USING CONSERVATION TENDERS FOR WATER QUALITY IMPROVEMENTS IN THE BURDEKIN RESEARCH REPORTS

Identifying scale and scope issues in establishing conservation tenders

RESEARCH REPORT No 1.

John Rolfe, Romy Greiner, Jill Windle and Atakelty Hailu

August 2007

Using Conservation Tenders for Water Quality Improvements in the Burdekin Research Reports are published by the Centre of Environmental Management, Central Queensland University, Rockhampton, 4702.

These reports represent the provisional findings of a research project titled ***'Optimising the efficacy of conservation tenders under varying degrees of heterogeneity: Achieving water quality improvements in the Burdekin Dry Tropics across different management actions in different agricultural production systems and different parts of a river basin'.***

The project is being funded by the Australian Government through the National Market Based Instruments Program, with additional support provided by the Burdekin Dry Tropics Natural Resource Management Group. The project is being conducted as a partnership between Central Queensland University, River Consulting, the University of Western Australia and the Burdekin Dry Tropics Natural Resource Management Group.

Any comments will be gratefully received and should be directed to Professor John Rolfe or to Dr Romy Greiner:

Professor John Rolfe
Centre for Environmental Management
Central Queensland University
Rockhampton, 4702
j.rolfe@cqu.edu.au
(07) 4923 2132 (ph)
(07) 4930 9156 (fax)

Dr Romy Greiner
River Consulting
68 Wellington St,
Townsville, 4812
romy.greiner@riverconsulting.com.au
(07) 47752448
(07) 47286436

1. Introduction

The aim of this report is to provide some theoretical and policy context to the issues involved in setting the scope of conservation auctions, and to outline the methodological steps that will be used to test those issues in a project setting. There is growing interest in Australia in the use of market based instruments (MBIs) to achieve environmental outcomes (Grafton 2005). Conservation auctions, such as the BushTender program described by Stoneham et al. (2003) are a price-based MBI that can be used to allocate public funds. These mechanisms are being trialled in Australia, but a number of questions remain about the most efficient ways to structure their design and application. This research project is funded under the second round of funding for the National Market Based Instrument program to address some of those issues.

The context in which this research will be conducted is to prepare auction/tender design principles for use by natural resource management (NRM) groups across Australia across different industries and policy issues. The research to be conducted will involve some theoretical analysis, experimental workshops, the development of agent based models, and a series of linked on-ground trials to test different mechanisms in real life. The purpose of the trials is to analyse how auction and contract design issues vary in competitive tenders applied across different agricultural production systems and parts of river basins. The key issue to be addressed is whether competitive tenders are more efficient when they are tightly focused on specific areas, industry group and the type of actions, or when they are broader in scope and allow more participation.

The case study will be conducted in the Burdekin Dry Tropics region in North-east Queensland, which combines tropical savanna grazing lands with coastal floodplains. The agricultural production systems applicable in this region are extensive beef cattle grazing and intensive farming enterprises – based predominantly on irrigated sugar cane, and in the fringe areas some combinations of both. The activities of both industries cause non-point source pollution and contribute to water quality problems in the Great Barrier Reef lagoon (Productivity Commission 2003). The region is subject to a NRM plan which stipulates the extensive use of incentives to support landholders adopting management actions to achieve end-of-catchment water quality improvement. If competitive tenders were adopted as a key incentive, a key question would be whether a single large-scale tender should be run across the region, or whether multiple small-scale tenders should be used to recognise for industry and regional variations.

In theory, levels of competition between landholders submitting bids and subsequent efficiency of the use of public funds will be enhanced if broad scale tenders can be run because they exploit heterogeneity between landholders. The more landholders included in a conservation tender, the more likely that lower cost bids are submitted and selected. However, this efficiency benefit may be outweighed by the additional transaction costs of designing, implementing and managing more complex schemes in comparison to applying smaller scale tenders that are industry and area-specific and therefore much simpler to apply. In addition, larger scale auctions might reduce participation levels and influence bidding patterns.

The developing interest in competitive tender mechanisms by NRM groups and catchment management authorities (CMAs) in Australia means these are increasingly likely to be trialled and used as mechanisms to allocate public funding for landholder conservation activities. However, much of the auction design literature is focused on relatively homogeneous assets, such as those for radio spectrum allocations, and a fixed number of relatively homogeneous or symmetric players (Klemperer 2002). In reality, conservation auctions are going to involve players that are more diverse and behaviourally richer than envisaged by the theory. Theoretical predictions are highly sensitive to model assumptions especially those relating to informational structures (Rothkopf and Harstad 1994; Klemperer 2002). Additional approaches such as experimental studies and agent-based modelling approaches may help to improve understanding of the potential performance of alternative auction designs for more realistic settings.

The knowledge gained from this project will help to understand the potential problems associated with auctions where there is substantial enterprise, geographic, climatic and industry variability involved, and how this may be incorporated into design and assessment processes. The expert design process will provide a mechanism for finetuning auction design as better information from theory, experimental, trial, and practical sources becomes available, providing a tool that CMA/NRM groups can use to design the appropriate scale of conservation tenders. The potential incorporation of administrative and transaction costs into the assessment of the efficiency of conservation tenders will allow a more complete appraisal of the potential efficiency of these mechanisms.

A strategic benefit of this type of work is that it will help to avoid potential problems or pitfalls in the applications of competitive tenders, and ensure that public funds are used efficiently. By recognising at the design stages that there are tradeoffs involved in setting the scale and scope of a tender mechanism, decision makers in NRM groups will be more aware of the potential problems in the application of a competitive tender, and make more informed decisions about the desired structure and design of a mechanism.

This report is structured in the following way. In the next section, the issues to be addressed are outlined in more detail, followed by an overview of lessons available from previous case studies in Section Three. The case study area of interest is outlined in Section Four, and a brief description of the methodology to be employed in the project is provided in Section Five. Some brief conclusions follow in the final section.

2. Conceptualising the Issues

Conservation auctions such as the Conservation Reserve Program (CRP) in the United States (Kirwan *et al*. 2005) and the BushTender program in Australia (Stoneham *et al*. 2003) have been used to identify landholders who can provide on-farm conservation and biodiversity protection actions at lowest cost. Under the programs, landholders are invited to submit tenders specifying their proposed actions and compensation (bid) levels, and a subsequent evaluation process identifies the biodiversity benefits involved and the most cost effective proposals. Use of these mechanisms reflects growing interest in the adoption of market-based instruments to improve natural resource management and environmental outcomes (Latacz-Lohmann and van der Hamsvoort 1997, 1998; Cason and Gangadharan 2004).

Competitive auction mechanisms have two theoretical advantages over fixed rate conservation payments. Auction prices are more likely to reflect the marginal value of the resources being used to produce the good or service, and as the mechanism introduces an element of competition between producers, the scope for rent seeking behaviour is reduced (Latacz-Lohmann and van der Hamsvoort 1998). These advantages mean that competitive bidding, as compared to fixed rate payments, can significantly increase the cost effectiveness of conservation contracting on private land (Latacz-Lohmann and van der Hamsvoort 1997, 1998).

