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Critical and comparative analysis of selected agri-environmental policy instruments implemented in other countries: Australia

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PRELIMINARY FINAL REPORT

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AGECO Group
2014 Jean-Talon Boulevard North, suite 307, Sainte-Foy, Quebec G1N 4N6
Tel.: (418) 527-4681 Fax.: (418) 527-7101 www.groupeageco.ca

Unisféra International Centre
2001 Marie-Anne Street East, Montreal, Quebec H2H 1M5
Tel.: (514) 527-2636 Fax.: (514) 527-0612 www.unisfera.org

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REPORT PREPARATION TEAM

Mission	Karel Mayrand Daniel-Mercier Gouin
Research	Isabelle Charron Stéphanie Dionne Cyril Michaud
Editing	Monique Mercier

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.1 AUSTRALIA'S NATIONAL MARKET-BASED INSTRUMENTS PILOT PROGRAM

1.1.1 LIFE CYCLE

The purpose of the National Market-based Instruments (MBI) Pilot Program is to support research and development activities with a view to enabling Australians, including not only political decision-makers but also ordinary people, to make more effective use of market-based instruments in natural resource management, and in particular to take adequate action to address problems in the area of salinity and water quality. The program was developed in the framework of the National Action Plan for Salinity and Water Quality (NAPSWQ), and is one of a number of projects currently under way in Australia that have been designed to test the feasibility of using market-based instruments to deal with environmental issues.

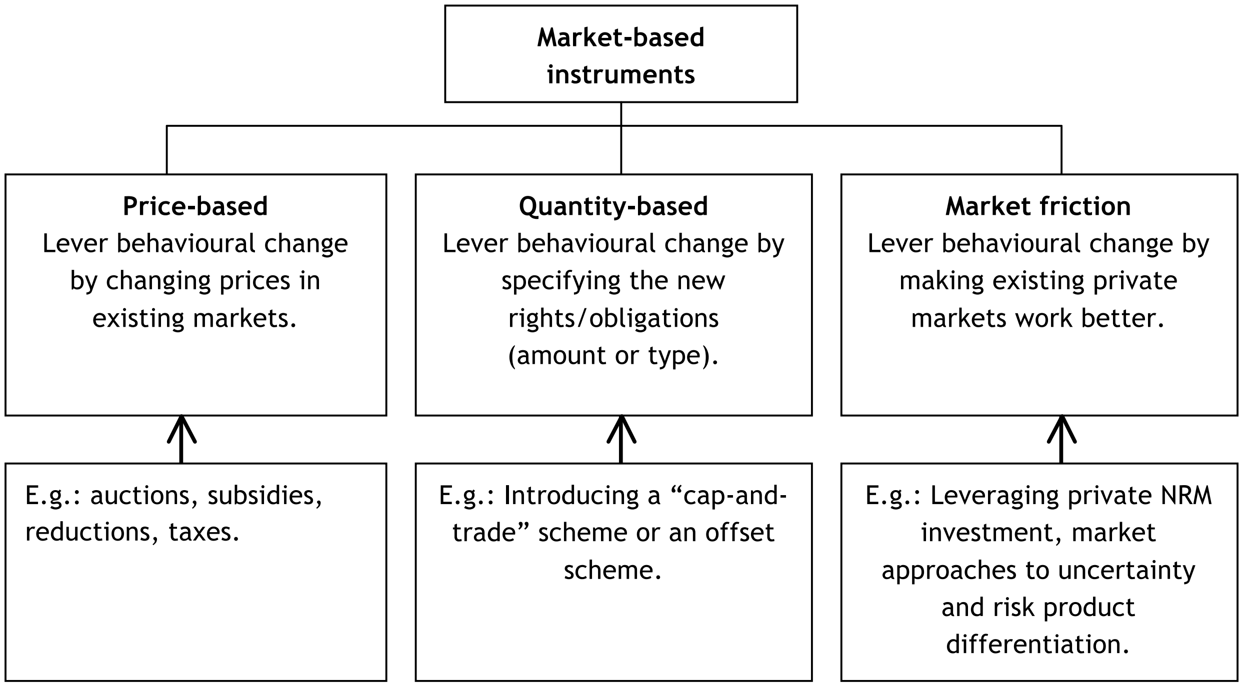
Funding for Round 1 of the program, which was launched in April 2003 and ended in April 2006, was A$5 million, and the same amount is expected to be allocated for Round 2. Pilots will be selected during 2006. The funding is being provided partly by the Australian federal government and partly by the state governments.

The market-based instruments program is designed as an approach to environmental issues through signals from the market rather than by means of directives or other explicit command-and-control measures (Grafton, 2005 b). In some cases these instruments are price-based, while others are quantity-based, and still others rely on market friction (see Figure 1.1) (Australian Government 2004 a).

Price-based instruments adjust prices to reflect their relative environmental impacts. With a price-based instrument, industry can be certain of the compliance cost of attaining an environmental objective. On the other hand, environmental benefits for the community are uncertain. Auctions, grants and taxes are examples of price-based instruments.

Quantity-based instruments control the quantity of environmental goods and services at the socially desired level (Australian Government 2004 a). Accordingly, they are characterized by certainty as to environmental outcomes, but uncertainty as to the cost to industry of attaining those outcomes. Cap-and-trade systems and offsets are examples of MBIs of this kind.

Figure 1.1
Typology of market-based instruments



Source: Australian Government 2004 a.

Instruments aimed at reducing market friction, for their part, stimulate the market to produce the desired environmental outcome by making existing markets work better, reducing transaction costs, or enhancing information exchange. The results tend to be less certain and more long-term oriented (Australian Government 2004 b). Leverage funds and product differentiation approaches (such as certification) are typical instruments in this category (Australian Government 2004 a).

The MBI approach to solving environmental problems is quite different from command-and-control systems. In essence:

- It provides incentives for individuals, firms and resource users to behave in such a way that in obtaining benefits for themselves, they also procure benefits for society;
- It gives individuals a degree of flexibility in how they respond to agreed environmental outcomes (Grafton, 2005 b).

This approach serves to encourage innovation, contribute to long-term, relatively self-sustaining solutions, attract private investment and address market failures (Australian Government 2004 a). MBIs also afford a means of making the environment part of the mainstream economics system (Australian Government 2005). In Round 1 of the National MBI Pilot Program, 11 pilots were selected following an open call for proposals. The pilots investigated the use of auctions (four projects), cap and trade approaches (three projects), offsets (two projects), a leverage fund (one project) and conservation insurance (one project).

Table 1.1 presents a summary of the pilots that were selected for Round 1 of the program. An interim report on the outcomes was published in December 2005. Final reports from 10 of the 11 pilots are currently available at the Australian government's Web site. The study on the leverage fund is not yet available (the final report was expected to be ready by April 2006). Accordingly, this study considers only the pilots involving auction systems, cap-and-trade approaches, offset mechanisms and conservation insurance.

Table 1.1
Summary of pilot characteristics

MBI type	Method		National resource management focus				Funding (% of total)
	Field pilot	Experiment/ workshop	Salinity	Water quality	Biodiversity	Carbon	
Auction	4	1	X	X	X	X	33
Cap and trade	1	3	X	X			17
Offset	1		X				12
Risk market	1						2
Leverage	1		X	X	X	X	36
Total	**7**	**4**					**100**

[1] The risk market pilot's focus was primarily wind erosion, and this was a "desk-based" pilot. One cap-and-trade pilot included both experiments and a field component.

Source: Grafton 2005 a.

Brief descriptions of the MBIs tested by means of these pilots are presented in the following paragraphs.

Auctions

An auction is a mechanism designed to maximize the value created from allocating a resource (usually an asset or a contract) to competing firms or individuals. It does this by creating a short-lived market with a set of rules that regulate the way buyers and sellers interact (Australian Government 2005). The environmental benefits accruing from auctions are uncertain, but the associated costs are determined. Well-designed auctions provide the government with information about the opportunity costs to farmers of producing specific environmental outcomes. This information enables the government to pursue those contracts that provide the most value and the greatest benefit to society (Australian Government 2005). An earlier study, the BushTender auction of conservation contracts, illustrated the application of auctions to a single environmental problem (non-point-source pollution) (Stoneham et al. 2003).

