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Trading Carbon into Agriculture: making it happen

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Abstract

With agriculture occupying approximately sixty per cent of Australia's land surface, policy makers, scientists and land managers are becoming increasingly interested in opportunities to sequester greenhouse emissions through land use change. The announcement of the Labor Government's Carbon Farming Initiative brings Australian agriculture a step closer to participating in recognised domestic and international climate change mitigation action. In this paper, the costs and opportunities for carbon sequestration options under the Carbon Farming Initiative are assessed. The following section discusses the substantial hidden costs that may be associated with an offset trading scheme and potential for these costs to substantially shrink the size of the market. The paper concludes by presenting some potential solutions to the challenges raised and identifies some critical questions for policy makers.

Introduction

It is now generally recognised that man made greenhouse gas emissions are contributing to climate change. Politically, this recognition manifested in 2009 at COP15 in the Copenhagen Accord, a commitment from developing and developed countries to limit the global temperature increase to 2°C. Under the Copenhagen Accord, Australia committed to a reduction of five per cent below 2000 levels regardless of the actions of other countries, and up to 25 per cent below 2000 levels given strong global commitment to mitigation.

In 2008, direct emissions from the Agriculture, Forestry and Fishery sectors totalled 120 Mt $C0_2$-e, accounting for over 20 per cent of national direct emissions (DCCE 2010). Through sequestration or changes in farm and forestry management there is strong potential to substantially reduce the emission profile of the agriculture and forestry sectors, and the Australian economy more generally.

Offset trading schemes have been proposed and implemented as effective policies to reduce agricultural emissions. For example, the state of Alberta in Canada has an operating agricultural offset scheme and offsets have long been part of the Kyoto Protocol. An offset trading scheme allows carbon credits to be generated through sequestration or carbon abatement. Once verified, that credit can then be traded in domestic or international markets, thereby creating new income streams for farmers and landholders.

At present, the two domestic policies driving potential abatement within Australia's agriculture and forestry sectors are the National Carbon Offset Standard (NCOS) and the Carbon Farming Initiative (CFI). At the conceptual level, the NCOS is classified as a voluntary offset in Australia. It sets minimum requirements for the verification and retirement of voluntary carbon credits and provides guidance to calculate the carbon footprint of an organisation or product in order to encourage 'carbon neutrality'. NCOS established the Carbon Neutral Program, which replaced the Greenhouse Friendly Program and enables Australian organisations and products to be certified as carbon neutral.

The draft legislation for the CFI was released in in January 2011. Once legislated, the CFI represents the most significant opportunity for agricultural offsets in Australia, as it will provide a mechanism for agriculture and forestry offsets to be created and sold to domestic and international markets.

One of the great attractions of agricultural offsets is their potential to facilitate a wide range of low cost mitigation activities. However, there is a risk that these low cost mitigation activities may be eroded away by the significant transaction costs associated with accounting, monitoring and verifying carbon abatement in the agricultural sector.

In this paper, the costs and opportunities for carbon sequestration options under the CFI are assessed. The following section discusses the substantial hidden costs that may be associated with an offset trading scheme and potential for these costs to substantially shrink the size of the market. The paper concludes by presenting some potential solutions to the challenges raised and identifies some critical questions for policy makers.

The Carbon Farming Initiative

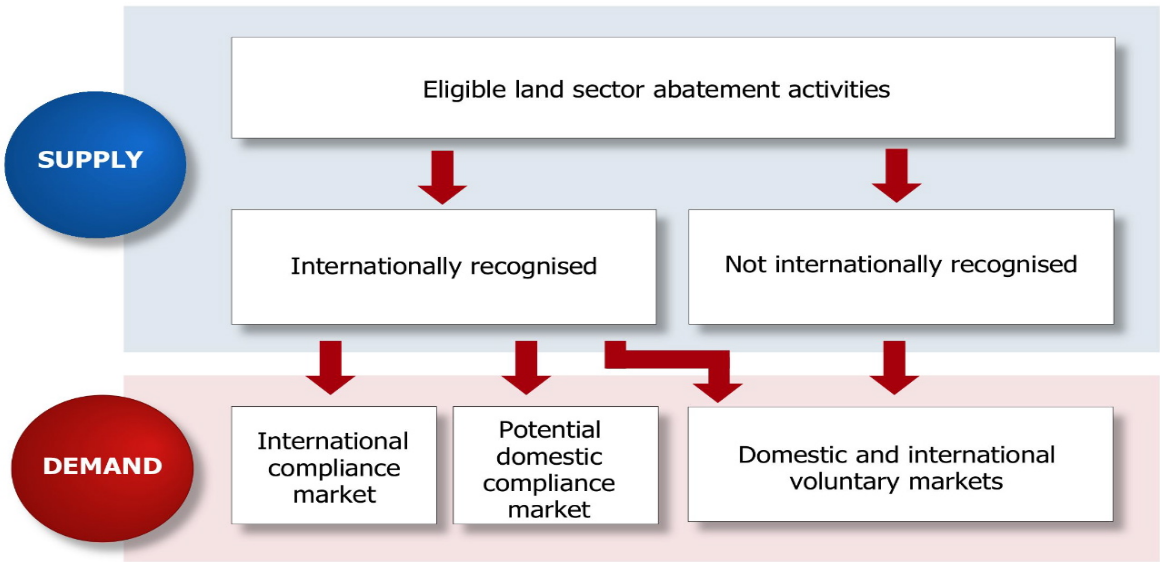
The CFI draft legislation was released in early 2011 and is expected to be admitted to Parliament in the first half of 2011.

The CFI will be designed to run in parallel to the NCOS, which was introduced in July 2010. While the NCOS will establish the rules for companies to either sell carbon neutral products or become carbon neutral themselves, the CFI will provide farmers and landowners with guidelines on what activities and methods can generate carbon credits.