Conservation auctions can be designed at varying levels of scope and scale. Issues of scale relate to the size of a program, where the proportion of fixed administration and operating costs tend to reduce as the funding level increases. Issues of scope relate to the coverage of a program across geographic and industry types. In some cases, issues of scope may also relate to coverage over institutional and political boundaries. There is often jointness in scale and scope issues, with larger scale programs often encompassing increased scope. However, scope and scale are not necessarily intertwined. For example, some programs may be large scale but narrowly scoped, while others may have a broad scope but a small budget.

Competition is enhanced when the scale and scope of a tender is larger, because there are more potential participants in an agricultural region. Some mechanisms, such as the Conservation Reserve Program in the United States, have a broad scope so as to increase participation, give near-universal access for equity purposes, and generate administration efficiencies (Kirwin et al. 2005). However, a broadly scoped tender comes at a cost. Because they may encompass multiple agricultural sectors, different geographic areas and a variety of potential actions, it is more difficult to target specific outcomes without generating substantial design complexities. For these reasons, competitive tenders in Australia have tended to be more targeted, often focused on specific areas (e.g. catchments), industry types (e.g. broadscale agriculture) and actions (e.g. protection of native vegetation).

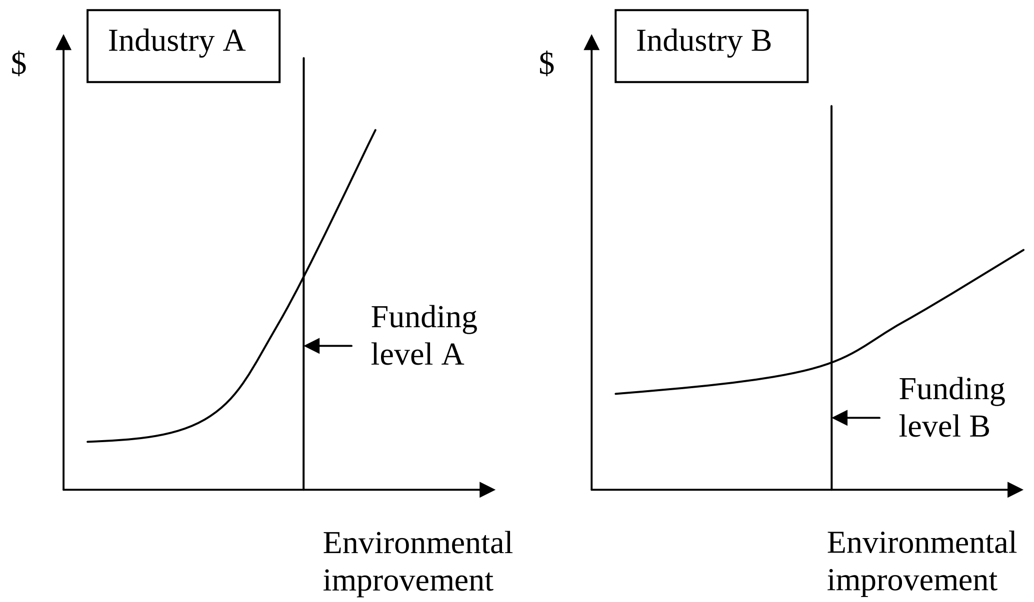
NRM groups choosing to implement competitive tenders have to consider how broad to scope the tender and what scale of activities should be targeted. However, there is little available information to guide this choice. Many of the conservation auctions run in Australia, such as the Victorian BushTender program (Stoneham et al. 2003) or the first-round MBI pilots (Grafton 2005) have tended to focus on one type of bioregion and one set of conservation objectives, eg. biodiversity conservation, without a clear explanation of why the scope and scale of application has been limited. Here, the issues involved in establishing the scale and scope of a conservation program are reviewed.

The key benefits of holding smaller scale auctions are that the risk of failure or some mis-allocation of funds are lower, implying that the design and allocation stages may not need to be as rigorous. The key benefits of having narrowly scoped auctions are that the design and assessment processes tend to be simpler, and that the number of issues and stakeholders to engage with are minimised. Other potential benefits are that it may be easier to target issues or equity outcomes specific to industries or regional areas. These are key reasons why many of the trials for conservation auctions have been exploratory in nature and relatively narrow in terms of scale and scope.

However, there are also a number of challenges in running a number of auctions that are narrow in scale and scope. The first is that it may be very difficult to allocate an appropriate level of funding to each program to generate efficient outcomes. In economic terms, efficiency will be reached when the marginal cost of achieving an environmental outcome is just equal to the marginal benefit gained, and that these costs and benefits are equivalent across allocation tasks. This latter condition ensures that further efficiencies can not be gained by reallocating funding between tasks.

The allocation problem can be illustrated with the aid of Figure 1, where the opportunity costs of generating environmental improvements in two different industries are represented. The diagrams represent ascending bid curves for landholders in Industries A and B to generate a supply of environmental services. The variations in opportunity costs between industries means that the supply functions have very different shapes.

Figure 1. Opportunity costs separately by industry

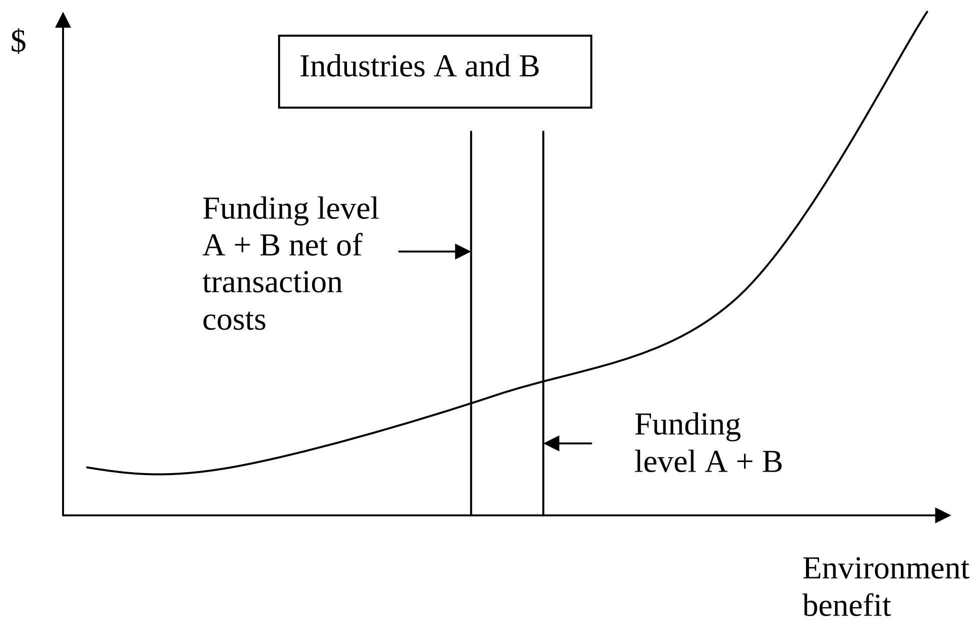


Because the potential supply of environmental services is difficult to predict before a conservation auction is run, it is very unlikely that funding can be allocated so that the last bids funded delivers equivalent costs per unit of environmental benefit. This means that separate conservation auctions will always differ in the efficiency of outcomes because the allocation issues.