Four of the pilots featured auctions as their market-based instrument:

- Catchment Care - Developing an Auction Process for Biodiversity and Water Quality Gains
- Establishing East-west Landscape Linkage in the Southern Desert Uplands
- EcoTender: Auction for multiple environmental outcomes
- Auction for Landscape Recovery (Southwest Australia)

Cap and trade

The cap-and-trade approach creates a market by setting an overall limit on a particular environmental impact. Discharges that add to that impact are assigned to landholders, and discharge rights can be exchanged in the market. It is clear, then, that not all landholders are supposed to meet the same environmental objectives. The sale of these rights generates income, giving participants an incentive to reduce their environmental impacts and thus enhance their long-term efficiency (Grafton 2005 a). Environmental benefits are even greater in the case of a program featuring a cap that declines over time, as in the case of the sulphur dioxide credit program for coal-fired electrical utilities in the United States (Grafton 2005 a).

The distinctive feature of a cap-and-trade system is thus the setting of an upper limit on environmental emissions, i.e. "landholders must not emit, discharge or recharge above a fixed amount or rate set by the regulator unless they purchase additional property rights to do so at the existing market price" (United States Environmental Protection Agency 2003, quoted in Grafton 2005 a). Markets can also be created for point-source emission problems by setting a cap on the production of a particular environmental outcome. Clearly defined shares of the cap, often referred to as permits, are then allocated between landholders. These permits are exchanged in a market in which the objectives are to maximize environmental benefits while minimizing costs (Australian Government 2005). Thus "the price of the property right provides a market signal to control discharges." This approach is commonly applied to point sources of pollution (Grafton 2005 a).

Three of the pilots investigated the cap-and-trade approach as their market-based instrument:

- Cap and Trade for Salinity: Property Rights and Private Abatement Activities, a Laboratory Experiment Market
- Dryland salinity credit trade
- Tradable recharge credits in Coleambally Irrigation Area: Experiences, Lessons and Findings

Offsets

With a conventional command-and-control system, where a particular action is known to lead to an undesirable outcome (pollution), that action is prohibited. With an offsets system, the action is permitted, provided a compensatory action is taken so that the overall environmental outcome at least remains the same. The compensating activity to offset the negative environmental impact may be taken by the polluter, or the polluter may pay a third party (individual or organization) to do so. Offsets are similar in some ways to cap-and-trade systems. Both mechanisms limit a particular type of environmental damage, but provide for a good deal of flexibility as to how the limit is met. To illustrate, an offsets system may involve contracts being exchanged only once, rather than being regularly traded between participants (Australian Government 2005).

Two of the pilots investigated the use of an offsets mechanism as a means of addressing water quality problems. These were:

- Green Offsets for Sustainable Regional Development
- Establishing the potential for offset trading in the lower Fitzroy River research reports

Conservation insurance

Conservation insurance assumes that some landholders are reluctant to adopt new farming practices that will reduce the environmental damage caused by their current practices because the new practices will put their farm profits at increased risk. The primary aim of an insurance mechanism is to reduce that risk by distributing it among a large number of individuals who contribute through a premium to a pool or common fund. Losses incurred by any individual contributor are at least partially covered by the fund (Australian Government 2005).

One pilot tested a conservation insurance mechanism:

- Adoption of New Land Management Practices through Conservation Insurance

Leverage funds

Leveraging uses public funds to influence the allocation of funds in capital markets. The hypothesis behind a leverage fund is that a poorly functioning capital market causes lower than optimal production of environmental goods. In this context, a state-financed leverage fund can correct the problem by mobilizing additional resources in the capital market to finance projects that are promising in terms of generating environmental benefits. Projects that provide both environmental goods and private returns must be available in large enough numbers to enable the leverage fund to attract sufficient private investment money. In addition, it must be possible to estimate and measure the environmental benefits delivered by projects, and to form contracts that will ensure the delivery of those environmental benefits.

One pilot was used to test a leverage fund:

- Farming Finance: Creating positive land use change with a Natural Resource Management Leverage Fund.[1]

Table 1.2 presents a summary of the various factors that must be taken into consideration for the adoption of an auction system, a cap-and-trade approach or an offsets mechanism. These various MBIs can thus be compared at a glance (Australian Government 2005, p. 52).

The following table (Table 1.3) contains descriptions of the 11 pilots.

[1] However, this study is not yet available (the final report was expected to be out in April 2006).

Table 1.2
The appropriateness of cap-and-trade, auctions and offsets systems

	Cap-and-Trade	Auctions	Offsets
Policy conditions, level of uncertainty	Requires community acceptance, regulatory basis for cap.	Requires payments to landholders for provision of environmental goods and services.	Agency use requires regulatory means to prevent action causing damage without offsetting.
Landholders' knowledge of actions to produce environmental goods	Landholders must have good knowledge to know whether to buy or sell permits.	Government has good understanding, passed on to landholders at site visits.	System to match offset demand with supply must take into account whether landholders or the agency have this knowledge.
Cost to develop contract/permit rules and exchange	Must be low cost as many trades may occur (and multiply costs).	Can be higher as each exchange occurs once.	Generally can be higher (one-off exchange); depends on offset matching system.
Difference in a unit of environmental good produced by one landholder and another	Low degree of difference needed for "like for like" trades; simple trade rules.	Can be higher, but the metric measurement to define a unit of the good must be weighted to account for preferences.	Requires "like for like" trades, but as trades may be less frequent (e.g. one-off purchase of offsets to allow development) the net cost to ensure like for like condition met is less than if trades occur regularly (cost multiplied by number of trades).
Number of players required to participate	Enough for competition for supply of and demand for permits.	Enough for competition for supply of environmental goods.	Low numbers okay, but if so, offset matching system must be low cost.

Source: Australian Government 2005, p. 52.

Table 1.3
Description of Round 1 MBI Pilots

Pilot Name, Lead Organization & Region	MBI	NRM Issues Investigated	Brief Description
Multiple-outcome auction of land use change (DPI Victoria) Goulburn-Broken Vic. **ID20 Interim Report Available**	Auction	Biodiversity Salinity Water Quality Carbon	Extension of the Bush Tender auction approach to include salinity, water quality, water quantity and biodiversity in a field pilot. Involved developing and implementing the Catchment Management Framework Model. Designed to address the *missing market for environmental goods*.
Tradeable net recharge contracts in Coleambally Irrigation Area (CSIRO Sustainable Ecosystems Canberra) Lachlan-Murrumbidgee NSW **ID33 Interim Report Available**	Cap & Trade	Salinity	Research, economic modelling and experiments with landholders conducted to assess the potential effectiveness of trading schemes for managing salinity in the Coleambally irrigation area with support of Coleambally Irrigation Cooperative. Designed to address the *missing salinity market*.
Creating positive land use change with a Natural Resource Management Leverage Fund (Greening Australia) Lachlan-Murrumbidgee, NSW/South Coast **ID46 No Report Available**	Interaction with Leverage Fund	Salinity Water Quality Biodiversity Carbon	A field pilot to investigate a fund that leverages private sector investment to deliver natural resource management outcomes and private returns to investors. Allows comparison between leverage fund and multiple outcome auction to achieve the same end. Designed to address *an inefficient capital market and a missing market for environmental goods*.