The CFI will facilitate the creation of two different types of offsets: Kyoto-compliant offsets and non-compliant voluntary offsets. Kyoto-compliant offsets will be credited to emission reductions that can be counted towards Australia's (or another country's) international emission target. As such, Kyoto-compliant offsets will need to comply with international accounting rules. Emission reductions that do not contribute to Australia's international emission reduction commitments may also generate offsets to be sold into voluntary markets. The different types of offset permits and potential markets are illustrated in Figure 1.1

Figure 1.1

CFI OFFSET PERMITS



Source: DCCEE, 2010.

Quantifying abatement and available technologies

The agricultural offset market is essentially a new market into which farmers can sell abatement (or other reduction activities) without the obligation to accept any emission reduction constraints, and is therefore a key opportunity for Australia's agricultural sector.

The CFI has been designed to be deliberately broad to maximise the opportunities for carbon abatement. As discussed, both Kyoto compliant emission reductions that contribute to Australia's international commitments and non-compliant emission reductions that can be sold into domestic and international voluntary markets can be created under relevant methodologies and specific accounting rules.

The established technologies and practices that may be used to produce Kyoto compliant offsets — subject to the development of accounting methodologies — include:

- increased efficiency of fertiliser application;
- sequestration through reforestation;
- manure management in intensive livestock production;
- improved feedstock quality;
- switching to rice varieties with reduced methane production;
- improved savannah fire management; and
- avoided deforestation.

The abatement potential of each of these technologies and processes will differ both between farm products and across agricultural regions. It is beyond the scope of this article to go into detail regarding the scientific potential for emission reductions in the agricultural sector. However, to understand the scale of emission reductions that are possible, the potential abatement from three activities are discussed below.

Reducing emissions from enteric fermentation in livestock

The level of methane produced by an animal depends primarily on the animal's digestive system and the amount and type of feed (Ford et al. 2009). It is estimated that between five and 15 per cent of dietary energy is lost from the farm system as methane (AGO 2005; Avcare 2003). Methane emissions from livestock can be reduced by increasing animal productivity, improving feed conversion efficiency, bioengineering and improved livestock and feed management.

The University of Melbourne (2008) estimated that using feed that is more easily digested (such as perennial ryegrass or white clover pasture) can improve milk production while reducing emissions per unit of output by up to 50 per cent. Further research has suggested that the addition of unsaturated fatty acids to animal feed can reduce emissions by up to 40 per cent (University of Melbourne 2008). The use of rumen modifiers such as antibiotics and tannins has also proven to reduce emissions by 25 per cent. However, as discussed in Ford et al. (2009), such emission reductions may be temporary and there is uncertainty regarding consumer preferences for meat that has been produced using such modifiers.

Reducing emissions from manure management

Emissions stemming from the decomposition of manure depend strictly on the amount of manure produced, temperature, moisture levels and the types and lengths of storage (Ford et al 2009).

There are a number of activities that can be implemented to reduce emissions associated with livestock production. Practices include: administration of anti-methanogens, improving feed quality, livestock breeding and the use of anaerobic digesters. Anaerobic digesters break down manure under anaerobic conditions to produce a biogas and a nutrient-rich fertiliser. Such digesters have been estimated to reduce emissions by between 50 and 75 per cent (Bates 2001; DeAngelo et al. 2003). It should be noted that the application of such abatement techniques and practices will be limited in extensive rangeland production systems.

Reducing emissions from agricultural soils

Article 3.4 of the Kyoto Protocol also identifies agricultural soil-based sinks as a further mechanism for countries to meet their emissions reduction commitments (Kyoto Protocol, 1997). However, Australia is not a signatory of Article 3.4 (due to uncertainties surrounding the flow of emissions from agricultural soils) and therefore soil carbon cannot contribute to Australia's international emission reduction commitments. That said, there are opportunities for farmers to generate and sell non-compliant offset credits into domestic and international voluntary markets.

A range of management practices can be implemented to increase soil carbon. Given robust accounting methodologies, current technologies or practices that could be used to generate voluntary offset credits include increased use of no-till farming, reduced fallow periods, application of biochar, switching to deep rooted pasture crops, improved grazing regimes, and conversion of cropland to perennial grazing vegetation (Calford et al., 2010).

There is much uncertainty and debate, particularly within Australia, as to the total potential of agricultural soils to store additional carbon, the rate at which soils can accumulate carbon, the permanence of this sink, and how best to monitor changes in soil organic carbon stocks (Sanderman et al., 2010). Current estimates range between 0.1 to 0.6 Mg C per hectare per annum. For a detailed analysis of the latest science regarding soil carbon sequestration see Bruce et al. (2010) and Sanderman et al. (2010). Both studies stress the importance of increased research to understand the processes of carbon sequestration in agricultural soils and subsequent development of accounting methodologies.

Cost of agricultural and forestry based abatement

The abatement potential of the agricultural and forestry sectors is a strategic issue for the industries themselves to investigate. Agricultural emissions are spread over a range of activities, each with different opportunities and costs associated with emission reductions.

Essentially, an offset market introduces a new commodity that farmers will need to consider in their product mixes. As discussed by Campbell and Barber (2010), in the same way that a farmer chooses between crops and livestock, with an operating offset scheme they will need to consider the costs and benefits of producing a given amount of carbon. To make efficient decisions, they will require clear information regarding the cost of different abatement methodologies and the expected revenue from permit sales.

The potential cash benefits that might flow to the agriculture and forestry from land-based offset arrangements are unclear. Critically, benefits will depend on the interaction of demand and supply and the prevailing carbon price and the cost of mitigation activities. The cost of abatement projects is likely to vary both between agricultural activities and agricultural regions (Gunasekera et al., 2007). Further, the timeframe over which emission reductions are credited and the relationship between stocks and flows of greenhouse gases will also affect the feasibility and cost of abatement activities.