A second problem with individual conservation auctions is that the metric developed to assess the bids in each case study tends to be unique, making it difficult to draw comparisons between different case studies. Variations in scope and the heterogeneity in different case studies tend to create differences in auction design, contract design and metric design, even where the same underlying environmental benefits may be targeted. This heterogeneity in smaller scale conservation auctions disguises many allocation problems because the cost-effectiveness of outcomes is not easily compared.

There are potential efficiencies in running a single auction, where the bids are combined into a single opportunity cost curve. This ensures that there is more consistency in the funding for environmental improvements across industry, and that there are not differences in the investment for the last unit of marginal benefit gained. The allocation problems are minimised, as increasing the scale and scope of conservation auctions helps to ensure that more actions are available for a given level of funding. These benefits are shown in Figure 2, where the potential bids from landholders across two industries are combined into a single bid function.

Figure 2. Opportunity costs jointly across industry



In this simple example where no changes in transaction or administration costs are considered, the benefits of combined conservation auctions into a single auction with one funding pool are information gains from having a consistent design across both industries and efficiency gains from the improved allocation of funds. Increasing the scale and scope of conservation auctions should help to ensure the allocation of public funds for environmental purposes.

There may be different cost structures associated with increasing the scale and scope of conservation auctions. At one level, administration costs may be streamlined by having only a single auction to organise and perform. However, there may be a range of different administration and transaction costs to consider when moving to more consolidated auction formats. Transaction costs relevant to NRM issues can include additional engagement, negotiation, institutional and compliance costs associated with changing management practices by landholders (McCann et al. 2005). Key administration and transaction costs to consider in larger scale and scope auctions include:

- political economy costs of dealing with a wider range of interests across institutional boundaries,
- transaction costs of designing a conservation auction with a range of different stakeholders and partners,
- transaction costs of engaging and negotiating agreements with a wider range of landholders,
- auction design costs associated with more complex contingencies such as varying engagement rates and the setting of reserve prices,
- contract design costs associated with more complex contingencies such as setting performance indicators and monitoring conditions across different industries,
- metric design costs associated with achieving increased preciseness of information and dealing with a wider range of potential actions and environmental improvements,
- The effect of larger scale auctions on incentives, including effects on participation and engagement rates, and crowding-out and crowding-out impacts on voluntary conservation efforts and attention to duty-of-care.

For the purposes of this discussion paper, these varying impacts are consolidated together as transaction costs. The implication of this framework while a number of issues can be identified relevant for determining the scale and scope of conservation auctions, these can be summarised into two key considerations:

1. The efficiency gains associated from holding larger scale and scope auctions (or the efficiency losses associated with smaller ones),
2. The change in transaction costs (including administration costs) associated with holding larger scale and scope auctions.

In many case studies, these influences are likely to be offsetting, helping to explain why there is some uncertainty about the appropriate levels of scale and scope to set in conservation auctions. Transaction and administrative costs of running tenders are likely to be lower when there is homogeneity between bidders, where proposals may need to be assessed from the same types of landscapes and the same type of industry. The implications for auction design and metric design are that homogeneity between bids means fewer factors need to be included and evaluated. However, in terms of economic efficiency of the instrument, increasing the pool of potential bidders is likely to bring advantages in terms of increased competition and greater diversity in opportunity costs. A summary of the potential influence of different factors according to the scope of conservation auctions is provided in Appendix One.

3. Lessons from other case studies

The first, most notable and largest of conservation tenders has been the Conservation Reserve Program (CRP) implemented by the United States Department of Agriculture. A total of 36.4 million acres nationally (10% of each state's total crop land and 25% of the country's total crop land) meets the qualification requirement under the scheme (Vukina et al. 2003). The scheme currently enrols about 10% of the country's crop land (under 10-15 year contracts) with an annual budget of about $US 1.6 billion (Feng et al. 2006). The scheme has increased in both scope and scale since inception in 1985 and there has now been over 20 signup periods. While the initial focus was simply to retire land from production as a means of controlling supply and reducing soil erosion, the objectives have since been extended to include conservation management on working land. After the 1990 Farm Bill an Environmental Benefits Index (EBI) was introduced into the assessment metric and redefined in 1996 as the sum of six very broad environmental factors:

- Wildlife habitat benefits
- Water quality benefits from reduced water erosion, runoff, and leaching
- On-farm benefits of reduced wind or water erosion
- Long-term benefits of cover such as trees, likely to be maintained beyond the contract period
- Air quality benefits from reduced wind erosion
- Benefits from enrolment in conservation priority areas and addressing the resource concern of the area.

(Hoag 2004).

While the CRP has been adjusted over the years to ensure the increased provision of environmental outputs, the broad scale and scope of the program means that it is difficult to achieve specific environmental outputs and even harder to assess the environmental outcomes. There are two key problems. The first is that the CRP has multiple objectives, including those relating to supporting farmers and agricultural and social policies. This may limit the focus and prioritisation of environment outcomes. Farmers submitting bids have been found to be largely indifferent to generating benefits which resembled public goods such as air quality and wildlife habitat (Miranda 1992; Vikuna *et al.* 2003).

The second problem is that the assessment criteria are limited and simplistic, with a linear relationship typically assumed between project outputs and environmental outcomes. Such an assumption ignores the biophysical heterogeneity of individual farms (Ferraro 2004); the impacts of threshold effects (Wu and Skelton-Groth 2002); biodiversity complementarity (Faith et al. 2003) or any other interaction between the environmental attributes. This suggests that the broad scope and scale of the CRP generates inefficiencies in both the bid nomination and bid selection processes.

A similar situation occurs in the European Union where very broadscale national stewardship schemes are implemented and the environmental focus is one of "additionality"[1], which does not necessarily provide optimal environmental outcomes. An environmental audit of five European agri-environmental schemes found that in

[1] The quantity of different environmental benefits involved (Boatman *et al.* 2004).

all countries the schemes had marginal to moderately positive effects on biodiversity. However, uncommon species benefited in only two of five countries and species listed in the Red Data Books rarely benefited from agri-environmental schemes (Kleijn et al. 2006).

In Australia, since the successful implementation of the BushTender trial in Victoria (Stoneham et al. 2003), there have been a number of trials of conservation tenders. Most of these have been relatively small scale and implemented at the sub-regional level. They have included trials implemented under:

- the National Market Based Instruments Pilot programs (MBI trials) e.g., Bryan et al. (2005); Cole et al. (2005);
- the National Action Plan for Salinity and Water Quality State-level Investments Program (NAP trials) in Queensland, e.g. Windle and Rolfe (2006); and
- the initiative of regional and sub-regional NRM groups/Catchment Management Authorities, e.g. Windle et al. (2007).

The success of these trials has been evaluated on a range of different criteria depending on the reporting requirements of the funding agencies, the stated objectives of the implementation trial and/or the objectives of the implementing agency. In most cases the trials were focused on the initial implementation of a new MBI management tool, rather than developing the mechanism in any way. All these trials have been small scale and usually focused on a specific environmental issue of local concern. They have generally had limited funding to allocate in incentive payments and there have been no reports of any adverse findings.