Pilot Name, Lead Organization & Region	MBI	NRM Issues Investigated	Brief Description
Auction for landscape recovery (WWF Australia) Avon. WA **ID21 Interim Report Available**	Auction	Salinity Biodiversity	Field pilot to assess an auction providing incentives for diffuse source salinity and biodiversity outcomes where bids are assessed based on the progress that they make towards achieving a regional biodiversity target considering the impact that other bids have on these targets (sub-additivity is accounted for). Designed to address *the missing market for environmental goods*.
Adoption of New Land Management Practices through Conservation Insurance (Dept Water, Land & Biodiversity Conservation) Lower Murray SA **ID8 No Report Available**	Interaction with Insurance Market	Wind Erosion	Desktop study of the use of insurance as a means of supporting changes in farming practices in the Mallee cropping regions. Conditions under which such a scheme may be successful were investigated and the need for and role of government involvement is also examined. Designed to assess potential *missing insurance market* to address increased yield risk faced by those who adopt conservation farming systems.
Cap and trade for Salinity: Property Rights and Private Abatement Activities, a Laboratory Experiment Market (DPI Vic) Lower Murray, Vic/SA ***ID10 Final Report Available***	Cap & Trade	Salinity	This pilot uses experimental economics to examine a tax/levy system. It investigates the use of experiments to test a cap and trade approach to the salinity problem and the use of experimental economics in policy design. Designed to *address missing market for salinity*.
Catchment Care-Developing an auction process for biodiversity gains and water quality outcomes (Onkaparinga CWMB) Mt Lofty-Kangaroo Island SA **ID26 Final Report Available**	Auction	Water Quality Biodiversity	Field pilot tests auction tool for use by regional natural resource management bodies. Also tests how measures for risk reduction and actions that cross property boundaries can be included in assessing bids. Designed to address *missing market for environmental goods*.

Pilot Name, Lead Organization & Region	MBI	NRM Issues Investigated	Brief Description
Green Offsets for Sustainable Regional Development (NEW EPA) Namoi-Gwydir/Macquarie_Castlereagh/Murray NSW **ID16 Final Report Available**	Offsets	Salinity	Pilot involves three field-based salinity offset schemes. Point source polluters are able to offset their salt emissions into stressed rivers in the Murray Darling Basin by investing in works that reduce salinity from diffuse sources. Designed to address *missing market for salinity*.
Establishing East-West Landscape Corridors in the Southern Desert Uplands (Desert Uplands Build-up & Devt Comm.) Burdekin-Fitzroy Qld **ID18 Final Report available**	Auction	Biodiversity	Uses experimental workshops (with landholders) to investigate the design of auctions to create biodiversity corridors. Uses payments distributed via an auction mechanism and accounts for the interdependence between bids (super-additivity problem). Designed to address *missing market for biodiversity*.
Establishing the potential for offset trading in the lower Fitzroy River (Central Queensland University) Burdekin-Fitzroy Qld **ID53 Final Report Available**	Offsets/ Cap & Trade	Salinity	Uses experimental workshops with landholders and choice modelling to examine how a salinity-trading scheme might work in new and developing irrigation areas in the Fitzroy River. Designed to address *missing market for salinity*.
Recharge Credit Trade in Bet Bet (CSIRO Land and Water) Avoca-Loddon-Campaspe Vic **ID57 Interim Report Available**	Cap & Trade	Salinity	Uses landholder experiments and a field pilot to investigate a credit trading approach to diffuse sources of dryland salinity. Involves investigating the use of group incentives to achieve individual targets where trading credits is allowed. Designed to address *missing market for salinity*.

Source: Draft Overview Report of the MBI Pilot program Round 1 (National MBI Working Group).

1.1.2 ANALYSIS OF SELECTED PILOTS

In the following sections, four pilots (one for each category of MBI) are reviewed in detail:

- **Auction**: Catchment Care - Developing an Auction Process for Biodiversity and Water Quality Gains
- **Cap-and-trade**: Dryland salinity credit trade
- **Offsets**: Green Offsets for Sustainable Regional Development
- **Conservation insurance**: Adoption of New Land Management Practices through Conservation Insurance

1.1.2.1 CATCHMENT CARE - DEVELOPING AN AUCTION PROCESS FOR BIODIVERSITY AND WATER QUALITY GAINS[2]

Biodiversity and water quality in the Onkaparinga drainage basin, or catchment, are under serious threat from productive land use activities. The Onkaparinga Catchment Watercourse Management and Assistance Program (WMAP) is the primary means of distributing public funds and the main source of technical assistance for natural resource management in the catchment. Experience showed, however, that the prioritization of funding applications under WMAP lacked a systematic, comprehensive, transparent and defensible framework. Accordingly, the objectives of the Catchment Care study are as follows (Brett et al. 2005):

- To improve the various aspects of the prioritization process and provide a basis for making funding decisions for on-ground works by landholders;
- To assess the auction process for increasing the cost-effectiveness of payments for natural resource management actions by landholders.

Landholders propose sites for environmental restoration and protection works; sites may include watercourses, riparian areas and drainage basins. Catchment Care is a discriminative first-price sealed bid procurement auction in which the most cost-effective works are purchased. The auction is sealed, i.e. bids are not disclosed. It is discriminative in that participants do not receive uniform funding, but are awarded funding equal to the amount bid. The same type of auction is used for the CRP in the United States, the NSW Environmental Services Scheme in Australia, and the BushTender program, also in Australia. A risk analysis framework is developed to score, rank and select the bids that offer the greatest benefits for biodiversity and water quality until the limited amount of funding available is exhausted.

[2] Information on this pilot is taken from Brett et al. 2005.

The main steps in Catchment Care are as follows:

(1) **Catchment Care promotion** – Funding opportunities available under the program for on-ground restoration and protection works are advertised. An information pack is mailed to interested landholders. The level of information supplied allows landholders to make an informed bid and address the priorities of the Onkaparinga Catchment Water Management Board ("the Board"), but does not give enough information to provide a basis for rent seeking.

(2) **Site visit and evaluation** – Interested landholders receive a visit from a field officer, and a range of appropriate actions and priorities are discussed. The environmental value of the site's geomorphology, hydrology and remnant vegetation and the associated threats are scored, and the scores are entered on a Site Assessment Sheet. Environmental values and threats are described for this project in the table in Appendix 4.9.a.

(3) **Site action plan development** – The Board considers appropriate action for each site and makes recommendations to the landholder. The landholder then develops a Site Action Plan outlining proposed actions aimed at stopping threats, the areas covered, techniques used and funding required. Cost-sharing for the proposed works is also included.

(4) **Bid submission and auction** – The landholder submits the Site Action Plan to the Board as a bid for Catchment Care funding.

(5) **Bid assessment** – An environmental benefit score is calculated for each bid using the risk analysis framework. To measure environmental benefits, the following values are calculated:

- Risk score: based on environmental value and threat.
- Impact score: risk multiplied by the amount of threat reduction that would be achieved by the landholder's proposed actions.
- Environmental benefit score: impact score multiplied by the area of action.

(6) **Bid selection and contracting** – Bids are ranked based on the environmental benefits per dollar of funding requested. The most cost-effective bids are selected for funding support. Cost-effectiveness is calculated by dividing the environmental benefits by the amount of funding requested.

A three-year contract is signed with each successful landholder. The proposed actions and a milestone-based payment scheme are specified in the contract.

The bid scoring and risk analysis framework of Catchment Care was tested by Monte Carlo simulations[3] and refined before going to trial. Following this, a full trial of the auction system was run in the Onkaparinga catchment. A total of 52 expressions of interest were received, 42 site assessments were made and 29 bids were submitted. A total funding limit of A$150,000 was set, resulting in the funding of the 17 most cost-effective bids.

(a) Environmental effectiveness

The project has been launched so recently that its environmental impacts are not evaluated in detail in the report published by the Australian government. We may reasonably suppose that, as we saw in the case of the CRP in the United States, the program's environmental effectiveness will depend on the accuracy of the method used to calculate environmental benefit scores. Another factor that should be borne in mind is that in the Catchment Care pilot, environmental benefits are weighed against the cost of the proposed measures aimed at producing them, and this suggests that some measures that would produce environmental benefits are probably excluded from the program on the grounds of cost.

(b) Economic efficiency

The Catchment Care auction system provides the Board with what appears to be a highly cost-effective mechanism for producing environmental benefits. The cost-effectiveness of Catchment Care was compared with the Board's previous program, the Watercourse Management and Assistance Program (WMAP). Taking development and implementation costs and also program funding into account, Catchment Care is estimated to be between 23.0% and 34.0% more cost-effective than WMAP. However, that estimate is subject to uncertainty, and a more robust methodology would be desirable.[4] Table 1.4 presents the data used to calculate the program's cost-effectiveness, defined as environmental benefits divided by total costs and funding (EB/$). As will be seen, strictly in terms of environmental benefits generated, WMAP (A$21.8 million) outperformed Catchment Care ($A20.8 million) by a small margin. This highlights the importance of assessing a program in its entirety.