One of the attractions of agricultural offsets lies in the evidence that there may exist a wide range of abatement opportunities that could be achieved at minimum or no cost and could possibly result in an increase in farm revenue (Ford et al. 2009, Gunasekera et al. 2007; Campbell and Barber 2010, Allen Consulting Group 2006). These are referred to as 'no-regrets' opportunities, as they increase farm profit while reducing greenhouse gas emissions.

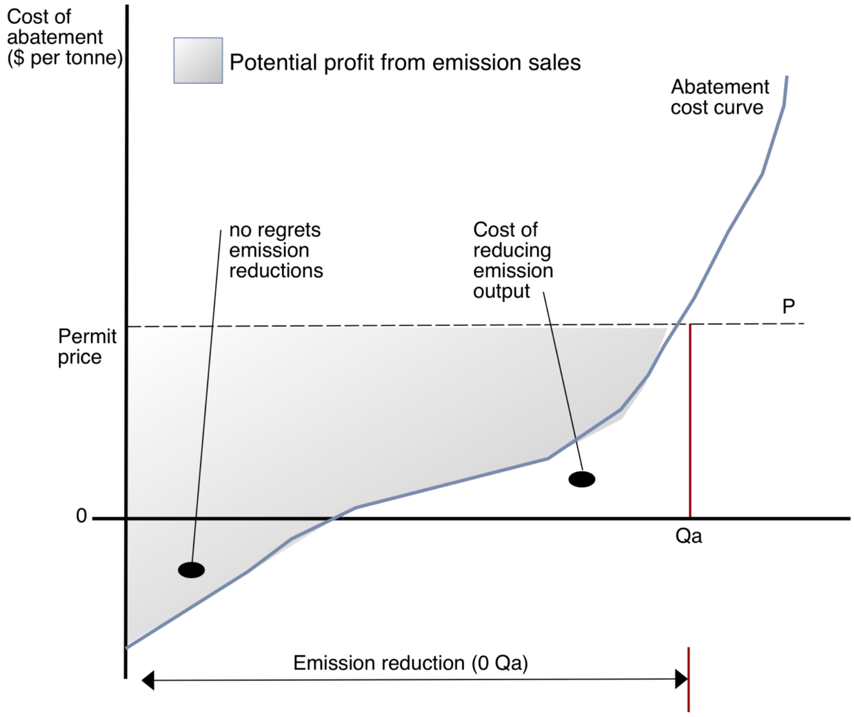
A key source of 'no-regrets' opportunities is thought to be mitigation of methane and nitrous oxide emissions. Methane and nitrous oxide emissions indicate residual energy being expelled from farm systems. Better targeting of feed and fertiliser application could result in improved farm efficiency, reduced operating costs and reduced greenhouse emissions (Campbell and Barber 2010). For example, in some instances reduced fertiliser application can increase yields, while reducing input costs and greenhouse emissions. Other examples of 'no-regrets' abatement opportunities include minimum-tillage cropping and improved grazing regimes.

However, there is uncertainty regarding the eligibility of 'no-regrets' abatement. Under an offset crediting scheme credits should not be issued for abatement activities that would have occurred under a business-as-usual scenario — which raises questions as to whether 'no-regrets' opportunities should be considered additional. To answer this question, consideration must be given to why 'no-regrets' activities have not previously been adopted. Transaction costs, incomplete information, technology lock-in, lack of purchasing power and limited technical expertise have all been put forward as explanations for the under exploitation of 'no-regrets' opportunities. These barriers may be reduced in the future and abatement activities adopted regardless of a carbon price. Therefore, based on the criteria of additionality, these abatement opportunities should not be credited. However, if there are hidden costs associated with 'no-regret' abatement activities and the introduction of a carbon price changed management decisions, then 'no-regret' opportunities may be considered to be additional. Clearly, decisions regarding the eligibility of 'no-regrets' abatement activities will have a large impact on the size of the offset market. Further research is required to fully understand the additionality of these abatement activities.

In addition to 'no-regrets' abatement options, additional abatement activities exist that entail reducing output and trading off production against profits from emissions credits. In a perfect market, farmers will participate in abatement opportunities up to the point where the marginal benefit from doing so is equal to, or greater than, the marginal cost. Abatement opportunities will occur whenever the permit price lies above the marginal abatement cost curve, such that as the permit price increases so too does the total pool of abatement opportunities. This relationship is detailed in Figure 1.2.