In contrast, the implementation of a large scale state-wide trial, the Vegetation Incentive Program (VIP) in Queensland, was more complex and a number of limiting factors have been identified (Comerford and Binney 2006). To address some of the complexities, attempts were made to limit the scope of the project with a three-stage phased roll out which targeted different regions across the State in turn.

Another approach to implementing large scale state-wide conservation tenders has been the EcoTender model in Victoria. The project was initially designed in a MBI trial (Eigenraam et al. 2006) and then developed for implementation at the State level by regional CMAs. The EcoTender approach has been the first attempt at designing a more generic model, in contrast to the ad hoc approach of the small scale trials. The approach is underpinned with sophisticated biophysical modelling that can readily be used to expand the scope of the conservation auction to include multiple environmental outcomes.

One of the main benefits of large scale schemes is the process of standardisation has the potential to reduce administration and transaction costs (Falconer and Whitby 2000). The use of biophysical modelling and the development of a Catchment Modelling Framework in EcoTender were found to significantly reduce the transaction costs associated with accurately determining the environmental outcomes of a specific project (Eigenraam et al. 2006). However, the potential cost efficiencies of large scale operations are not guaranteed. Conservation tenders run by large government organisations and/or interdepartmental associations such as the Environmental Services Scheme in New South Wales (Grieve and Uebel 2003) may be prone to the use of excessive process and bureaucracy which can increase administration costs. Similarly, there is some indication that large scale schemes may incur higher transaction cost, particularly if they are implemented through a third party. This was the case with the VIP in Queensland where the State Government contracted Greening Australia to implement the program (E. Comerford pers. comm.).

One of the substantial costs involved in a conservation tender is the expertise needed to design the tender and assessment process. The MBI trials conducted in Australia have tended to be resourced with a high level of skills and expertise that would not normally be available or affordable for small scale implementations. Similarly, resource support was provided to the NRM groups in Queensland to engage design experts in the NAP trials. While these implementation trials were very ad hoc in nature they built capacity and understanding within NRM groups to expand their use of conservation auctions.

Given the resource constraints of regional NRM groups in Australia, the implementation of small scale conservation tenders has obvious benefits, such as:

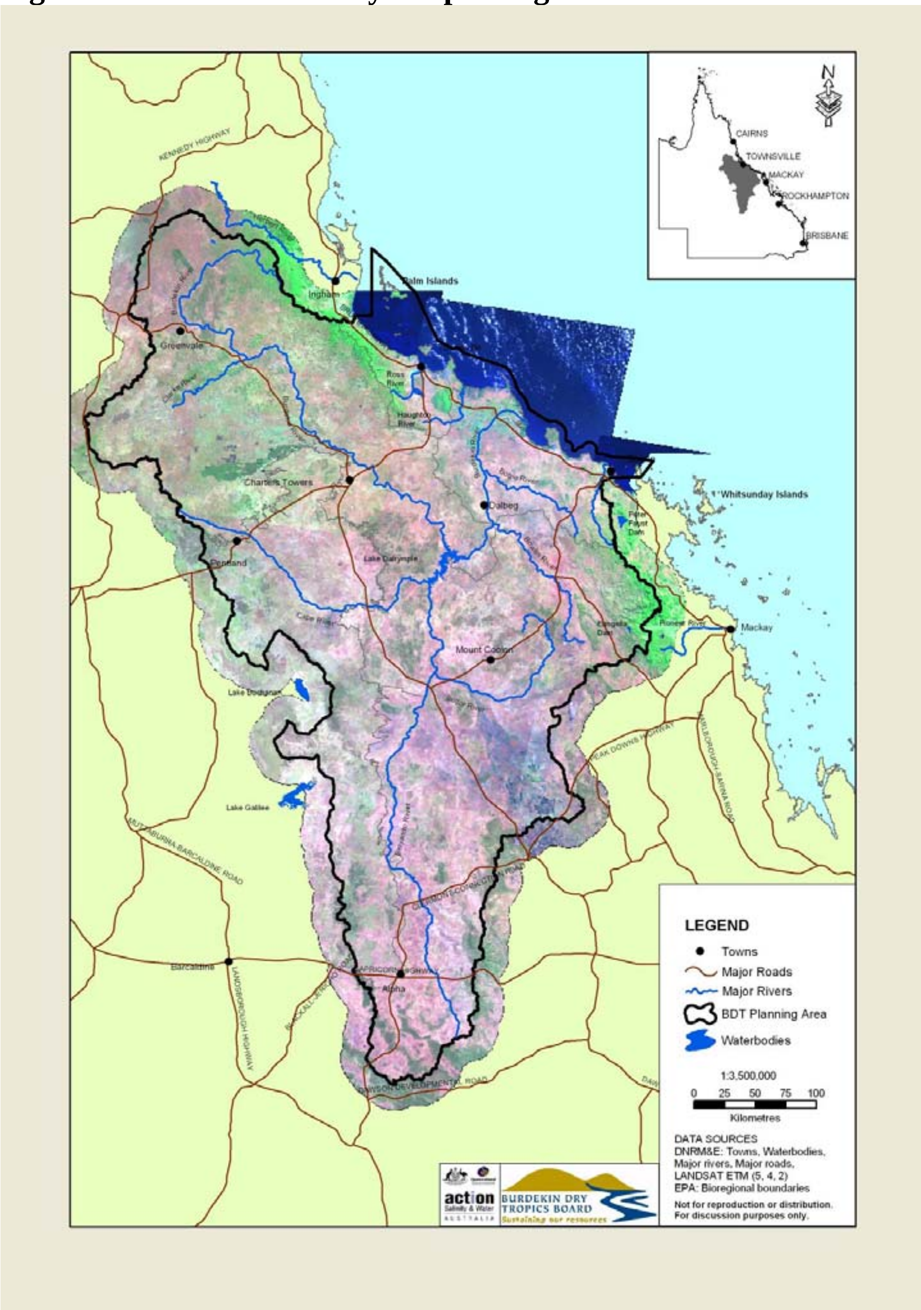
a) Small scale tenders can be implemented in a similar fashion to the more familiar developed grant schemes.
b) NRM groups are closely aligned and work in cooperation with their stakeholder groups, which can favour the use of specifically targeted schemes.
c) Groups generally favour a mix of incentive tools and approaches, where smaller scale conservation tenders can be integrated with other regional programs.
d) Small scale conservation tenders may be easier and less risky to implement when design and implementation skills are limited.

However, NRM groups are becoming more institutionally robust and many are developing more effective partnerships with other organisations. These developments in capacity overlay with increasing requirements for NRM groups to demonstrate consistency and efficiency in achieving environmental outcomes. In these circumstances, there is potential to implement more complex and larger scale conservation tenders.

4. The case study region

The pilot will take place in the Burdekin Dry Tropics (BDT) NAP region.
The BDT region (Figure 1) is one of the largest NAP regions with an area in excess of 133,432km^2 (approximately twice the size of Tasmania). Its geographical location is North-east Queensland, and it combines tropical savanna landscapes with coastal floodplains. The dominant agricultural production systems are extensive beef cattle grazing and intensive farming enterprises, with the latter based predominantly on irrigated sugar cane. In the fringe areas there are some combinations of both extensive and intensive agricultural systems.