[3] Monte Carlo methods consist of experimental or computer simulations of problems in mathematics or physics based on random number drawing.

[4] It is undeniably difficult to draw any clear-cut conclusions. The authors note that in the case of WMAP, a cost-benefit analysis is a complex exercise that is based on a number of assumptions, including, for purposes of comparison with Catchment Care, the assumption that 29 projects were funded, which was not the case. Some of these assumptions would enhance WMAP's cost-effectiveness, while others would diminish it, but the authors are unable to determine their respective magnitudes. As a practical matter, the two projects are hardly comparable in cost-benefit terms.

Table 1.4
Comparison of the cost-effectiveness of Catchment Care and WMAP accounting for both funding and implementation costs

	WMAP	Catchment Care	
		Assuming board officer only	Assuming 50/50 board officers to contractors
Total Hours	416	443	443
Labour Costs $	12,470	13,275	24,338
Material Costs $	458	2,789	2,789
Total Costs $	12,928	16,064	27,126
Costs/Property $	923	945	1,596
Total Funds $	202,951	139,278	139,278
Total (Funds+ costs) $	215,879	155,341	166,404
Total Environmental Benefits	21,835,533	20,873,972	20,873,972
Cost-Effectiveness (EB/$)	101	134	125

Source: Brett et al. 2005.

(c) Summary

The Catchment Care pilot afforded an opportunity of developing and testing an auction system based on environmental risk and the impact of particular practices or approaches to environmental management. A list of the lessons learned from this trial of an auction system aimed at solving environmental problems will be found in the paragraphs below.

- **Catchment Care promotion**: Significant interest in the trial was generated among the target group (farmers in the catchment). The most effective form of promotion was direct mailing. Getting the correct balance of information provision, so as to adequately inform bids while yet not encouraging rent-seeking by participants, was one of the most time-consuming but important aspects of the trial.
- **Site visit and assessment**: Experience with the field trial indicates that a major revision of the site assessment parameters would be desirable. In order to favour bids aimed at weed eradication, for example, the report on the pilot suggests that the Weed % Cover and Invasive Weed Presence parameters could be combined. The authors also suggest that the site assessment parameters could usefully be expanded to include other objectives such as environmental flows and groundwater/aquifer recharge.
- **Site action plan development**: Landowners were free to modify actions recommended by the Board in submitting their bids. This left too much scope for landholders to bid for actions that were not high priority or were incorrectly conducted, sequenced or located.
- **Bid submission and auction process**: The first price sealed bid auction format worked well, and significant efficiencies were achieved. Bids did not seem to be systematically shaded high, and there was no evidence of collusion among landholders.

- **Bid assessment**: The bid assessment process was deemed to be flexible and extensible, and thus could easily cope with a more complex version of the program. It would also accommodate the incorporation of combinatorial or cooperative bidding to capitalize on synergies between bids. This would result in more adequate coverage of some areas or achieve economies of scale.
- **Bid selection and contracting**: In the context of the Catchment Care pilot, payments were staged and dependent upon meeting milestones. This was an important aspect of the project and substantially reduced the risk of underperformance by introducing more control points.

The study concludes that an auction system is an effective means of generating environmental benefits for farmers, especially at sites where the implementation of environmental management actions does not require substantial funding. However, the auction instrument does not enable access to very highly priced environmental benefits. In that connection, it appears from this pilot that as a rule, higher-priced bids tend to offer the lowest amounts of environmental benefits.

1.1.2.2 Dryland Salinity Credit Trade[5]

Salt loads from drainage in the upper Bet Bet sub-catchment of the Loddon River in north central Victoria are very high. For that reason, revegetation is one of the region's priorities in terms of agri-environmental policy. Substantial revegetation efforts have previously been undertaken in the region, but these have been inadequate: in 2004, for example, only 5 ha of revegetation work was performed in exchange for payments. Hence the need for a new program aimed at stimulating enrolment in a salinity management scheme.

The fundamental goal of this project was to set an aggregate threshold for groundwater recharge volumes for each participant. Participants signed agreements committing them to reduce salinity recharge to an agreed baseline value based on current land use.

In this pilot, groundwater recharge was used as the proxy for salinity, as it could be estimated on the basis of observed outcomes of land management, with estimates differentiated across biophysical and land management differences (Clifton 2004, quoted by Connor 2006).

Participants could meet their recharge objectives either by applying soil management techniques that resulted in reduced recharge, or by exchanging credits with other participants. They could establish three types of soil management to meet their objectives: a new plant cover, reforestation, or restoration of the native vegetation. Participants whose recharge was under the baseline value received salinity recharge

[5] Information on this pilot is taken from Connor et al. 2005.

credits, which could be sold to those who were above the baseline value. In this way, the environmental objective could be attained at minimal cost.

Preparations for the implementation of a cap-and-trade approach

Several steps were involved in the task of determining conditions for success in the implementation of a cap-and-trade approach under field conditions.

The first step was to identify impediments that could prevent cost-effective and environmentally satisfactory outcomes if not addressed. Six main impediments were found:

- A lack of fully articulated and enforceable property rights arrangements;
- A lack of performance-based incentives to reduce recharge;
- Capital/cash-flow/time preference constraints;
- Costly information;
- A thin market, i.e. one in which there are only a few buyers and sellers;
- Non-market motivations.

Experimental economics were then used to test these potential impediments. This led to the design of policies that could address the impediments in question (see Table 1.5). This information is vital for the implementation of a cap-and-trade approach under field conditions.

Table 1.5
Impediments addressed by recommended design features

Impediments/Design features	Property rights	Lack of performance incentive	Capital/time preference/risk constraints	Thin market/rent seeking	Costly information	Non-market motivations
Payments to establish obligations	X					
Performance based payment		X				
Multiple year agreement with establishment and annual performance payments		X	X			
Higher payment for more permanent change		X				
Uniform price auction				X	X	
Group performance component of payment to establish initial obligations				X		X
Group incentive payment for reconciliation of credit/debits positions					X	X

Source: Connor et al. 2006.

Lastly, a survey was conducted to gain an understanding of what might motivate local landholders to participate in a recharge credit trade trial and what kinds of implementation design might be most effective given the social characteristics of local communities. Key findings were as follows:

- Landholders in the region were noticeably unreceptive to change. For the most part, they used similar sheep-grazing-based farming systems. There was little use of computers as management tools, little adoption of non-traditional selling methods, and little use of formal farm business planning. In a word, the majority of landholders lacked the skills and familiarity with markets and trading to participate effectively in an individualistic trading scheme.
- The most likely motives for participation in a pilot of this type were the community spirit and land care ethic on the one hand, and on the other hand widespread recognition of the fact that while salinity was a problem in the district, it was one that could be managed on-farm.

These survey findings indicate that ethical motivations strongly influenced landholders' decisions to participate in the pilot, and that high-cost information would constitute an impediment to the implementation of a cap-and-trade approach.

Implementation approach

Implementation of the pilot featured three main actions: establishment of a recharge outcome monitoring system, preparation of credit accounting protocols and drafting of a legal agreement that formed the basis of the on-ground trial. Land management outcomes were related to estimated salinity impact through a monitoring process: plant cover was assessed by means of field sampling techniques. Lookup tables were developed to estimate recharge reduction in relation to crop type and landscape position. The contract was a commitment either to meet a salinity recharge obligation or to offset any recharge in excess of that obligation through the purchase of tradable salinity recharge credits. The main features of the contract were as follows:

(1) A voluntary multi-year agreement with landholders for management changes that would reduce recharge to agreed levels in exchange for payment. As a rule, participants undertook to reduce their salinity recharge for a period of three years;

(2) Establishment of a payment with a level that varied based on the estimated level of annual recharge reduction, the permanence of the management change undertaken, and the location of the associated works. The base payment was set at A$32 per salinity recharge credit;

(3) Annual payments based on monitored ground cover and estimated recharge reduction as determined from lookup tables. Performance payments of A$3.20 per credit were made at the end of the second and third years, but only to participants who had met their commitments;

(4) Estimated recharge achieved was compared with the level of recharge obligation specified in the contract. Credits were then issued to participants whose recharge was under the contractual level. To qualify for annual performance payments, a participant who had exceeded his recharge obligation level needed to have an equivalent number of credits;

(5) Borrowing and banking of credits was allowed so that a deficit in one year could be made up in another year;

(6) A collective agreement provision stipulated that funds would be withheld until a minimum aggregate level of reduction was met. If land management changes and trading proved adequate for that objective to be attained, all participants received a bonus payment. An amount of $A15,000 was allocated for that purpose.