Figure 1.2

ECONOMICS OF AGRICULTURAL ABATEMENT

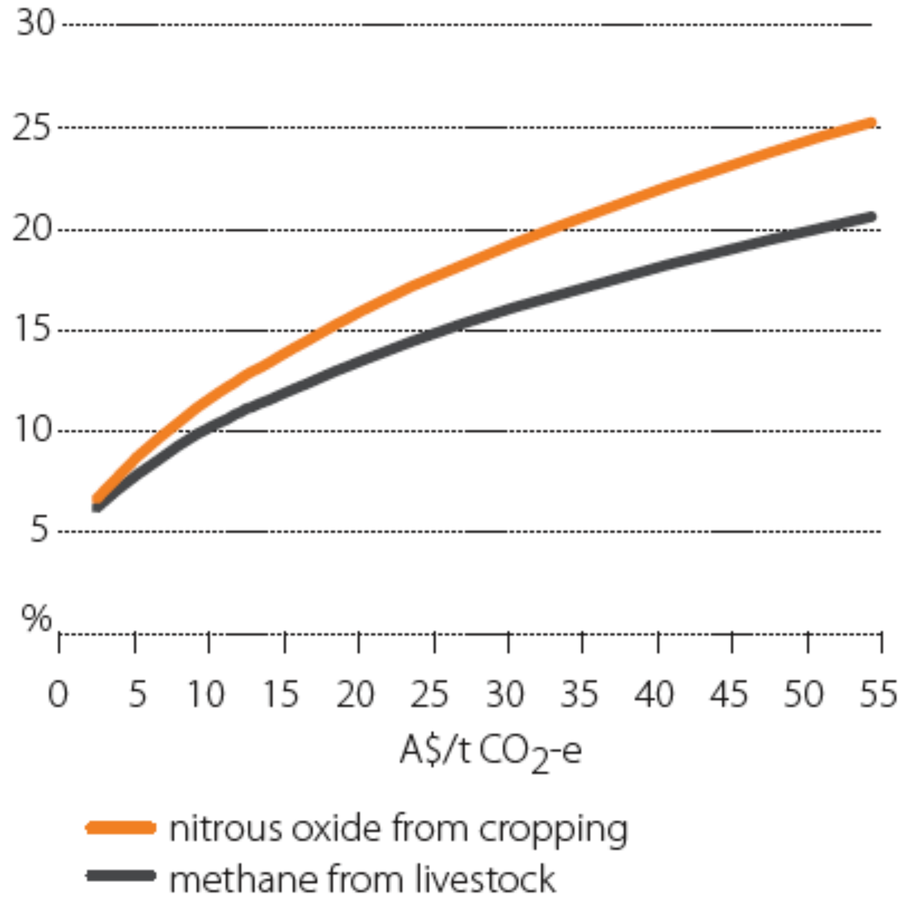


Source: ACG 2010

ABARE has developed an aggregated Marginal Abatement Cost (MAC) curve as part of their GTEM general equilibrium-modeling framework (Ford et al 2009). The MAC curve is based on information from the Australia Government (2008) CPRS modeling report, the United States Environmental Protection Agency (EPA 2006), and analysis by the Energy Modeling Forum (DeAngelo et al. 2003). The MAC is disaggregated into methane from livestock and nitrous oxide from cropping, as illustrated in Figure 1.3.

Figure 1.3

GTEM MARGINAL ABATEMENT COST CURVES IN AUSTRALIAN AGRICULTURE, PERCENTAGE REDUCTIONS IN EMISSION INTENSITY



Source: Ford et al. 2009,

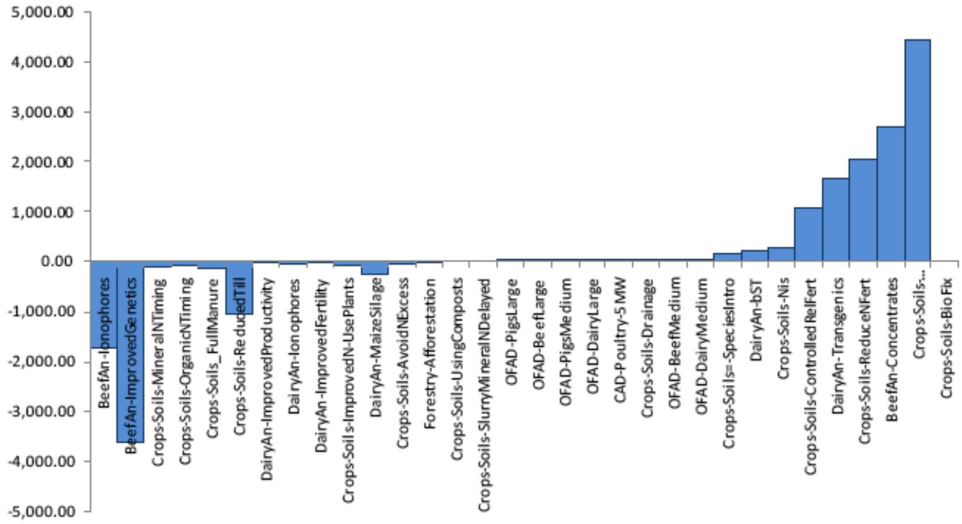
Applying this MAC curve, ABARE has investigated the impact of an agricultural offset scheme on the Australian agricultural sector. Due to data limitations, only Kyoto-compliant offsets were included in the analysis. At a carbon price of A$10[1] in 2011, emission reductions of 10.2 million Mt $C0_2$-e are expected in 2030 (Calford et al., 2010).

Internationally, research is also being conducted to assess emissions abatement potential and cost within the agricultural sector. In December 2008, the United Kingdom Climate Change Committee (UKCCC) published research regarding the marginal cost of abatement in the agriculture, land use, and land use change (ALULUC) sectors. The research constructed a bottom up marginal cost curve that identified a technical abatement potential of 17.5 Mt CO_2–e by 2020 at a carbon price of up to £100 per t CO_2-e (Moran 2010). This MAC curve, as published in Campbell and Barber (2010), is presented in Figure 1.4. As with all MAC curves, care needs to be taken when drawing conclusions and interpreting the results. The abatement costs presented are averages with actual costs likely to be sensitive to site specific factors. Further, the MAC curve can be considered a snapshot of abatement opportunities and does not consider market feedback mechanisms that could alter the technology mix.

[1] This carbon price pathway is consistent with that used by the Commonwealth Treasury in their modelling of the CPRS (Treasury, 2010).

Figure 1.4

UNITED KINGDOM MARGINAL ABATEMENT COST CURVE, AGRICULTURE AND LULUC SECTORS



Source: Moran in Campbell and Barber 2010.

However, the MAC curve is useful in detailing the range of options that are estimated to exist at little or no cost. From an efficiency perspective, policies should guide landholders to these abatement options before exploiting more costly abatement activities.

Currently detailed analysis of the scope and cost of greenhouse abatement in Australian (and global) agriculture is poor. The abatement potential of the agricultural and forestry sectors is a strategic issue requiring comprehensive research, as the abatement cost curve will dictate the potential profits available at a given offset price. The processes of carbon sequestration in agricultural soils and subsequent development of accounting methodologies are of particular importance.

