

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

## **Testing for scope and scale efficiencies in water quality tenders: Final Report**

*RESEARCH REPORT No 7.*

John Rolfe, Romy Griener, Jill Windle, Atakelty Hailu and Daniel  
Gregg

June 2008

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 has been conducted as a partnership between Central Queensland University, River Consulting, the University of Western Australia and the Burdekin Dry Tropics Natural Resource Management Group.

The Bureau of Sugar Experiments Stations (BSES) and the Queensland Department of Primary Industries and Fisheries (DPI&F) contributed critical staff resources to enable implementation of the Tender. We specifically wish to thank Dr Scott Crawford, Diana O’Donnell, Paul Duncanson and Duan Biggs (BDTNRM); Adam West, Rob Milla, John Nicholas and Marnie McCulloch (DPI&F); Evan Shannon, Tony Anderson, D Millard, R Matthews, J Dowie, and M Davies (BSES); Dr Jon Brodie (ACTFR), Dr Peter Thorburn (CSIRO) and Clinton Muller (CQU) for supporting the implementation of the Tender in various capacities.

The views and interpretations expressed in these reports are those of the author(s) and should not be attributed to the organisations associated with the project. Previous reports in the series are outlined in Appendix 1. Any comments on the reports will be gratefully received and should be directed to Professor John Rolfe or to Dr Romy Greiner:

Professor John Rolfe  
j.rolfe@cqu.edu.au  
(07) 4923 2132 (ph)  
(07) 4930 9156 (fax)

Dr Romy Greiner  
romy.greiner@riverconsulting.com.au  
(07) 47752448  
(07) 47286436

## Contents

User Friendly Project Summary.....	4
Executive Summary.....	5
1. Introduction.....	6
2. Achievement of project objectives.....	6
3. Achievement Against the M & E Framework .....	11
4. Implications.....	20
5. Conclusions.....	21
Acknowledgements.....	21
References.....	22
Appendix 1: Reports for this project.....	24
Appendix 2: Water quality issues in the Lower Burdekin region.....	25

## User Friendly Project Summary

The Burdekin Water Quality Tender tested a mechanism for the competitive allocation of public funding for improving agricultural water quality from cane and grazing industries into the Great Barrier Reef lagoon. The program was funded by contributions from the National MBI pilots program and the Burdekin Dry Tropics NRM, involving a research partnership between Central Queensland University, River Consulting, the University of Western Australia and the Burdekin Dry Tropics NRM.

The focus of the project was to evaluate how the size (scale) and coverage (scope) of a tender mechanism affects the efficiency of results. Increasing the scale of tenders allows more environmental services to be purchased, while increasing the scope over geographic areas, industries involved and the types of environmental outputs allows a greater range of proposals to be advanced. However, there may be offsetting impacts on administration and transaction costs, and on participation and bid setting by landholders.

The tender was performed between September 2007 and March 2008, and incorporated landholders from the cane and grazing industries in the Burdekin and Haughton catchments. Proposals were received for more than \$2.1 million in funding for a range of activities that would reduce nitrogen, sediment and pesticide emissions. A metric was used to select 33 proposals out of 87 submitted, with \$605,000 allocated in funding. The tender was predicted to achieve the following emission reductions:

- 491.8 tons of sediment reduction for \$89.22 per ton (0.04% of catchment load)
- 96,207 kg nitrogen reduction for \$4.55 per kg (1.7% of catchment load), and
- 55.6 kg Pesticide reduction for \$2,221 per kg (0.04% of application in catchment).

The following messages to policy makers can be drawn from the results of the project:

- Running fewer and larger tenders will generate efficiency gains in some circumstances.
- The largest efficiency gains regards scope are to be found in increasing the type of environmental services required and the industries involved, rather than across broad geographic regions,
- Increasing the scale and scope of tender mechanisms will not automatically generate net efficiencies because of the potential offsetting impacts of the indirect effects (e.g. changes in participation and bid prices). There are large efficiency gains from ensuring the funding scale is tailored to adequate levels of competition.
- Increasing the scope of a tender may lead to decreased participation and lower bid prices, while increasing monitoring and verification requirements leads to decreased participation and higher bid prices. Larger scale and scope tenders may also be associated with higher administration and transaction costs, and may require more detailed assessment to evaluate proposals across different regions, industries and activities.
- Increasing the scope may be counterproductive if there is not a specific effort to ensure participation and provide appropriate monitoring.