Preliminary implementation results

Implementation on the ground began in 2005, with a gratifyingly high participation rate. Enrolment in the project may be summarized as follows:

- 22 sites totalling just over 103 ha on which native vegetation was to be established;
- 12 sites totalling 257 ha on which new perennial pasture was to be established.

An audit undertaken late in 2005 and early in 2006 led to a prediction of the credit situation up to that point. Overall, it seemed likely that there would be a net surplus of 78.4 credits on native vegetation sites and a net surplus of 8.2 credits on pasture sites. Participants are allowed to trade credits at any time during the three-year on-ground implementation phase. No trading has taken place to date. However, given that some sites are in deficit and others in surplus, and given that there are incentive payments for participants who meet their environmental obligations, it seems likely that trading will take place over the next two years.

(a) Environmental effectiveness

In pursuit of its environmental objectives, the pilot uses a number of incentives. In the first place, dynamic incentive is used to sustain motivation (Young 1997, Tietenberg and Johnstone 2004, quoted in Connor et al. 2006). This is achieved through a monitoring approach: performance monitoring repeated at intervals, and a payment schedule relating a level of repeated payments to monitored outcomes. Incentive for dynamic efficiency is created through second- and third-year payments in the three-year trial, contingent on achieving agreed credit levels through monitored outcomes and/or credit trade.

In addition, a collective performance incentive feature is included in the trial. The basic idea is that part of the total payment is disbursed to participants only if the sum of individual outcomes reaches a pre-specified aggregate level. A collective incentive of this kind is attractive in settings where environmental action is a high priority but voluntary participation is low.

(b) Economic efficiency

A cost-benefit analysis showed that an estimated total of A$246,334 in salinity damage on a net present value basis was avoided as a result of the pilot. By comparison, the cost of payments to participants was A$119,775. This figure is based on the projection of a probable net credit surplus at the end of the trial. It is thus assumed that participants will receive all possible individual performance payments and the community payment (the A$15,000 bonus). There was an additional A$210,000 cost for project development and the overhead costs associated with administering the MBI trial program more generally. However, these costs are not included in the cost-benefit analysis and are treated as general public good research investment.

Another factor that adds to the complexity of a cost-benefit analysis is that a side effect of the revegetation realized under the pilot is likely to be flow reduction in some regional rivers, and this may mean that less water will be available for irrigation purposes in the future. If high-opportunity costs are associated with this adverse impact on river flows, the pilot will ultimately show a net cost rather than a net benefit.

It is noteworthy that in the context of this pilot, the use of contracts served to keep costs down to a reasonable level. Tradable credit or cap-and-trade policies require individual limits on allowable emissions. Often, in diffuse source emission settings, no limits exist. Defining individual emission limits for all in such settings would involve fundamental changes to legal definitions of environmental property rights. The use of a legal agreement represents a way of setting emission limits more simply and at lower cost than doing the same thing through legislation.

(c) Summary

The on-ground implementation of the pilot points to several conclusions that have implications for the cap-and-trade approach generally:

- The pilot has shown that it is feasible to use individual legal agreements in a context of tradable credit policy.
- Collective dynamic incentive can be built into credit policies.
- The outcomes of the pilot indicate that the collective incentive resulted in greater voluntary enrolment in the project. The success of this collective incentive appears to be due in part to a high level of social cohesion, the fact that a good many of the participants were members of the organization that administered the pilot, and a strong belief that on-farm action can improve salinity outcomes. These results might not be replicable in settings where those conditions did not exist.

1.1.2.3 Green Offsets for Sustainable Regional Development[6]

The pilot entitled Green Offsets for Sustainable Regional Development explored the use of environmental offset mechanisms as a means of reducing salinity problems resulting from point- and diffuse-source pollution in several catchments in a heavily industrialized region of Australia. Originally, there were three participants:

- A coal mine (Macquarie and Hunter catchments);
- A paper mill (Murray catchment);
- A spa (Gwydir catchment).

In contrast to the pilot just discussed, in this case a legislative approach was used to set salt load limits for participants intending to expand their operations (and consequently

[6] Information on this pilot is taken from NSW Environment Protection Authority 2005.

increase their discharge of salt to the environment), or where the environmental impact of the existing salt load was clearly excessive.

As yet the offset mechanism has been implemented only in the case of the Ulan Coal Mine. The two other participants (the paper mill and the spa) are still at the offset program development stage.[7]

Funding in the amount of A$400,000 was made available for the project over a two-year period (see Table 1.6). As two of the three participants are not yet active, expenditure to date does not account for the entire budget.

Table 1.6
Project expenditure

	Specified pilot activities	Breakdown proposed in Deed of Grant	Total expenditure
1	Preparing offset programs	120,000	84,729
2	Scientific assessment of offsets	200,000	102,075
3	Mainstreaming offsets	40,000	36,254
4	Knowledge transfer	20,000	11,537
5	Project management	20,000	14,637
	Total	**400,000**	**249,232**

Source: NSW Environment Protection Authority, 2005.

Ulan Coal Mine offset measures

Modelling predicted a residual salt load of approximately 280 tonnes a year potentially leaching into local shallow aquifers. Measures were then developed to progressively offset those 280 tonnes of salt. These on-ground offsets involve land-use and land-management changes to reduce salt exports from 4,460 ha of other lands that the mine owns and manages. The changes primarily involve revegetating with trees and sowing perennial pastures.

The expected results of the offsets are an improvement in the condition of native forests and pasture lands, and less salt being exported from those areas, because water use by the vegetation cover will increase. However, it will take many years for the vegetation, and thus the offset, to reach maturity.

For this offset program, a trading ratio of 1:1.5 applies, i.e. the mine is required to offset 1.5 tonnes of salt for every tonne of salt discharged into the shallow aquifer. A results

[7] The Norske Skog paper mill has invested a significant effort in the development of an offsets program, but modelling did not confirm the predicted benefits for the Murray River, and this has delayed the implementation of the program. The spa operators are still having trouble identifying offset options. To overcome this information and skills barrier, the Department of Environment and Conservation (DEC) has commissioned a cost-benefit study comparing several salt-reducing alternatives.

monitoring and reporting system has been developed. In addition, it was important to ensure that the system would be cost-effective.

(a) Environmental effectiveness

Offsets are environmentally advantageous in several ways. In particular, they afford a means of providing funding to combat diffuse-source pollution that would otherwise not be available. They also show the effectiveness of new management techniques and methods for pollution source reduction and promote their acceptance on a wider scale.

The challenge of meeting the project's environmental objective entailed the application of a number of basic principles designed to ensure that the environmental impact of the offsets would be at least neutral. Those principles are presented in the table below.

Table 1.7
Principles for applying offsets

• On-site pollution reduction should be optimized: environmental impacts must be avoided first by using all cost-effective prevention and mitigation measures. Offsets are then used only to address the remaining environmental impacts. • Offsets must not reward poor environmental performance. • Offsets must be consistent with and complement board environmental objectives. • The pollutant must be suitable for an offset, and the offset must be for the same pollutant being discharged. • They must offset the impact in the same area. • They must offset the impact of the development for the period that the impact occurs. • The pollution impacts and offset benefits must be reliably estimated. • The offset should result in a net environmental improvement. • The offset must be enforceable using licence conditions. • Design of an offset should maximize community acceptance and environmental benefit.

Source: NSW Environment Protection Authority 2005.

In the case of the mine, an alternative to the offset program would have been the installation of desalination equipment. In view of the capital investment and operating costs that that would have entailed, however, to say nothing of the cost of managing the wastes that would have been generated, this approach would probably have made the company uncompetitive. At present, while it is difficult to determine the effectiveness of the offsets program, it does appear to be an attractive option for the mine, the environment, and the governments involved. From an environmental standpoint, offsets have conferred multiple benefits in addition to load reduction, including:

- Reduced soil erosion;
- Reduced nutrient runoff;
- Reduced flood flows through reduced runoff and more gradual release of water into waterways;
- An increase in native vegetation cover;
- Maintenance of biodiversity;

- Capture and storage of carbon.