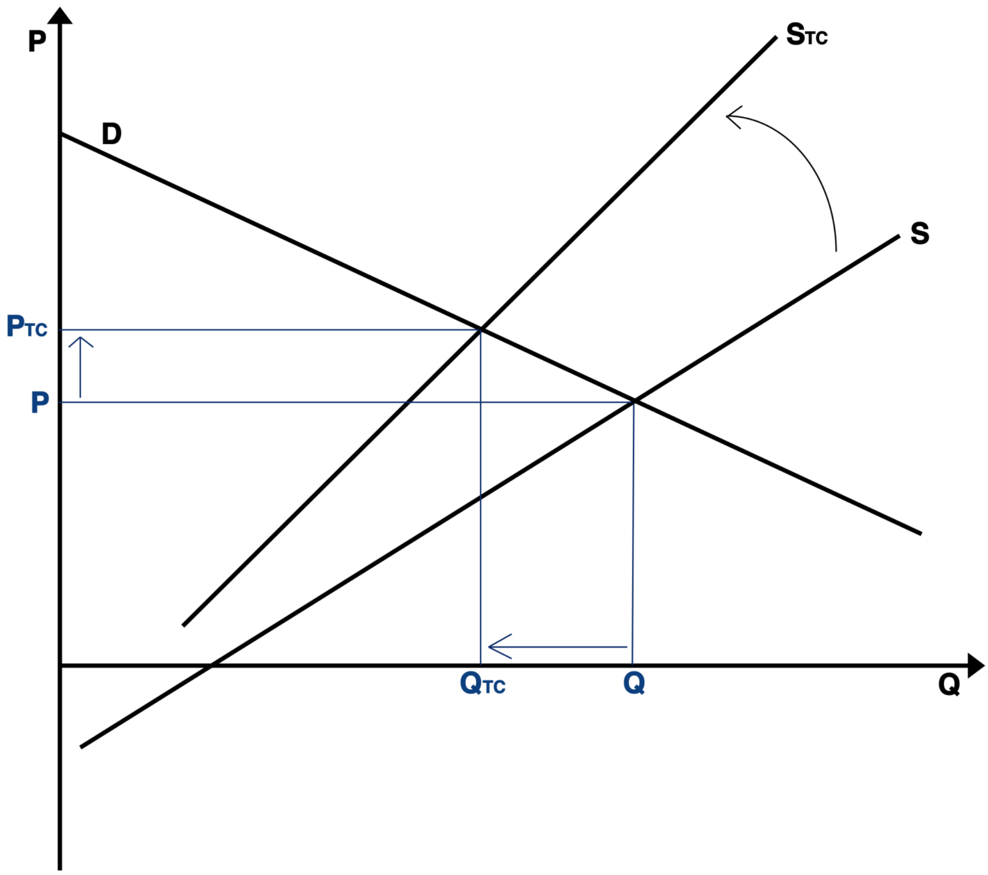
Transaction costs and market erosion

The direct cost of emission abatement is only one of the costs that affect landholder's decisions to participate in offset markets. Also important are the transaction costs of undertaking the investment and trading the permits (Stavins 1995). Monitoring, verification, enforcement and compliance can also place additional costs on both the regulator and landholders.

Transaction costs increase the total cost of doing business and hence shrink the size of the market. The relationship is represented graphically in Figure 1.5. Where high transaction costs exist it is possible that the costs of production increase beyond what the market is willing to bear, resulting in a missing market.

Figure 1.5

THE EFFECT OF TRANSACTION COSTS ON OFFSET MARKETS



Source: Allen Consulting Group, 2011

Coase (1937) first described the importance of transaction costs in his seminal paper 'The Nature of the Firm'. However, only recently have transaction costs been explicitly considered by resource economists. By definition, transaction costs are the costs:

> Of arranging a contract to exchange property rights ex ante and monitoring and enforcing the contract ex post, as opposed to production costs, which are the costs of executing a contract.
>
> Matthews 1986, p. 906

A number of studies have aimed to define and categorise transaction costs, so as to structure the process of evaluating transaction costs related to natural resource policy options (McCann and Easter 1999; Thompson 1999). Dudek and Wienar (1996) have categorised transaction costs related specifically to the creation of emission offsets in relation to the Kyoto Joint Implementation Scheme. Specifically, they identified six types of transaction costs including: search costs, negotiation costs, approval costs, monitoring costs, enforcement costs and insurance costs. For a detailed description of transaction costs in environmental markets see Dudek and Wienar (1996) and Cacho et al (2002).

Transaction costs are difficult to measure and will be heavily reliant on scheme design. Based on the Canadian Alberta Trading Scheme experience, it has been estimated that transaction costs associated with evaluating and certifying offset credits could be between 65 and 85 per cent of the total costs (Fulton et al 2005). However, these costs are generally considered to be the lower bound to the total transaction costs that are expected to exist.

As a further indication, Kooten et al. (2002) showed that while around 75 per cent of farmers in the Western Canadian grain belt expressed a willingness to undertake carbon offset projects, very few indicated that they would actually implement abatement projects even if they were adequately compensated. The authors suggest that these results indicate the substantial hidden costs in undertaking offset projects.

The transaction costs associated with CFI participation could be substantial. Reliable monitoring, verification and reporting (MRV) are necessary to ensure the effectiveness of the system in delivering abatement objectives and also to establish the bona fides of the allowances being traded. Poor or disparate estimation methods can lead to inefficiency and compliance risks (as resources are drawn to activities where emissions are being systematically under-estimated) and a loss of confidence in the allowances being traded by market participants.

However, land-based abatement does not lend itself readily to MRV or trading. Difficulties generally relate to the:

- large number of dispersed and often small abatement sources;
- variability of actual abatement between sources, and over time from the same source; and
- paucity (and cost) of abatement measurement and verification techniques.

