transfer of resources away from grains and toward other broadacre industries, which causes the estimated 1.3 per cent drop in grains production, relative to not having an offsets scheme. These results could be affected by the availability of non-CPRS voluntary offsets.

5 Change in production, relative to the reference case, 2030 (%)

	CPRS *with* offsets	CPRS *without* offsets	Impact of offsets scheme
Grains	1.1	2.4	–1.3
Other crops	0.6	0.6	negligible
Beef cattle and sheep meat	1.6	–3.7	5.3
Other animals	–0.5	–1.5	1.0
Dairy cattle	1.9	–0.5	2.4
Wool	–1.7	–3.6	1.9
Processed meat	1.7	–2.0	3.7
Processed other food	negligible	–0.1	0.1
Processed milk	2.0	–0.4	2.4
Total Agriculture	0.8	–0.3	1.1
Total Food	0.6	–0.5	1.1

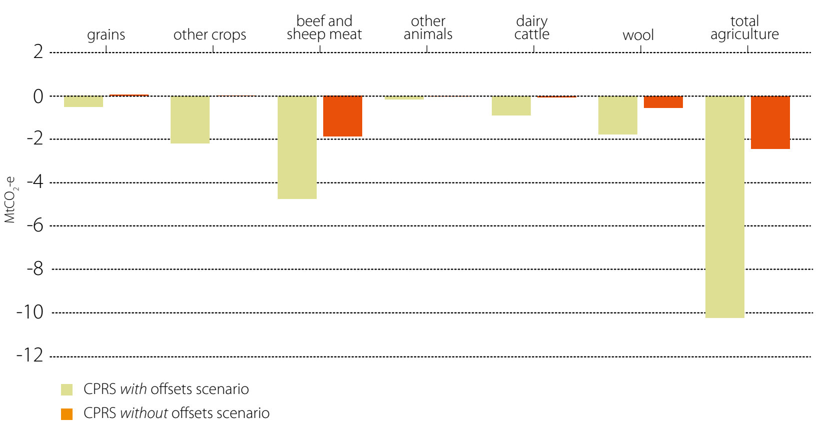
Source: ABARE GTEM estimates.

Emissions

Total Australian agricultural emissions (excluding savanna burning) were 75.1 million tonnes of CO_2-e in 2008, a slight decrease from the 80.2 million tonnes of CO_2-e emitted in 1990 (DCC 2009). However, there have been large variations in sectoral emissions over this period. While most sectors have experienced an increase in emissions, emissions from sheep have almost halved due to declining flock numbers.

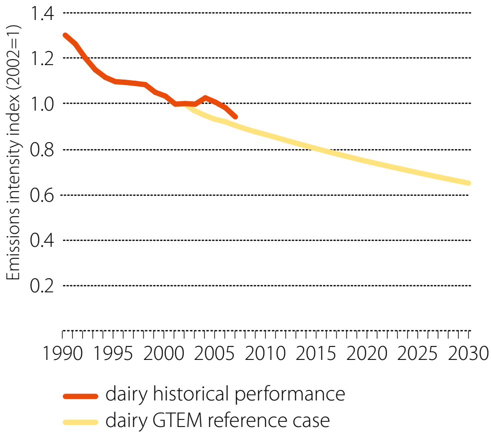
Figure a shows the projected agricultural emissions abatement at 2030, by agriculture sector, for both the CPRS *with* offsets and CPRS *without* offsets policy scenarios. The projected decline in agricultural emissions of about 2.4 million tonnes CO_2-e under the CPRS *without* offsets scenario, relative to the reference case, is caused by the projected small decline in agricultural production, as well as a shifting of production between agricultural sectors under the scenario,

a GTEM agricultural emissions at 2030
deviation from the reference case



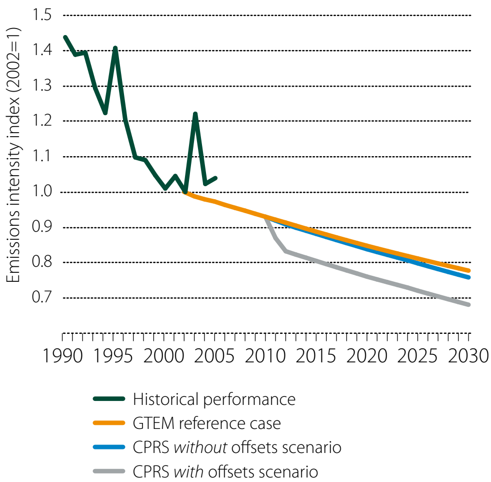
Source: ABARE GTEM estimates.

b Dairy sector emissions intensity



Source: DCC (2008b), ABARE GTEM estimates.
Historical figures are three-year moving averages.

c Emissions intensity of agricultural production



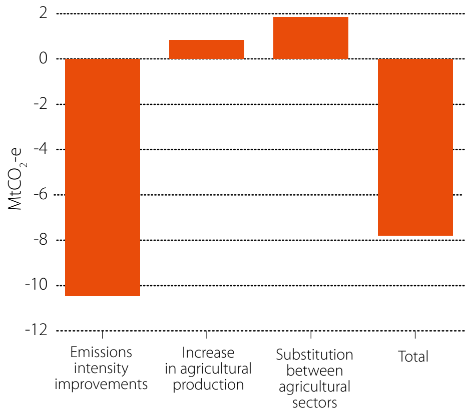
Source: DCC (2008b), ABARE (2008), ABARE GTEM estimates.