Figure 1. The Burdekin Dry Tropics region



The Burdekin basin forms part of the Great Barrier Reef (GBR) catchment. It is one of two key exporters of sediments, nutrients and other water-borne substances into the GBR lagoon (the other one being the Fitzroy basin), which almost exclusively originate from non-point source processes. Water quality and quantity have been identified as a central issue for the BDT region and the severity of water quality degradation is high. Existing impacts and potential risks to downstream systems, coastal and floodplain wetlands (including Ramsar wetlands), groundwater aquifers, irrigation and water supply, and the GBR World Heritage Area have been documented (Roth et al, 2002). Causes for the degradation include inappropriate grazing management, specifically excessive stocking rates, nutrient contamination from farming, altered flow regimes and aquatic weeds.

In the Burdekin Dry Tropics NRM Plan, end-of-catchment water quality objectives form a key set of the resource condition targets identified (BDTB, 2005a). The BDT-NRM Plan identifies incentives as a key strategy for supporting the implementation of management actions, which are designed to achieve the resource condition targets in relation to water – and ultimately the associated aspirational targets defined in the NRM Plan. For example management action target (MAT) SWW1.2.ii reads "support the protection and enhancement of riparian and wetland areas through extension and financial support for on-ground works" while SWW3.1.1.ii and SWW3.1.2 stipulate extension and financial support as incentives for riparian fencing and rehabilitation and de-fragmentation of freshwater wetlands and lagoons. The Regional Investment Strategy (RIS) identifies an investment of $2.88 million over three years to June 2007 for the achievement of surface water and wetlands targets (BDTB, 2005b).

Improvements in water quality can often involve a range of different activities across different regions. Changes in grazing management and farming systems, rehabilitation of riparian areas and wetlands, reductions in fertilizer use, and the implementation of storm water management systems are all important activities that can improve downstream water quality. However, the effectiveness of these actions can vary across systems and geographic zones. As well, the outputs are difficult to assess in a single metric. The outputs may involve reductions in sediment, nitrogen and phosphorus outputs, as well as changes in biodiversity condition.

Extension and financial support are two broad categories of incentives – or two types of instruments within an "incentives tool-box". To ensure that the management action targets are achieved, incentives need to be tailored to the specific situations and contexts where intervention is deemed necessary. Achieving targets for improved wetland condition and (surface) water quality reduced pollution requires the participation of landholders, who are often reluctant to change land use and/or land management practices for a number of reasons, including financial, operational and personal. A suite of incentives is required to address the various barriers to adoption that land holders encounter. To enable the best choice of incentive instruments, the NRM Plan clearly identifies a need to evaluate existing and alternative incentives schemes in MAT ME3: "Evaluate existing and alternative investment models for delivering landholder incentives and determine appropriate models for the region".

The BDT region is also serviced by the Coastal Catchments Initiative (CCI), which is an Australian Government program that seeks to deliver significant targeted reductions in the discharge of pollutants to agreed hotspots, including the GBR catchment. The CCI Project is supporting the development and implementation of a Water Quality Improvement Plan (WQIP) for the BDT region. It is likely that many projects for water quality improvements will leverage funds from both the CCI and the BDT-NRM plan.

The proposed pilot will value add to existing BDT-NRM and CCI activities. It is specifically intended to support the achievement of a number of management action targets and resource condition targets identified in the BDT NRM Plan. The pilot will inform the choice and design of incentive mechanisms that will encourage landholders – both graziers and farmers – to adopt recommended land management practices leading to water quality improvements. While there is a focus on the achievement of water quality improvements, it is acknowledged that many activities which improve water quality (eg. riparian vegetation restoration and management) also aid the achievement of other environmental objectives, for example in the area of biodiversity conservation.

Greiner et al (2003) identified a significant level of interest by landholders – across the catchment and a variety of industries – in market-based incentives to support the implementation of NRM practices on farms. Mackenzie et al (2004), based on a review of existing incentive programs provided for NRM across Queensland, suggest that the Burdekin – specifically the Lower Burdekin – could be a fitting location to trial auction-based financial incentives given the generally strong financial performance of farms in the region and the business acumen of many landholders, who tend to embrace debt-based strategies to maximise wealth generation.

5. Methodology design and implementation

The key challenge of this project is estimating whether a broad-scale conservation tender may generate net economic efficiency gains over a single industry tender. Three broad approaches have been developed to test these issues, and these are outlined below.

5.1 Case study evaluation

A case study application of conservation tenders across two industries will be one methodological approach to testing the issues of interest. In the case study example, this involves consideration of a joint grazing-intensive farming tender compared to separate grazing and intensive farming tenders. In developing the tender design, the crucial requirement is to develop a way of comparing the application of conservation tenders across industries. Two approaches are available for this purpose:

> Option A: conduct a combined tender, and evaluate the results of the separate industry components in comparison to the overall tender outcomes.
>
> Option B: run multiple tenders in parallel, with one tender being a single industry tender and the other being a combined tender involving more than one industry.

The choice of approach is determined by a number of factors, most principally the financial scope of the tender, i.e. the pool of money that landholders are competing for. Option A can be run with a smaller funding pool whereas Option B requires a larger funding pool. In a methodological sense Option B offers a clearer test of the differences between two approaches because it involves a split-sample comparison between different scoped tenders.

The financial scope of the tender, set at $200,000 under the National MBI program would have enabled option A to be pursued with confidence. It was envisaged that at an average value of ca $10-20,000 per successful tender, there would have been available funding for possibly 15 successful bids. Assuming a success ratio of no larger than 1:3, up to 45 bids may have been generated for data assessment purposes.

However, following negotiations with the Burdekin Dry Tropics NRM, that organisation has allocated a further approximately $400,000 to the funding pool, making available a total of $600,000 for tender roll-out. This increased financial scope has enabled the research team to pursue option B and, potentially, more than double the anticipated number of data points available for analysis.