This can result in substantial transaction costs and uncertainty within the trading system — imposing a significant (and possibly inequitable) burden on the emitters themselves, the regulator and potentially having an adverse affect on the efficiency and acceptability of the scheme.

In this section, we review some of the key challenges relating to the trade of land-based offsets that are likely to increase the overall cost of the CFI scheme. Specifically, transaction costs are assessed in terms of producer costs, setting baselines and monitoring and enforcement.

The cost of offsets participation: producer transaction costs

For agricultural and forestry businesses to begin producing offset credits, they must first select the relevant CFI methodology, become a recognised offset entity (gaining an account with the registry) and have their project approved by a scheme administrator. Approval costs normally manifest in terms of delays and uncertainty, although could also arise as out-of-pocket costs involved in compiling required information (Dudek and Wienar 1996).

Transaction costs are also incurred through project reporting. Reporting timeframes are yet to be determined but would likely occur annually. When reporting, landholders will be required to submit an audited report regarding their offset activity to the scheme administrator.

In addition, a number of markets exist in which Australian landholders may sell carbon offset credits. Different markets allow different abatement activities, require different standards and attract different offset prices. Australian landholders will need to identify the market that is most attractive for their specific abatement activity. In doing so, they will incur further costs.

Setting baselines and assessing additionality

In order to issue credits, abatement must be measured against a certified emission baseline. In setting baselines the additionality principle is necessary because some abatement activities generating direct financial or other benefits may have been undertaken in the absence of climate change mitigation polices. In addition, some abatement activities are required under regulatory arrangements. In both cases, the decision to reduce emissions is not driven by carbon abatement and therefore should not be classified as an offset.

To test additionality under an offset scheme, abatement activities must be assessed against a business-as-usual baseline. However, establishing this baseline is subjective, administratively complex, and requires an investigation into what outcomes would result in the absence of a proposed offset project. Baselines are required for different abatement activities across different industries and should be updated to reflect changes in agricultural production process or government policy. As such, the transaction costs involved in setting baselines and assessing additionality may be high.

The recent experience of the Clean Development Mechanism (CDM) Executive Board highlights some of the potential risks and pitfalls that may prove insightful for regulators in Australia, including those related to the CFI and the NCOS.

In 2010 the CDM Executive Board has been heavily criticised over delays in project registration and verification. Specific issues have included an over-burdensome administration process, difficulties in establishing baselines, and lengthy verification processes. Such delays increase the cost of offset projects and restrict the scope of the CDM market.

Given the range of offset activities to be considered under the CFI and the geographical spread of Australia's agricultural sector, there is a large risk that the regulator will face similar registration and verification delays as the CDM Executive Board. To avoid such operating delays, it will be important for the regulator to make projections of the likely volume of project registrations and ensure they have sufficient operational capacity.

Monitoring and compliance

The effectiveness of any market, in part, depends on the degree to which market participants comply with the terms of the contract they sign (Mihal and Fulton 2005). Compliance in the offset market cannot be assumed as offset producers have an incentive to over-report the carbon offsets created from their emission abatement activities. Governments will therefore need to implement measures for monitoring and enforcement to ensure offset credits sold are the result of actual abatement activities.

The economics of compliance can be credited to Becker's (1968) seminal paper. Becker states that risk neutral agents will comply with the law only when the expected benefits from doing so are greater than the expected costs. The costs incurred from non-compliance will depend on the specific regulation. However, they generally involve penalties such as fines or imprisonment and social sanctions inflicted by one's peers.

A number of studies have assessed issues surrounding compliance of agricultural producers in environmental programs. For example, Giannakas and Fulton (2000) assess misrepresentation and cheating in policy analysis of output quotas and subsidies. The authors show the impact of non-compliance on the welfare effects of policy instruments and conclude that a mix of instruments can result in a more efficient outcome.

Classen (2000) demonstrates that agricultural producer non-compliance is a substantial issue in United States conservation programs that aim to protect highly erodible land. Since policy inception, over 11,000 producers have been cited for violations on approximately 281,000 acres with a total of nearly $16,000,000 in denied benefits. Giannakas and Kaplan (2005) assess the determinants of non-compliance and equilibrium enforcement policy in such conservational programs. They conclude that the policy enforcement depends on the size of the penalty and audit probability, which is determined, in turn, by the costs of monitoring producer compliance and the available budget. Specifically:

> The greater the monitoring costs and/or the lower the resources available to policy enforcers, the lower the audit probability and thus the lower the policy enforcement is expected to be.
>
> Giannakas and Kaplan (2005, p.32)

Mihal and Fulton (2005) extend analysis of non-compliance to markets for land-based carbon offsets. Using comparative statics, they show that a lack of enforcement creates incentives for non-compliance through producers over-reporting levels of carbon abatement. They go on to determine that increasing the audit probability as well as the penalty applied per unit of non-compliance can increase compliance. Finally, they indicate that increasing carbon prices will increase the total pool of participants and hence the costs of enforcement.

These studies have significant implications for implementation of the CFI. Non-compliance will be an issue so long as monitoring is imperfect. Given the disperse nature of agricultural businesses, monitoring and enforcement costs within Australia could be substantial indicating that non-compliance may present a considerable risk to the credibility of offset markets. As an example, Fulton et al. (2005) report Canadian based research that estimates the cost of monitoring and verification of individual agricultural abatement projects can be as high as C$18.56 per tonne of CO_2-e.

Reducing transaction costs through offset pools

Pooling refers to a situation where landholders group together to sell a commodity. Australian agriculture has a long history of collective investments, both compulsory and voluntarily. Wheat pools have been a major selling method in grain markets for years, and there are numerous cooperatives through which farmers procure inputs and sell produce (Campbell and Barber 2009).

Given the correct incentives, offset pools can be designed to overcome many of the challenges that have been discussed in Section 1.6 of this report. Their application to the CFI is discussed below.