(b) Economic efficiency

The participants in the pilot have been confronted with high transaction costs, owing to the complexity of the task of identifying an appropriate offset activity and the costs entailed by the development of an outcomes tracking and monitoring system. However, all three of them have found that the use of offsets may allow them to achieve the required environmental outcomes at lower cost than would have been the case if they had used on-site mitigation measures alone.

The pilot found that the offset implemented by the Ulan Mine was cost-effective for the company when compared to the command-and-control approach of installing a desalination plant (Australian Government 2005). To date, the offset program (which is described in detail in Appendix 4.9.b) has cost about A$1.3 million, in addition to annual operating costs of approximately A$94,000, but it has enabled the company to avoid installing a desalination plant at a capital cost of about A$15 million, with estimated annual operating costs of A$6 million (Grafton 2005 a).[8] From the standpoint of the government, it is difficult to determine the amount of resources that would have had to be committed to address the issue with a conventional command-and-control approach. To be sure, the establishment of an offsets program entails costs and time for community information and securing the services of various experts, but those costs are likely to decline over time.

(c) Summary

One of the main conclusions to have emerged from this pilot is that as a rule, offsets cannot be implemented quickly, as is apparent from the fact that two of the three participants have not yet been able to implement their programs. Table 1.8 shows the reasons why time is required for implementation and expectations about these various constraints as offset measures become better-known and more effective with further experience.

[8] The net present value of these savings is approximately A$91 million, on the assumption that the costs will continue for the next 20 years and that there is a discount factor of 7% and an inflation rate of 2.4%.

Table 1.8
Reasons why time is needed for implementation and expectations about constraints

Time is needed to:	We expect this need to:
Educate people about the way the approach works and ensure that they have a reasonable level of comfort with it.	Be reduced over the medium term as the community becomes more familiar with offsets.
Engage a wide range of stakeholders (licensees, councils, the general public, Catchment Management Authorities, technical experts).	Continue to be true into the foreseeable future. However, as for the point above, this need may be streamlined over time.
Potentially deal with complex expansion plans, which may have complex issues in addition to environmental ones and are potentially subject to changing company priorities (e.g. in the case of the proposal to expand Norske Skog paper mill).	Remain for sites that have complex processes. On-site measures will still need to be investigated first, before offsets are considered.
Seek our information on possible options; there is currently limited information available on the options that may be used to reduce salt loads.	Reduce as we gain more experience with offsets. The UNE advice will help here. Offset scheme managers and CMAs are likely to become storehouses of information on offset options.
Investigate a number of different offset measures that may be used, each with their own set of pros and cons. Proper investigation and analysis of these options plus the development, negotiation, consultation, design and implementation of an offset proposal (that may involve a number of options) takes time.	Remain the case for site-specific offset programs (outside a formal scheme). However, this would be streamlined if offset banks and/or offset schemes were established. CMAs and similar bodies could source offset measures and on-sell them in whole or as credits to operators that need to fulfil offset obligations.
Engage a number of potential offset providers, since there is currently no mechanism to easily bring buyers and sellers together.	Reduce as mechanisms, such as offset schemes (with Scheme Managers) and offset banks, are established.
Seek expert advice, since there is only a small pool of such experts available; they are in high demand and have limited availability.	Remain in the short-term. However, this is likely to be reduced as we gain more experience with offset measures.

Source: NSW Environment Protection Authority, 2005.

Another noteworthy point is that offsets are beset by uncertainties, making the task of implementation difficult. To illustrate, offsets often involve the reduction of diffuse sources of pollution. The challenges and uncertainties that stem from this include the fact that:

- It is difficult to predict and measure diffuse discharges;
- Offset measures based on reducing diffuse sources are less well understood than measures for point sources of pollution;
- The environment is a series of complex systems that interact with each other and are not fully understood;

- It is not possible to isolate the system being studied from the surrounding systems (e.g. changes in salinity may be caused by other sources);
- It may take years (and sometimes decades) for environmental benefits to be fully accrued where offsets involve land-use changes.

Difficulties of this kind, of course, occur with the implementation and evaluation of most agri-environmental policy instruments, but they appear to be exacerbated in this particular case by the fact that the problem is one of diffuse-source pollution.

During this pilot, technical advice and expertise have been essential, providing the government with specialized knowledge and providing the participants with support and guidance in identifying and designing their offset measures. Many firms do not possess the necessary resources and expertise to do the job themselves. This issue may be addressed by training offset scheme managers who could identify a range of options for various industrial sectors that some day may find themselves required to reduce their environmental pollution. Managers could make their services available to firms that were interested in participating in offset schemes. Offset funds or banks could also be established to provide project funding.

1.1.2.4 Adoption of New Land Management Practices through Conservation Insurance[9]

Risk is an integral part of both agricultural management and environmental management. One motivation for the EconSearch (2006) pilot on conservation insurance was that studies in the United States and Australia have identified risk as a key barrier to the adoption of sustainable farming practices by dryland farmers. For farmers, as a rule, the risk associated with the adoption of new management practices is that their production, and consequently their income, may be adversely affected. Conservation insurance would afford a means of reducing the level of risk and thereby give farmers an incentive to adopt management practices that are perceived as being risky, but would be beneficial from an environmental standpoint.

The principal purpose of this project was to undertake a scoping study into the use of conservation insurance as a means of supporting changes in land management where risk was perceived to be a major barrier to implementation. The Lower Murray region in South Australia was selected as the case study area.

[9] Information on this pilot is taken from EconSearch, 2006.

Insurance in agriculture

Crop insurance is available, covering multiple risks such as hail, frost, wind and drought. However, none of these programs is commercially viable, and consequently all of them are heavily subsidized by governments. In contrast to European and North American countries and Japan, Australia does not subsidize multiple-peril crop insurance.

In fact, for a specific risk to be commercially insurable, there are two situations that must be avoided:

- Asymmetric information: the potential buyer of insurance and the insurance company may not have the same information regarding the probability of losses occurring. In a farming context, the insurer does not know the average yield or yield variability for each farm. More specifically, there are two factors that may give rise to the problem:
  - Moral hazard occurs when a landowner alters his production or management practices in order to increase the probability of losses;
  - Adverse selection occurs when those who purchase insurance face a higher risk than those who do not. Consequently, insurance premiums paid into a pool may not be adequate to cover the losses sustained. To correct this problem, a means of separating individuals who have different probabilities of sustaining losses into separate risk classes would have to be found.

- Systemic risk: situations in which many individuals can suffer a loss simultaneously, with the result that the premiums paid in may not be sufficient to cover the losses incurred. In a normal farming context, price and yield risks are systemic.

Owing to the frequent occurrence of these situations, crop insurance is known to be one of the most difficult forms of insurance for the insurance industry (Hertzler 2003, p. 3, quoted in EconSearch 2006).

Conservation insurance

Conservation insurance offers, potentially, several advantages over alternative means of compensation for damage. Those advantages include:

- Private risk management: insurers have an incentive to reduce policyholder risks;
- An efficient means of control, as risks are spread across a large number of people;
- Insurance can modify behaviour by raising or lowering premiums, and behaviour modification is a dominant aim of environmental regulation.

Given the objective of more environmentally benign farmland management, the importance of the yield uncertainty constraint would suggest that there is a role for conservation insurance in reducing the risk associated with the adoption of conservation techniques.

(a) Environmental effectiveness

It is clear from the results of farm-level modelling in the case study region that farmers perceive a greater degree of risk in moving to improved farming systems characterized by more intensive cropping and reduced tillage. Research indicates that adoption of these practices would be likely to confer a number of advantages, including in particular improved soil fertility, a significant reduction in wind erosion, and improved timeliness of sowing, allowing for more efficient water use and hence a decrease in groundwater recharge. Furthermore, increased cropping intensity correlates, on average, with enhanced profitability.[10]

At the same time, modelling indicates risks as well, including:

- Financial risk arising from increased reliance on cropping for farming income (intensification rather than diversification);
- Financial risk arising from the need to purchase new machinery (greater indebtedness);
- Cost variability as a result of more intensive farming;
- Need for increased management and labour capacity.