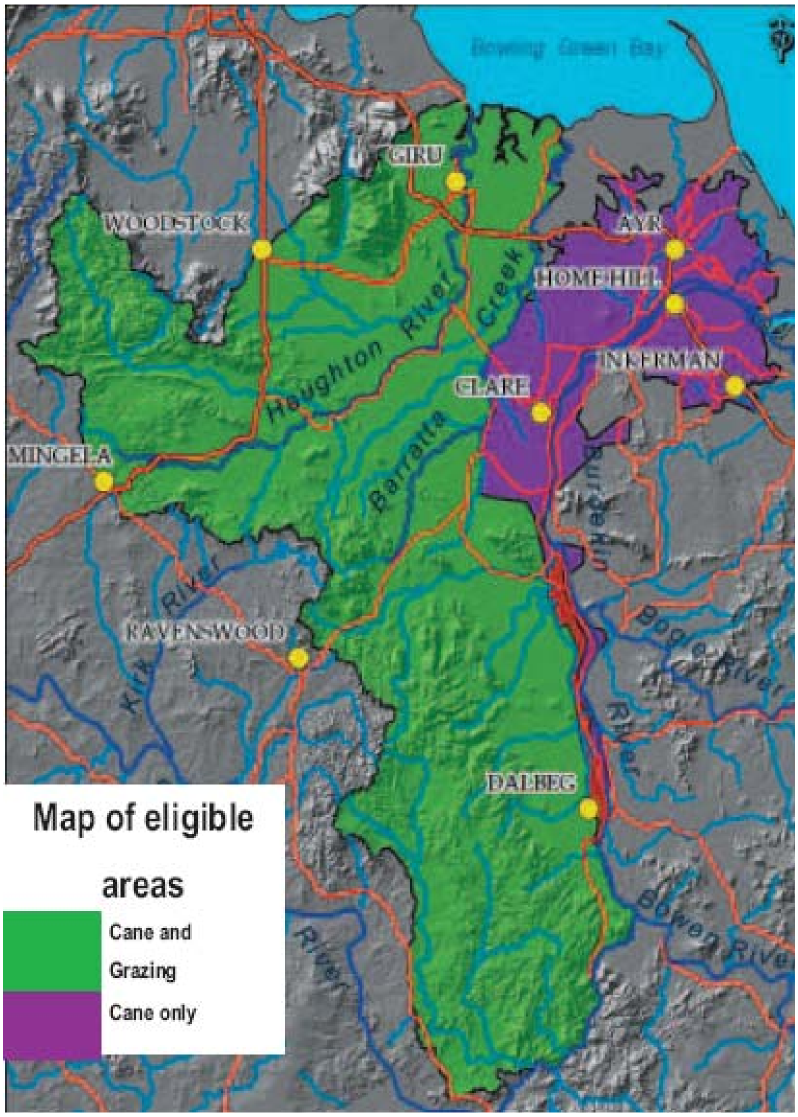
On this basis, the Lower Burdekin region has been divided into two investment areas (Figure 2). The criteria for the investment areas were based on hydrological boundaries as well as land use. The Lower Burdekin hydrological boundary formed the outer boundary of the region. The Barratta Creek riverine channel was used as a clear and unmistakeable demarcation line between the two regions. East of the Barratta Creek line contains cane growers only in the Lower Burdekin catchment. This area contains about three quarters of the total cane growing area in the Lower Burdekin. To the west of the Barratta Creek line contains the remainder one quarter of the cane growing area as well as the grazing lands in the Haughton and Reid River catchments and Barratta, Stone and Landers Creek catchments. The western region is larger than the eastern region, but has fewer landholders in it.

Each region will receive 50% of the total funding pool of the tender. The eastern region will involve only bids from cane growers, while the western region will involve bids from both cattle and cane enterprises. This will allow a direct comparison to be performed between differently scoped conservation auctions. The conservation auction will be performed in the latter half of 2008. It will be administered by the Burdekin Dry Tropics NRM Group, with support from the research partners and other stakeholders.

The conduct of the tender will allow two key efficiency issues to be analysed. The first relates to the potential efficiency gains available from increasing the scope of the auction. This will be addressed after the conduct of the tender by evaluating how different allocation systems would have affected the level of environmental benefits generated. For example, the available funding can be allocated by geographical area and industry, and then compared to the bids lodged in the auction. The level of environmental benefits generated from successful bidders in the different allocation programs can then be compared to identify relative efficiencies.

The second key test relates to the potential transaction costs involved in designing a broadly scoped as compared to a narrowly scoped auction. There are two main elements to this process. The first relates to the additional complexity involved in the design and negotiation process, where the number of stakeholders and level of negotiation involved provides some indication about the additional transaction costs generated in a broader tender mechanism. The second main element relates to the lack of preciseness in the bid selection and contract design process that may arise from developing generic process that suit different industries. This may cause more complex assessment, evaluation and monitoring processes, or generate inefficiencies in the bid selection process. These issues will be captured in the metric design process, where optimal designs for industry-specific conservation tenders can be compared to the design used in a combined tender process.

Figure 2: Lower Burdekin investment areas
(Source: map custom designed by Burdekin Dry Tropics NRM, 2007)



5.2 Experimental workshops

There are a number of possible sources of data that can be used to predict the behaviour of landholders and other participants in an auction process. Economic theory may provide a key starting point, but experimental economics, field trials, other conservation tenders, expert opinion and various other sources may provide insights into the likely behaviour of participants. Experimental workshops will be used to predict landholder behaviour in different auction settings as well to provide some realistic inputs into the parameters of the agent based modelling.

The use of experimental workshops was developed in the earlier auction trial by Rolfe et al. (2005a) in the Desert Uplands (MBI ID18). Similar workshops have been adapted for assessing water quality actions by sugar cane growers in the Mackay region, and have been reported in Rolfe et al. (2005b). The workshops involve actual landholders in the region of interest being given a ‘dummy’ property or farm map, and then identifying potential environmental improvement actions and the required bid amount needed. By varying the scenarios under which actions can be performed, and by comparing workshop results with different industries in different areas, some indication of variations in opportunity costs can be generated. The experimental workshops also have important advantages in testing metric designs prior to an actual rollout, and in helping to familiarise landholders with competitive tender processes.

Both experimental workshops and agent-based models will be enhanced by data predicting how landholders might tradeoff production goals to improve environmental outcomes. Bioeconomic models of grazing and farming activities can be adapted or developed for this purpose. Rolfe et al. (2005b) report the use of farm-level analysis and experimental workshops with the cane industry at Mackay, which provides some base level data about economic-environmental tradeoffs in the sugar industry. Additional data and models will be sourced from the Department of Primary Industries and the Bureau of Sugar Experimental Stations (BSES).

5.3 Agent-based modelling

The field trials and experimental workshops employed in the project will be complemented by a third auction evaluation approach – agent-based modelling. Agent-based modelling (ABM) is based on the use of computational experiments in which the players in the auction market are represented by software agents. Interest in ABM among economics researchers has been driven by the desire to make economic models more realistic through the incorporation of elements such as heterogeneity, learning, bounded rationality and interaction among economic agents (Tesfatsion 2002). The benefits of this method for the study of auctions are described and its complementarity with human experiments discussed in detail in Hailu and Schilizzi (2004). Recent studies applying ABM to the study of auctions include Andreoni and Miller (1995), Nicolaisen, Petrov and Tesfatsion (2001), Bower and Bunn (2001), Bunn and Oliveira (2001), Hailu and Thoyer (2006, 2007). Computational experiments provide an inexpensive way of thoroughly testing alternative market design rules.

The ABM experiments undertaken for this project will be structured using data from the field trials, surveys and experimental workshops. These data will provide the basis for the formulation of landholder participation levels, cost structures as well as for the design of the agent bid revision/learning rules. Computational experiments paralleling the field trials and experimental workshops will then be used to assess the robustness of observed auction outcomes to auction repetition, bidder learning, and variations in auction settings (e.g. varying competition levels, degrees of bidder heterogeneity, scale of auction, etc.). Further, the agent-based modelling will be used to test some auction design issues which are not explored in the field trials and experiments. This would primarily involve testing alternative payment rules for the auction (particularly uniform pricing of auctioned environmental services). The purpose of these additional experiments is to explore if alternatives to the currently predominant auction pricing format, namely discriminatory pricing, can deliver improve auction performance. Natural resource managers are likely to be interested in uniform pricing as it is perceived to be more equitable (equal pay for equal service) than discriminatory pricing.

6. Conclusions

There is developing interest and use in Australia of conservation auctions and other market based instruments to improve the efficiency of resource allocation to protecting environmental assets. A key stage in the establishment of a conservation tender is identifying the scale and scope over which it will operate. However, little attention to date has been paid to analysing what the tradeoffs might be between different options and how this decision should be made.