Managing uncertainty

Pooling can greatly reduce uncertainty surrounding the estimation of emission abatement from new technologies or practices. Diversification has long been a tool in managing the downside associated with risk. Offset pools present an opportunity for investors to purchase permits from a diverse range of emission activities. When emission reductions are sourced from a wide range of diverse activities, the pool as a whole exhibits much less volatility than individual farm level projects. With reduced uncertainty investors can purchase and trade credits with greater assurance regarding the actual emission reductions, reducing the need for discounts or trading ratios. In this way, offset pools will reduce the operating costs of a trading scheme and ensure offset providers receive adequate compensation for their abatement activities.

As with any investment portfolio, the choice of activities to include in the portfolio will depend on the objectives of the investors and their attitude to risks. However, given the great diversity in Australian agriculture (across regions, industries, farms within industries etc) there exists vast potential to create diverse offset pools.

Reducing transaction costs

Offset pools could play two roles in lowering transaction costs. Firstly, through the provision of education and training, offset pools could facilitate the participation of producers in offset markets, thereby lowering costs. Second, through the facilitation of project aggregation, offset pools could spread the fixed costs of market participation.

Offsets represent a potential new income stream for the agricultural and forestry sectors. However, farmers are likely to face both administrative and managerial hurdles that may prove both financially costly and time-intensive. The accreditation of offsets is likely to represent a significant cost to farmers, who will likely benefit from education and training. Further, by selling into an offset pool, farmers' will not need to navigate complex carbon markets.

Offset pools may also reduce per unit transaction costs by achieving economies of scale. As discussed in Dudek and Wienar (1996), many of the transaction costs associated with emissions offset projects are fixed costs — costs that do not change with the level of output. For example, approval costs are unlikely to be affected by the size of the offset project.

It is possible that pools be designed to allow for small landholders to aggregate up similar abatement projects. Hence spreading the fixed transaction costs over a broader range of abatement projects and lowering the per unit cost of market participation.

Aggregation of small abatement projects has proven successful in the Clean Development Mechanism via the Program of Activities approach. Programmatic CDM groups identical emission reduction projects that rely on the same technology (and hence the same standards for monitoring and verification) into one Program of Activities (PoA). Once a program has been established, additional CDM projects that can be defined within the PoA can be added without undergoing individual verification. This is intended to augment the CDM's traditional single-project based approach by facilitating many small-scale projects to reduce emissions.

PoA's could be incorporated into offset pools as a means of reducing the transaction costs associated with small scale, dispersed abatement activities. Investors in offset pools would need to consider the total mix of abatement activities to ensure the pool provides the desired diversity and manages risk.

Opportunities for co-regulation

Offset pooling also provides an adequate framework to introduce industry co-regulation to enforce offset production compliance. Co-regulation occurs when public and private actions and resources are co-ordinated in enforcement efforts. Co-regulation aims to combine the predictability of binding legalisation with the flexibility of self-regulated approaches. It thus involves self-regulation and legislation working together in a manner that mutually reinforces the other (Garcia Martinez et al. 2007).

It is in both the offset pool operator and regulator's interest that offset producers adequately deliver on their contractual arrangements. Clearly, the Australian government requires compliance in order to accurately report on national emission profiles. Further, an offset pool operator must ensure the environmental integrity of offset credits to attract investment from domestic and international permit buyers. Under such conditions, it could be possible for the pool operator to offer incentives for compliance and function under a code of best practice. In this way, the threat of government sanctions would only be required as a last resort for farm operators that are caught dishonouring offset contracts.

Regardless of the mechanism of enforcement, access to reliable information and advice is a vital component of any strategy aimed at increasing compliance (Garcia Martinez et al. 2007). As discussed above, offset pools provide a convenient channel to provide such information and advice to offset providers.

Other challenges and potential to reduce barriers

There are a number of additional challenges associated with the implementation of an emissions offset scheme. Specifically, uncertainty, the permanence criterion, irreversibility of offset investments and the supply response all present barriers to market participation. In some instances, it is may be possible to reduce these barriers through appropriate policy design.

The cost of uncertainty

The ability to confidently quantify pollution abatement is crucial for the success of a permit trading scheme (Cantin, Kalff, and Campbell 2005). With current techniques and technologies, emissions abated through changed agricultural processes or sequestration cannot be directly measured in a cost-effective manner. Therefore estimation tools and methodologies must be developed to assess emission reductions from abatement activities. Inherent in such tools is uncertainty regarding the actual level of emission abatement and the potential to underestimate or overestimate actual emissions reductions.

Where land based emissions have been included into a permit trading scheme, a common approach has been to apply discount ratios to emission reductions or to only recognise a safe lower-bound estimate (Fulton et al. 2005). Discount ratios are applied to reduce the value of credits where there is uncertainty surrounding the exact level of emission reduction. However, as pointed out by Campbell and Barber (2010), this process only recognises the downside risk associated with estimation techniques and is therefore heavily biased against the agricultural sector. Such bias could potentially result in higher than necessary costs in delivering a given level of pollution abatement.

Schemes should be designed to recognise both the downside and the upside when there is uncertainty surrounding emission measurement. This could be achieved by applying a specific 'future value' to each offset permit that explicitly recognised the value of any future upside (where abatement turns out to be greater than expected) (Campbell and Barber 2010). The 'future value' would be directly linked to the permit but could be traded separately. These 'future values' would retain a value based on market expectations surrounding the abatement potential of relatively new technologies or processes. In addition, they would encourage private sector research and development into the agricultural sector to improve measurement techniques and accounting methodologies. Such 'future values' have the potential to improve the efficiency of any offset trading scheme. Consideration should be given to their implementation in the CFI.