(b) Economic efficiency

Conservation insurance can be financially viable only if it covers its operating costs and turns a profit for the insurer. Unless a farmer was highly risk-averse, it is unlikely that he would be interested in buying insurance coverage unless it were subsidized.

The transaction costs associated with this type of insurance may also be substantial. Contracts are necessary, and compliance monitoring can be costly, especially in a context of moral hazard and adverse selection. Furthermore, if the insurance is to be profitable, or at any rate break even, the market must be of reasonable size and geographically extended.

(c) Summary

The findings of the Australian government study suggest that there probably would not be much demand for conservation insurance. Farmers in the case study region reported that they found the concept difficult to understand. Even without taking premiums into account, there appeared to be little interest in conservation insurance. Farmers have other options for dealing with risk, including diversification, savings, credit reserves, and deferral of major expenditures.

[10] Surprising as it may seem in an agri-environmental policy context, the objective of the Australian project is to achieve environmental effectiveness through more intensive agriculture.

As regards supply, a number of potential problems were identified in the case study, indicating that conservation insurance would be an unattractive addition to an insurer's product line:

- Moral hazard: there are no historical data available on potential losses consequent upon the adoption of conservation management practices;
- Adverse selection: a survey conducted during the study showed that adverse selection was a potential drawback in view of the fact that some farmers had already adopted conservation practices and were not interested in conservation insurance. Another issue is that as the new practices became more widely adopted and farmers became progressively more familiar with them, the pool of subscribers might tend to shrink as the perception of risk diminished;
- Systemic risk: conservation insurance would probably be specific to a region or industry, and this would raise the problem of systemic risk.

In brief, a conservation insurance mechanism is unlikely to meet the conditions for an insurable risk, and is therefore unlikely to be commercially viable. This raises the issue of a role for government in the development of a conservation insurance product. Government involvement appears to be essential for the success of this type of insurance, as is the case with traditional crop insurance. Given the context, this would probably not be an economically advantageous approach from the government's standpoint.

The survey revealed that the reasons why farmers did not adopt conservation practices had more to do with inadequate information and financial constraints (input costs, outlays for machinery and management techniques) than with uncertainty about yields. In that case, the government's role could be more accurately targeted: it could offer tax incentives for farmers to purchase the machinery required for conservation practices. Other useful areas for government action might be the organization of awareness campaigns and support for research and development.

1.1.3 Environmental effectiveness of the National MBI Pilot Program

Generally speaking, Round 1 of the program has demonstrated that the use of auctions, cap-and-trade approaches for point-source pollution and offsets can be successful means of addressing a broad range of environmental problems, including water quality and salinity (Grafton 2005 b). The pilots have also shown that there is no one one-size-fits-all approach to salinity and water quality problems; a variety of MBIs can be used, and they must be tailored and adapted to specific environmental issues (Grafton 2005 a and b).

MBIs have frequently been used to address point-source pollution problems (such as sulphur dioxide emissions) or precise tradable quantities (as in the case of fishery resources). However, it is only very recently that they have been applied to the issues of diffuse-source pollution and changes in land use. These new instruments must be designed with care to ensure that users receive the right signals (Grafton 2005 b). In this connection, Grafton

(2005 b) notes that "The more diffuse the source of environmental harm, the greater the risk imposed on landholders, and the greater the uncertainty over biophysical linkages, the lower the rate of adoption and participation."

The Australian program also afforded an opportunity of analyzing the specific environmental effectiveness of the various MBIs with which trials were conducted. For one thing, the pilots confirmed that auction mechanisms were ready for large-scale implementation in a broad range of landscapes. Auctions are the MBI that most closely resembles existing regulation systems, and that similarity is undoubtedly a factor in the target community's comparatively ready acceptance of them (Grafton 2005 b).

In order to achieve its environmental objectives, an agency running an auction must be able to:

- Define and measure the environmental goods and services, or proxies for those goods and services, that the auction is designed to procure (for example, through an environmental benefits index);
- Model or estimate the anticipated result that a management action will have;
- Write efficient contracts for the environmental goods and services involved, so that the government becomes an "intelligent purchaser" and landholders become "competitive suppliers;"
- Monitor and enforce the contracts transacted in the auction.

(Australian Government 2005)

Cap-and-trade mechanisms, for their part, can successfully meet their environmental objectives in the case of point sources of pollution or discharge that can be readily identified and monitored. Traditionally, they have not been used to address environmental problems that arise from diffuse sources, such as salinity, as the task of dealing with problems of that kind calls for certain and defined units of measurement. This could change with the development of new biophysical models and better scientific understanding of problems of environmental degradation, but at present, these limitations suggest that offsets or other alternatives may be preferable to cap-and-trade approaches in cases of pollution from many and diffuse sources (Grafton 2005 a).

Lastly, offsets are workable only within a regulatory framework by means of which environmental standards can be enforced. Without this, offsets must rely on voluntary actions that may not occur to the extent necessary to achieve the desired environmental outcomes (Australian Government 2005).

As we have seen, offsets offer an alternative to cap-and-trade mechanisms in cases where there may be "thin" markets, with few buyers and sellers, or considerable uncertainty over the impact of non-point sources on the environment. In addition, offsets may allow trading between point sources and non-point sources, something that would be difficult to achieve with a cap-and-trade approach. An increase in salinity from a point source, for example, might be allowed provided there was compensating remedial action elsewhere to control non-point sources, resulting in a net environmental improvement. Such offset approaches are certainly worthy of further study and trial, but are probably not yet ready for direct implementation (Grafton 2005 a).

1.1.4 Economic efficiency of the National MBI Pilot Program

The launch of the National MBI Pilot Program was motivated in part by a concern that existing programs were too expensive in relation to the environmental benefits they procured, i.e. that they were not cost-effective.

One of the principal reasons for using market-based instruments is precisely that they can be more cost-effective than traditional approaches to environmental protection. That is, they achieve a greater set of environmental benefits for a given budget (Grafton 2005). MBIs recognize that landholders "possess information, individually and collectively, that can be used to more effectively deliver desired environmental and natural resource management outcomes" (Grafton 2005). In particular, many landowners have a sophisticated knowledge of landscapes and markets and are willing to try innovative approaches that generate financial or other payoffs. In a word, in participating in market-based instruments, farmers provide relevant information that should lead to more cost-effective use of available natural resource conservation funds.

However, the cost-effectiveness of MBIs depends on a number of factors: the desired environmental benefit, the landscape where they are applied, differences in conservation costs between landholders, and the institutional structures of state or regional authorities (Grafton 2005 a). Unless all these conditions are fulfilled, the economic efficiency of MBIs may be dubious. Moreover, economic efficiency is variable depending on the type of MBI selected.

One finding that emerges from these pilots is that auctions, in particular, are clearly advantageous in terms of cost-effectiveness. On the supply side, an auction affords a means of reducing transaction costs, i.e. ensuring that environmental goods are produced at the lowest possible cost by placing landholders in competition with each other. Landholders submit assorted proposals for projects, some more costly than others, aimed at realizing various environmental benefits, and the auction takes these heterogeneous costs and outcomes into account.

At the same time, single-dimension auctions aimed at generating multiple environmental outcomes can be more cost-effective in that the total environmental benefit per dollar spent is maximized (Australian Government 2005). Among other things, transaction costs are lower with auctions of this type because a number of environmental issues are integrated within a single mechanism, so that the costs resulting from participation in a number of mechanisms simultaneously are avoided (Eigenraam et al. 2005, quoted in Australian Government 2005).

Cap-and-trade systems, for their part, derive their cost-effectiveness from the fact that landholders who face a high cost to meet their discharge targets can purchase the right to discharge from landholders who meet their targets at a lower cost (Grafton 2005 a). The end result is that the desired cap is achieved, but at a lower cost than would be the case if all landholders were obliged to achieve a uniform target.