## Executive Summary

The design of competitive tenders to purchase environmental services requires judgements to be made about the funding scale and tender scope, with the latter incorporating considerations of geographic area, industries involved and the types of environmental outputs required. Increasing the scale of tenders allows more environmental services to be purchased, while increasing the scope allows a greater range of proposals to be advanced. As well, there may be some administrative efficiency gains in running fewer and larger tenders. These potential efficiency gains have to be balanced against potential indirect effects on participation and bid setting, where larger scale and scope tenders may generate perverse incentives for landholders to be involved.

In the study reported here, these issues have been tested with a water quality tender performed in the Burdekin catchment in north Queensland in 2007 and 2008. The tender incorporated landholders from the cane and grazing industries in the Burdekin and Haughton catchments. Proposals were received for more than \$2.1 million in funding for a range of activities that would reduce nitrogen, sediment and pesticide emissions. A metric was used to select 33 proposals out of 87 submitted, with \$605,000 allocated in funding. The tender was predicted to achieve the following emission reductions:

- 491.8 tons of sediment reduction for \$89.22 per ton (0.04% of catchment load)
- 96,207 kg nitrogen reduction for \$4.55 per kg (1.7% of catchment load), and
- 55.6 kg Pesticide reduction for \$2,221 per kg (0.04% of application in catchment).

A wide range of opportunity costs were identified for landholder to improve water quality outcomes, justifying the use of a competitive mechanism to select proposals. However, the tender process did not attract the best proposals from all landholders, and further efficiency gains would be possible if landholders had better information about which proposals to submit. These efficiency losses may be one cost of running large scale tenders.

The tender outcomes, workshop results and survey data were used to test the key issues. The results show scale and scope changes can have large direct and indirect effects on the cost-efficiency of these mechanisms. Increases in funding scale can have positive effects on participation rates, increasing the pool of proposals to consider. However, it may mean that some more expensive bids are accepted.

Changes in geographic scope were found to have little impact on efficiency, although smaller scoped auctions tend to have higher participation rates. It is still possible that smaller scoped areas have lower efficiency when there is significant variation in opportunity costs and participation rates between regions. There were large, direct, reductions in efficiency from reducing industry scope (17% lower) or focusing on separate emissions (26% lower). However, there may be offsetting increases in participation rates expected from these changes.

The results show that larger scale and scoped tenders should normally be associated with efficiency gains, but these may be offset by changes in participation rates, and higher negotiations and transaction costs.

# **1. Introduction**

Agricultural enterprises are often non-point sources of pollution into waterways. While regulatory controls are important in some situations, there is growing interest in the use of incentives, often bundled under a descriptive term of ‘market based instruments’, to encourage changes in behaviour through market signals rather than direct controls. The use of auction mechanisms such as a conservation or a water quality tender has potential to provide better incentives to landholders (Cason et al. 2003), and can generate economic efficiencies in several ways (Latacz-Lohmann and van der Hamsvoort 1997, 1998; Stoneham et al. 2003).

The focus of this project and report is on how conservation auctions are framed, where choices have to be made about the funding scale, environmental targets, geographic scope and industry scope of a water quality tender. There are likely to be some efficiency gains associated with tenders that are larger in scale and scope because there are more opportunities for landholders with cost-effective proposals to participate. However, there may be several offsetting costs associated with these tenders, including higher administration and transaction costs, particularly those associated with the assessment of bids over multiple areas and water quality impacts. There may also be changes in landholder behaviour to consider, with potential impacts on both participation rates and bid levels as both scale and scope of a tender mechanism changes. These reasons mean that there may sometimes be net efficiencies in running smaller-scale, targeted tenders rather than larger scale general tenders.