A review of conservation tenders shows very wide variation in the scale in which that they have been applied. Applications in Australia range from very small targeted projects at the sub-regional level to larger scale projects at the state level. Examples of larger programs exist in the United States and Europe. There have also been large variations in scope, with assessment metrics used to help evaluate proposals with very different types of environmental benefits. Given this potential diversity in the way that conservation auctions can be designed and applied, it is perhaps surprising that more attention has not been paid to designing the scale and scope of conservation auctions.

A number of standard economic concepts can be applied to the analysis of these issues. Increasing the scale and scope of a conservation auction should lead to efficiency gains because the pool of available choices increases, allowing funding to be applied to projects that deliver larger environmental benefits. However, this increase in scale and scope may be associated with higher transaction costs. The latter will be sensitive to a range of institutional, technical, social and other factors, helping to explain why the design of conservation tenders can vary so much between case studies.

While the tradeoff between efficiency gains and transaction costs helps to establish a framework for analysis of conservation auctions, it is not clear that these factors have been explicitly considered in the case study applications that have occurred to date in Australia. It is likely that the scale and scope of applications to date have been set by institutional and political considerations rather than by an economic analysis of the tradeoffs involved. There appears to be three key gaps relating to these issues for conservation auctions.

The first deficiency is that there is not an established framework for evaluating the choices about scale and scope issues. Governments and agencies that are considering the use of conservation auctions do not have a clear framework to follow when designing the extent of a conservation auction. This means that they may not be aware of many of the different tradeoffs involved.

The second deficiency is that no clear mechanisms are available to help governments and agencies to assess and evaluate the different tradeoffs. There needs to be more guidelines and tools available to help identify what the changes in benefits and costs will be with the adoption of different options. Some factors, such as elements of transaction costs, will always be difficult to quantify, but having a more definitive framework will help to develop a more rational approach to designing conservation auctions.

The third deficiency is that there is little available case study work to help guide governments and agencies with practical examples. The provision of some direct evidence about the tradeoffs between efficiency gains and transaction costs at a case study level will help a number of governments and agencies to ‘adjust’ the scale and scope of many applications without necessarily moving into a formal evaluation process.

The aim of this research project is to test a number of scale and scope issues associated with the conduct of a conservation auction. The research findings will help to address the deficiencies identified above, and will enable government agencies and NRM groups to identify the tradeoffs involved in scoping conservation tenders at different levels.

Acknowledgements

The design of the case study project has involved several staff from the Burdekin Dry Tropics NRM Group, particularly Diana O’Donnell, Scott Crawford, Ian Dight and Duan Biggs. Their help and input is gratefully acknowledged.

Additional support for the preparation of this report has been contributed by Clinton Muller.

References

Andreoni, J. and Miller J. H. 1995. Auctions with Artificial Adaptive Agents, *Games and Economic Behavior,* 58: 211-21.

Boatman, N.D., Deppe, C., Garthwaite, D., Gregory, S. and Jones, N.E. 2004. “Evaluation of the pilot entry level agri-environment scheme”, Final Report, Central Science Laboratory, Sand Hutton, York.

Bower, J. and Bunn, D. W. 2001. Experimental analysis of the efficiency of uniform price versus discriminatory auctions in the England and Wales electricity market’, *Journal of Economic Dynamics and Control,* 25: 561-92.

Bryan, B., Gatti, S., Connor, J., Garrod, M., and King, D. 2005 “Catchment Care – Developing an auction process for biodiversity and water quality gains”, Volume 1 – Report, National Market Based Instruments Pilot Project, July 2005, CSIRO, Land and Water.

Bunn, D. W. and Oliveira, F. S. 2001. Agent-based simulation: an application to the new electricity trading arrangements of England and Wales’, *IEEE transactions on Evolutionary Computation,* 5: 493-503.

Burdekin Dry Tropics Board (BDTB), 2005a. Burdekin Dry Tropics NRM Plan (2005-2010), BDTB, Townsville.

Burdekin Dry Tropics Board (BDTB), 2005b. Burdekin Dry Tropics Regional Investment Strategy, BDTB, Townsville.

Cason, T. N. and L. Gangadharan. 2005. A laboratory comparison of uniform and discriminatory price auctions for reducing non-point source pollution. *Land Economics* 81: 51-70.

Cole, C., Burton, M., Williams, K. et al. 2005. "Auction for Landscape Recovery", Final Report, National Market Based Instruments Pilot Project, October 2005, WorldWide Fund for Nature, Perth.

Comerford, E and Binney, J. 2006. "Using auctions for conservation contracts to protect Queensland's vegetation: Lessons from the Vegetation Incentives Program", Paper presented at the 26th conference of the International Association of Agricultural Economists, August 2006, Brisbane.

Eigenraam, M., Strappazzon, L., Lansdell, N., Ha, A. and Beverly, C. 2006. "EcoTender: auction for multiple environmental outcomes", Final Report for the National Market Based Instruments Pilot Program, Victoria Department of Primary Industries, Melbourne.

Faith, D. P., Carter, G., Cassis, G., Ferrier, S., Wilkie, L. 2003. Complementarity, biodiversity viability analysis, and policy-based algorithms for conservation, *Environmental Science and Policy* 6: 311–328.

Falconer, K. and Whitby, M. 2000. Untangling red tape: scheme administration and the invisible costs of European agri-environmental policy, *European Environment* 10:193-203.

Feng, H, Kurkalova, L. A., Kling, C. L. and Gassman, P. W. 2006. Environmental conservation in agriculture: land retirement vs. changing practices on working land, *Journal of Environmental Economics and Management*, 52: 600-614.

Ferraro, P. 2004. Targeting conservation investments in heterogeneous landscapes: a distance-function approach and application to watershed management, *American Journal of Agricultural Economics*, 86(4) 905-918.

Grafton, Q. 2005. Evaluation of Round One of the Market Based Instrument Pilot Program, Report for the National MBI Working Group, The Australian National University, Canberra.

Greiner, R., Stoeckl, N., Stokes, C., Herr, A., Bachmaier, J. 2003. "Natural resource management in the Burdekin Dry Tropics: social and economic issues", Report for the Burdekin Dry Tropics NRM Board, CSIRO Sustainable Ecosystems, Townsville.

Grieve, A. and Uebel, K. 2003. Developing new income streams for farmers. NSW Environmental Services Scheme, Environmental Markets Team, NSW Government.

Hailu, A. and Schilizzi S. 2004. Are auctions more efficient than fixed price schemes when bidders learn? *Australian Journal of Management*, 29:147-68.

Hailu, A. and Thoyer, S. 2006. Multi-unit auction format design *Journal of Economic Interaction and Co-ordination,* 1: 129-146.

Hailu, A. and Thoyer, S. 2007. Designing multi-unit multiple bid auctions: An agent-based computational model of uniform, discriminatory and generalized Vickrey auctions, *Economic Record*, forthcoming.

Hoag, D. 2004**. "**Economic incentives for soil conservation in the United States", Paper presented at the 13th International Soil Conservation Organisation Conference, Brisbane July 2004.