Where environmental damage can be monitored or modelled as a point source, there are numerous examples of cap-and-trade systems that have proved to be more cost-effective than command-and-control, tax or voluntary approaches. However, this approach will work only provided a regulatory cap is set and enforced (Australian Government 2005). More precisely, there are several important requisites for the effectiveness of cap-and-trade mechanisms (Grafton 2005 a):

- Landholders must differ in terms of the costs of meeting their discharge targets; trading in a cap-and-trade system enables participants with lower costs (greater cost-effectiveness) to meet more ambitious environmental targets than those who are burdened with higher costs;
- There must be effective monitoring and enforcement to ensure that landholders do not discharge more than they claim and ambient measures can be recorded accurately;
- There must be a clear and understandable relationship between the amount discharged and the impact on the environment;
- The market for the right to discharge must be competitive so that the price of the rights reflects the marginal cost of reducing discharges;
- The cost of trading rights must be sufficiently low that it is worthwhile for most landholders to participate in the market.

Lastly, when assessing the effectiveness of an offsets scheme, it is essential to consider the transaction costs involved, as the Australian government report (2005) notes:

> *"The effectiveness of an offset system depends on the transaction costs involved. The transaction costs of an offset system depend largely on the system chosen to match offset demand with supply. The choice of matching system can vary considerably, and may need to take into account such important factors as participant numbers, the ability to use science and modelling to accurately represent the environmental outcomes involved, stakeholder awareness of the issue, and the ability to link offsets with other MBIs." (Australian Government 2005)*

In general, the relative cost-effectiveness of the several market-based instruments does not emerge clearly from analysis of the pilots. In that connection, Grafton (2005 a) suggests that in a future round of pilots it would be useful to test the effectiveness of mixed policies, such as instruments that were simultaneously price-based (auctions) and quantity-based (offsets). An auction might be used to identify participants in an offset scheme, for example, while supply and demand for the latter could be created by a cap-and-trade approach (Australian Government 2005). A mixed policy instrument might prove more cost-effective than a single type used in isolation. Grafton (2005 b) also notes that in the interests of cost minimization, MBIs must be appropriately tested before being implemented.

Training and enforcement costs

The implementation, training and enforcement costs associated with MBIs may be substantial. In the first place, MBIs may be costly to design, as are all agri-environmental policy instruments that call for the selection of eligible lands or determination of the degree of environmental degradation (salinity, erosion or the like) that needs to be addressed. This consideration applies to, in particular, the tasks of designing appropriate contracts in auction systems, establishing effective cap-and-trade mechanisms, or setting trading ratios between point and non-point sources with offsets (Grafton 2005 a and b).

As we have seen with other agri-environmental policy instruments analyzed in this study as well, the costs associated with the promotion of new measures are by no means negligible. The Australian pilots have shown that an effective communication strategy is essential to ensure landholder participation (Grafton 2005 a). Communication is critical with the cap-and-trade approach, which imposes penalties on farmers who continue to apply their current management practices, rather than offering them rewards for adopting new ones. Accordingly, it is essential to win participants' confidence. This suggests that cap-and-trade approaches are likely to take longer to implement than auctions and other systems (Whitten et al. 2005). Indeed, it appears that auctions are already viewed as an acceptable alternative to conventional approaches (Grafton 2005 a).

Furthermore, as noted earlier, MBIs need adequate testing prior to implementation. Although the economic theory underlying MBIs is well developed, the details of how to apply the mechanisms must be adapted and tailored to the landscape, environmental problem and institutional capacity in any given case (Grafton 2005 a, b). The pilots show that the use of experimental economics in laboratories, workshops and field trials are all useful ways of testing MBIs and adapting them to particular circumstances (Grafton 2005 a). Field pilots are costly as a rule, and consequently it is preferable to begin by assessing MBIs' potential for success by means of experimental economic analysis. In addition, training sessions may be a less costly approach to environmental objectives in some cases than a field pilot (Australian Government 2005).

Once MBIs have been developed, it is essential to ensure that participants' actions are adequately monitored and compliance enforced, and this gives rise to costs. Grafton (2005 a) argues that simply creating a market for conservation action is not sufficient; considerable regulatory oversight is required to ensure that MBIs are effectively implemented. In the case of a cap-and-trade mechanism, for example, a regulatory framework is essential to ensure that the cap is not exceeded.

1.1.5 General summary of the National MBI Pilot Program

A number of general conclusions can be drawn from the National MBI Pilot Program. Grafton (2005) concludes that auctions, cap-and-trade mechanisms and offsets can be used successfully to address a wide variety of environmental problems. According to this author, auctions are substantially more cost-effective than conventional natural resource management methods. Conservation insurance, however, has performed much less impressively.

Grafton (2005) also finds that if MBIs are to be successful, they require good biophysical modelling and a regular system of monitoring of outcomes and landholder actions. Furthermore, MBIs can be cost-effective only provided they are adequately tested prior to implementation, and a communication strategy must be developed in order to maximize participation. Lastly, MBIs must be adapted to address specific environmental problems in the environmental and socio-economic contexts in which they are implemented.

Round 1 of the program has left a number of unanswered questions, and it would undoubtedly be of interest to explore these in Round 2. In the case of auctions, for example, it would be useful to try to determine whether separate auctions are required for each environmental issue, or whether a single auction can be utilized for a combination of environmental outcomes. Another important question is whether it would be preferable to specify contracts defined by environmental outcomes rather than management actions. The second round of pilots could also be used to compare the environmental effectiveness of price-based and quality-based MBIs. Yet a further possibility might be to explore the matter of whether the use of a number of MBIs in combination would be advantageous from the standpoint of costs.

Grafton (2005) offers some interesting recommendations for Round 2 of the program. In the first place, another pilot on offsets would be a useful means of exploring the feasibility of trading between point and non-point sources and investigating the question of how offset banks might be utilized. In the second place, the pilot selection process should take into account differences in landscapes and the capabilities of catchments and conservation authorities. In the third place, funding should be provided for the purpose of establishing a technical committee to improve the technical reporting from pilots and to ensure that they provide answers that will help to fill identified knowledge gaps in a timely manner.

APPENDIX 4.9.A SUMMARY OF ENVIRONMENTAL VALUES AND THREATS CATCHMENT CARE

Environmental Values	Threats	Description
Geomorphology	Bed Instability Bank Instability	▪ Value is described by rarity, intactness and the role of the stream form in catchment wide ecological processes. It is measured in terms of stream style category. The stream style category is an indicator of the reach's capacity to change. ▪ In this project the impact of bed and bank erosion is seen to be the most useful and easiest measure of threat for this assessment process and threats are often of a nature and size that can be tackled by landholder actions.
Hydrology	Dams and Off-Takes	▪ Undisturbed natural base flow is considered to be healthy and valuable. Threats are defined as the presence of water storages and of artificial discharges affecting the flow of stream water.
Remnant Vegetation*	Patch Size Invasive Weed Presence Weed % Cover Grazing Pressure	▪ Value is described by presence of remnant native riparian vegetation, its conservation significance, condition, and connection to other stands of remnant vegetation. These characters are particularly important for creating biodiversity corridors in the Board's catchments. ▪ Level of threat is indicated by the presence of factors such as percentage and type of weed infestation, absence of fencing from stock, size of the remnant.

* Note that the Remnant Vegetation environmental value is not scored directly but is calculated as a weighted sum from the Conservation Significance, Condition and Landscape Connectivity characters.

Source: Brett et al. 2005.

APPENDIX 4.9.B OFFSET PROGRAM: IMPLEMENTATION COSTS AND ANNUAL OPERATING COSTS

Program development activities	Cost (A$)
Initial licence and pollution reduction program negotiations with EPA	5,000
Scoping of available modelling, initial and supplementary modelling	5,500
Assessment of available lands for use changes and definition of their current condition	5,500
Design and set-up of monitoring regime	150,000
Negotiation and implementation of offset program land lease arrangements/changes	755,000
Total	**921,000**

Note that over 80.0% of these transactions costs were a result of the decision to change lease arrangements on the offset lands.

Source: NSW Environment Protection Authority, 2005.

Ongoing activities	Cost (A$/year)
Ongoing licence and PRP negotiations with EPA	500
Annual implementation and maintenance of land-use changes	73,000
Annual running costs of monitoring	20,000
Total	**93,500**

Source: NSW Environment Protection Authority, 2005.

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