Permanence

The permanence criterion reflects concerns that carbon stored in biological sinks may be released via natural or anthropogenic processes. If carbon abatement is not permanent, it only reflects a temporary reduction in greenhouse emissions. As temporary emission reductions will not reduce global climate change over the long run, many argue that they should not be included in an environmentally sound offset scheme (Calford et al., 2010).

However, as discussed by Campbell and Barber (2010), non-permanent sequestration should not be considered valueless. Early, non-permanent abatement could potentially push out the timing of any predicted 'tipping points' in the climate system and buy time in terms of developing cost effective, permanent sequestration technology. In this way, early cheap abatement could provide a transition to lower cost future technologies that are currently not technically available. Recognising this value, non-permanent abatement could be specifically credited through fixed terms contracts.

Non-permanence also represents a risk to landholders that have invested in sequestration activities. In the instance that credited abatement is released back to the atmosphere carbon credits must be surrendered. A key challenge for any offset-based scheme will be the development of adequate insurance markets to protect landholders against unexpected events that emit sequestered carbon. As well as insurance markets, assurance factors can also be used to manage risks of carbon reversal to landholders. Assurance factors account for the risk and magnitude of carbon sequestration reversal throughout the life of the project. They are calculated on the likely number and magnitude of reversal events and then applied annually, to avoid the project proponent incurring a large liability during a carbon reversal event.

Irreversibility and 'option values'

Offset producers must also make decisions with uncertainty regarding the price of offset permits over the life of the investment. Many offset projects are long-term investments and therefore must be made based on projections of permit price. However, the offset market is driven by a number of key supply and demand drivers that may not be known at the time of investment.

By definition of the permanence criterion, sequestration and other abatement activities are irreversible investments. In making irreversible decisions under conditions of uncertainty, there may be an 'option value' in waiting for further information. The term 'option value' was first discussed by Arrow and Fisher (1971) and refers to the welfare gain or benefit associated with delaying an irreversible investment decision with uncertain payoffs.

Applied to agricultural offsets, it implies that producers will only engage in offset markets when the net present value of their investment exceeds the 'option value' of waiting for further information. Vercammen (2002) demonstrated that a farmer considering entering an irreversible offset project may require a premium of up to 60 to 70 per cent to compensate them for the option value. That is, the market price would need to be 60 to 70 per cent above the farmer's cost before the farmer would have sufficient incentive to invest in irreversible carbon abatement projects.

The supply response effect

Over the long term, an offset scheme is likely to increase the returns to the agricultural and forestry sectors and therefore attract additional investment. This additional investment is likely to induce an increase in the supply of agricultural goods and may therefore result in an increase in emissions, relative to a situation where there was no offset-induced supply response (Calford et al., 2010). This supply response effect is witnessed in other activities that aim to reduce emissions such as increased energy efficiency.

The size of the supply response effect will be dictated by the relative increase in agricultural returns and changes in emission intensity within the sector. In the instance that offset credits encourage investment in more emission intensive activities such as intensive livestock production the supply response effect will be larger than if investment is directed into lower intensive agricultural activities.

According to ABARE analysis, the size of the supply response effect could be significant. It has been estimated that the supply response may reduce total emission reductions by as much as 25 per cent (Calford et al., 2010). It is important for policy makers to understand the implications of the supply response effect in meeting international abatement commitments. Further research in this area should therefore be considered a priority.

Key questions for Australian policy developers

By facilitating the trade of offset permits, there is great potential for Australia to reduce the emission profile of the agriculture and forestry sectors. As detailed in this paper, much research identifies the scope of abatement activities that could be harnessed at little cost. In recognition of this, the government is moving to legislate the Carbon Farming Initiative and establish a domestic market for agricultural offsets.

For any market to be effective, there must be a number of agents that are willing to purchase a good at a price that producers are willing to supply. Currently detailed analysis of the scope and cost of greenhouse abatement in Australian (and global) agriculture is poor. Further research and development to better grasp how costs change with increased abatement will be essential to determine the potential profit that might be available through participation in offset arrangements. In addition, research is required to fully understand the scope and additionality of 'no-regrets' abatement activities. Such activities could be achieved at minimum or no cost and could possibly result in an increase in farm revenue. However, their adoption is hampered by the fact that there is inadequate analysis in relation to the quantity of abatement that could be generated by these activities and whether these practices meet international eligibility criteria.

While it is possible that a wide range of abatement activities exist at little or no cost, there is considerable risk that the transaction costs associated with the scheme will be high, eroding the market and diminishing the effectiveness of the policy tool. As has been discussed, the costs of monitoring, enforcement, verification and the option values and risk premiums required by farmers may be more than what the market is willing to pay for agricultural offsets — particularly given the lack of a domestic compliance market. Currently, there is little research that aims to understand or quantify the transaction costs associated with agricultural offset markets. Such research should be seen as a priority for policy makers.

Given these risks, offset schemes must be designed to limit transaction costs and increase incentives for market participation. Pooling represents an opportunity to reduce the transaction costs associated with an offset trading scheme. Specifically, through diversification, the provision of information, the aggregation of small-scale abatement activities and through retailing offset permits, offset pools could reduce the costs to abatement activities to landholders. Further, given the likely cost of monitoring and verification and constrained government budgets, non-compliance should be seen as a substantial risk to the effectiveness of the CFI. Offset pools represent an opportunity to implement public and private partnerships, reducing the costs of monitoring and verification while increasing compliance.

While pooling offers large potential to reduce the operating costs of the CFI, it is currently unclear what role they will play. Research is needed to better understand the best institutional structure of offset pools or their impact on the offset market.

It is clear that the Australian government is keen to harness cheap emission reductions from the agricultural sector. However, there is a risk that without clever design, substantial transaction costs could erode the benefits of market participation to landholders and shrink the offset market. This paper has identified a number of challenges to the implementation and operation of the CFI and has proposed some potential solutions. Further research is required to understand what role offset pooling and other policy tools could play in the Australian offset market.

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