Kleijn, D., Baquero, R. A., Clough, Y., et al. 2006. Mixed biodiversity benefits of agri-environment schemes in five European countries, *Ecology Letters* 9:243-254.

Klemperer, P. 2002. What really matters in auction design, *Journal of Economic Perspectives* 16 (1): 169-189.

Kirwan, B., R. N. Lubowski and Roberts, M. J. 2005. How cost-effective are land-retirement auctions? Estimating the difference between payments and willingness to accept in the Conservation Reserve Program. *American Journal of Agricultural Economics* 87: 1239-1247.

Latacz-Lohmann, U. and Van der Hamsvoort, C. 1997. Auctioning conservation contracts: a theoretical analysis and application. *American Journal of Agricultural Economics* 79 (2): 407-418.

Latacz-Lohmann, U., van der Hamsvoort, C., 1998. Auctions as a means of creating a market for public goods from agriculture, *Journal of Agricultural Economics* 49: 334-345.

Mackenzie, R., Robinson, J., Dent, J. and Scheltinga, D.M. 2004. "Capacity of NRM regions and Local Governments in the reef catchment to support sustainable land management practices and conservation on private and leasehold land", CRC for Coastal Zone, Estuary and Waterway Management.

McCann, L., Colby, B., Easter, K. W., Kasterine, A. and Kuperan, K. V. 2005. Transaction cost measurement for evaluating environmental policies. *Ecological Economics*, Vol. 52(4), pp.527-542.

Miranda, M. L. 1992 Landowner incorporation of onsite soil erosion costs: An application to the Conservation reserve Program, *American Journal of Agricultural Economics* 74 (2): 434-443.

Nicolaisen, J., Petrov V. and Tesfatsion, L. 2001. Market power and efficiency in a computational electricity market with discriminatory double-auction pricing, *IEEE transactions on Evolutionary Computation*, 5: 504-23.

Productivity Commission, 2003. “Industries, land use and water quality in the Great Barrier Reef catchment”, Research Report, Australian Government, Canberra.

Reichelderfer, K. and Boggess, W. G. 1988. Government decision making and program performance: the case of the Conservation Reserve Program. *American Journal of Agricultural Economics* 70: 1-11.

Rolfe, J. C., McCosker, J.C. and Windle, J. 2005a. “Final report For MBI Project 18”, Establishing East-west Corridors in the Southern Desert Uplands Research Report No. 6, Queensland Environmental Protection Agency and Central Queensland University, Rockhampton.

Rolfe, J., Wake, J. and Donaghy, P. 2005b. “Designing incentive mechanisms to improve water quality in Sandy Creek,” Research report, Central Queensland University, Rockhampton.

Roth, A. E. 2002. The economist as engineer: game theory, experimentation, and computation as tools for design economics. *Econometrica* 70 (4): 1341-1378.

Rothkopf, M.H. and Harstad, R.M. 1994. Modeling competitive bidding: a critical essay, *Management Science:*40(3): 364-384.

Stoneham, G., Chaudhri, V., Ha, A. and Strappazzon, L. 2003. Auctions for conservation contracts: an empirical examination of Victoria’s BushTender trial. *Australian Journal of Agricultural and Resource Economics* 47 (4): 477-500.

Tesfatsion, L. 2002. Agent-based computational economics: growing economies from the bottom up’, *Artificial Life,* 8: 55-82.

Vukina, T., Levy, A. and Marra, M. 2003. “Do farmers value the environment? Evidence from the Conservation Reserve Program”, Research paper, Dept of Agricultural and Resource Economics, North Carolina State University, Raleigh.

Windle, J. and Rolfe, J. 2005. “Competitive tenders for conservation contracts. a practical guide for regional NRM groups in Queensland”, Report prepared for the Queensland Department of Natural Resources and Mines, Brisbane.

Windle, J and Rolfe, J. 2006. “Fitzroy Basin Association's Biodiversity Tender: an outline and evaluation”, Main Report for the Fitzroy Basin Association, Central Queensland University, Rockhampton

Windle, J., Rolfe, J., McCosker, J., Linguard, A. 2007. “The Desert Uplands Committee’s Landscape Linkage Auction: an outline and evaluation”, Report for the Desert Upland Committee, Central Queensland University, Rockhampton.

Wu, J. and Skelton-Groth, K. 2002. Targeting conservation efforts in the presence of threshold effects and ecosystem linkages, *Ecological Economics*, 42:313-331.

Appendix 1. Scale and scope issues.

`		Small scale conservation tender		Large scale conservation tender
1. Design				
1a auction design	+	Easier to target issues specific to industries		
	–	Greater requirements for skilled staff and experts		
1b metric design	+	Easier to design and use the metrics	+	More potential to include biophysical modeling which can reduce transaction costs
	+	Bid selection less sensitive to specific assessment components		
	+	Easier to design metric focused on environmental outputs		
1c contract design				
Compliance	+	Less likely to be an issue	–	Increased public accountability means compliance more important
Legal issues	+	Less likely to arise	–	Could become an issue
Monitoring	+	Can be simple and effective More informal processes may work	+	Standardised process can be cost effective
	–	Maybe perceptions that contracts will not be strictly enforced	+	Greater prominence may mean increase likelihood of enforcement
2. Implementation				
Lower transaction costs	+	Smaller operations are cheaper	– / +	Costs more but with more opportunities for standardization and cost efficiencies
Project management	+	Easier to manage if staff resources are limited	–	Need more staff and expertise
Target issues	+	Easier to tailor to specific local needs		
Communications	+	Might be easier to organise a well targeted communications plan	+	More resources to implement extensive communication plan
Implementation authority		More suited to implementation by regional NRM groups as easier to implement: • with limited expertise & resources • in conjunction with other incentive schemes & organisational priorities		More suited to implementation by Govt with more resources and staff expertise
	+	Easier to align with broader range of objectives of NRM groups	+	More opportunities for standardization and cost efficiencies
	+	More landholder trust	–	Can be subject to excessive focus on process and protocol
	+	Good means of developing staff skills for larger scale schemes	–	Low institutional acceptability (in Qld)
	+	More scope for innovation	–	Need for interagency cooperation can increase transaction costs
	–	Need for interagency cooperation can increase transaction costs		
	–	Has been less accountability		

Participation	+ Easier to align with landholder objectives. + Maybe better perceptions about chances of success + More opportunities for shared learning (principal and agent)	? impact on participation unclear
3. Outcomes		
Perverse outcomes	+ less risk and consequences of unforseen/perverse outcomes	
Equity	+ more targeted equity outcomes for each scheme	+ Potential to include equity or enrolment targets within the scheme – This may reduce environmental outcomes
Moral hazard	+ Issues of compliance failure or moral hazard less obvious	Greater need for public accountability
Cost efficiencies	– Less efficient allocation of money – higher overall administration costs	+ More opportunities for standardisation to reduce costs – May loose heterogeneity & reduce environmental outcomes
Other	– Less conformity and consistency across applications – More scope for Bayesian learning if very simplistic metrics are applied and therefore implications for sequential auctions + Possibly more additional intangible project benefits (social captital)	+ More opportunities for optimisation and buying packages or bundles of bids + If well targeted more likelihood of having real environmental outcome