Box 3: Emissions intensity in agriculture industries

While emissions for most agriculture industries have historically increased over time, agricultural output has also increased. In this situation, the change in the emissions intensity per unit of output provides a better indicator of relative improvements in emissions. Using an emissions intensity measure, the dairy industry has been the best performing Australian agriculture industry over the past 20 years. Figure b shows both the historical emissions intensity and the GTEM reference case emissions intensity of the dairy industry. GTEM assumes continued improvements in dairy emissions intensity in the reference case because of increased dairy sector productivity as projected by ABARE commodity analysts. Similar trends hold for the other agriculture sectors.

Figure c shows the emissions intensity of Australian agriculture as a whole. The emissions intensity of Australian agriculture fell by 30 per cent from 1990 to 2002 and is projected to fall by a further 22 per cent by 2030 in the reference case. The rate of improvement in emissions intensity is projected to slow, because of a switching of production from low emissions intensive commodities such as grains and cereals to higher emissions intensive commodities such as milk and red meat. Figure c also highlights the additional emissions intensity reductions that occur under the policy scenarios. In the CPRS without offsets scenario, emissions intensity is projected to fall by 24 per cent from 2002 to 2030; in the CPRS with offsets scenario, emissions intensity is projected to fall by 32 per cent over the same period. This lower emissions intensity of agricultural production in the CPRS with offsets scheme, relative to the CPRS without offsets scheme, can be attributed to the offsets scheme and abatement options modelled in this paper.

d Sources of emissions reductions under the CPRS with offsets policy, relative to the CPRS without offsets policy in 2030



Source: ABARE GTEM estimates.

relative to the reference case (table 5). Total agricultural emissions in the CPRS *with* offsets scenario are projected to fall by about 10.2 million tonnes CO_2-e, relative to the reference case (figure a). The spread of emissions reductions across various activities within the agriculture sector is projected to be pronounced. Specifically, emissions in the beef cattle and sheep meat sector are projected to fall the most, relative to the reference case, because that sector's high emissions intensity implies a large potential for emissions reductions. In general, the emissions reductions relative to the reference case are projected to be substantial in the large industries (such as other crops) or high emissions intensive industries (such as beef cattle and sheep meat).

Figure d shows sources of the projected reduction in total emissions attributable to offsets: improvements in emissions intensity, increases in agricultural production and substitution between different agriculture sectors. The latter two are caused by the supply response effect discussed earlier. Improvements in overall agricultural emissions intensity generate emission reductions of a little over 10 million tonnes CO_2-e by 2030, relative to the CPRS *without* offsets. The supply response effect may have implications for Australia's ability to meet its international obligations. As offsets credits are awarded on a project-by-project basis, offsets methodologies are unlikely to be able to incorporate the supply response effect accurately. The supply response is projected to be equal to 25.5 per cent of the gross reduction in emissions caused by emissions intensity improvements in 2030. Other factors being the same, increases in agricultural production are projected to increase emissions by 800 000 tonnes CO_2-e (7.9 per cent) while substitution between agriculture sectors is projected to increase emissions by 1.8 million tonnes CO_2-e (17.6 per cent). The supply response effect can be interpreted in several different ways. For example, if the supply response effect was incorporated directly into offsets methodologies (via a pro rata reduction in the number of offset credits awarded to each project), the offsets revenue for each project would fall by 25.5 per cent, relative to a scenario in which there was no supply response effect.

Conclusions

Offsets schemes have the potential to achieve emissions abatement in Australian agriculture. The development of a wide-ranging and robust set of offset methodologies is essential for the successful implementation of an agricultural offsets scheme.

Introducing an offsets scheme for Australian agriculture is projected to have a positive effect on the performance of Australian agriculture to 2030. While the effects are projected to differ between sectors, the introduction of a domestic offsets scheme is projected to increase total agricultural production and decrease production costs (adjusted for offsets credits).

Although introducing offsets for agriculture seems to be beneficial for most agricultural sectors, the policy may not be costless, as the money needed to pay for the offsets must come from the covered sectors. The effects of offsets on the broader economy has not been considered in this paper.

The policy has the potential to increase emissions-intensive agricultural production above what it would have been in the absence of any mitigation policy. However, the analysis has found that this supply response, or rebound effect, is not likely to completely counteract the reduction in total emissions, suggesting that a system of offsets is effective in encouraging abatement in agriculture while maintaining the international competitiveness of Australian agriculture industries.

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