In this report the effects of performing a tender at different levels of scale and scope are assessed to provide insights into the efficiency gains and losses associated with framing water quality tenders at different levels. The context in which these proposals are to be evaluated is the application of a water quality improvement tender in the Lower Burdekin region in North Queensland, Australia. Water quality improvements are being targeted by government because the river systems discharge into the Great Barrier Reef lagoon, and pollutants may ultimately harm the reef (Furness 2003, Wolanski and De'ath 2005). Entering into contracts where landholder are paid to improve water quality emissions are one potential way of addressing concerns about the health of the Great Barrier Reef.

The research into the potential design of a water quality tender has been performed in two main phases. The first has involved the conduct of a ‘real’ tender across different aspects of scope. This allows some tests of scale and scope efficiency to be conducted. The second has involved field experiments and surveys with landholders where the impacts of tender scale and scope changes on potential participation and bid construction have been assessed. Data analysis and modelling have been used to help gain further insights into key research questions.

## **2. Achievement of project objectives**

### **2.1 Project objectives**

The efficiency of a competitive tender is related to the size and coverage of the mechanism. Here, scale is defined as the size of the tender, largely measured by the funding allocation, while scope is defined as the coverage of a tender over

geographic, industry and environmental target dimensions. Increasing scale can generate efficiencies by holding fewer, larger tenders, thus minimising transaction costs. Competition in a conservation or water quality auction is enhanced when the scope of the tender is larger, because there are more potential participants in an agricultural region.

In Australia many of the trials for conservation auctions have been exploratory in nature and relatively narrow in terms of scale and scope. 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. 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.

The policy question of interest is whether it is more efficient to run fewer larger tenders or multiple, small scale and narrowly scoped tenders. The key issues can be identified as:

1. What are the efficiency gains associated from holding larger scale and scope auctions (or the efficiency losses associated with smaller ones)?
2. What are the change in transaction costs (including administration costs) associated with holding larger scale and scope auctions? and
3. Do incentives for landholders to participate and set bid levels change as scale and scope changes?

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 cumulative 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.

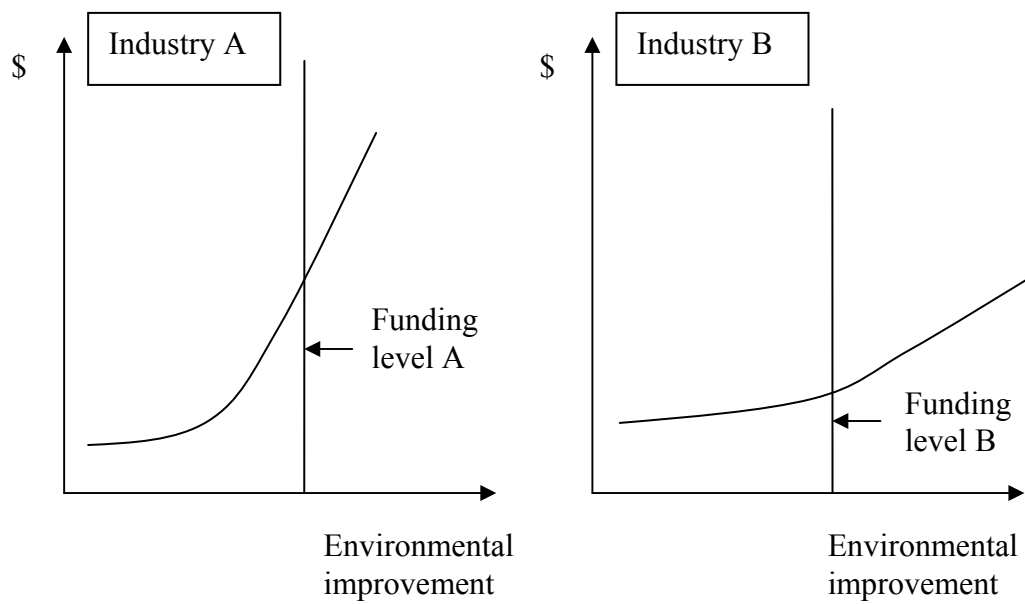
There are potential efficiencies in running a single auction, where the bids are combined into a single opportunity cost curve. These benefits are shown in Figure 2, where the potential bids from landholders across two industries are combined into a single bid function. Average bid cost is lower because bids are considered in a pool.

However, there may be offsetting costs to consider:

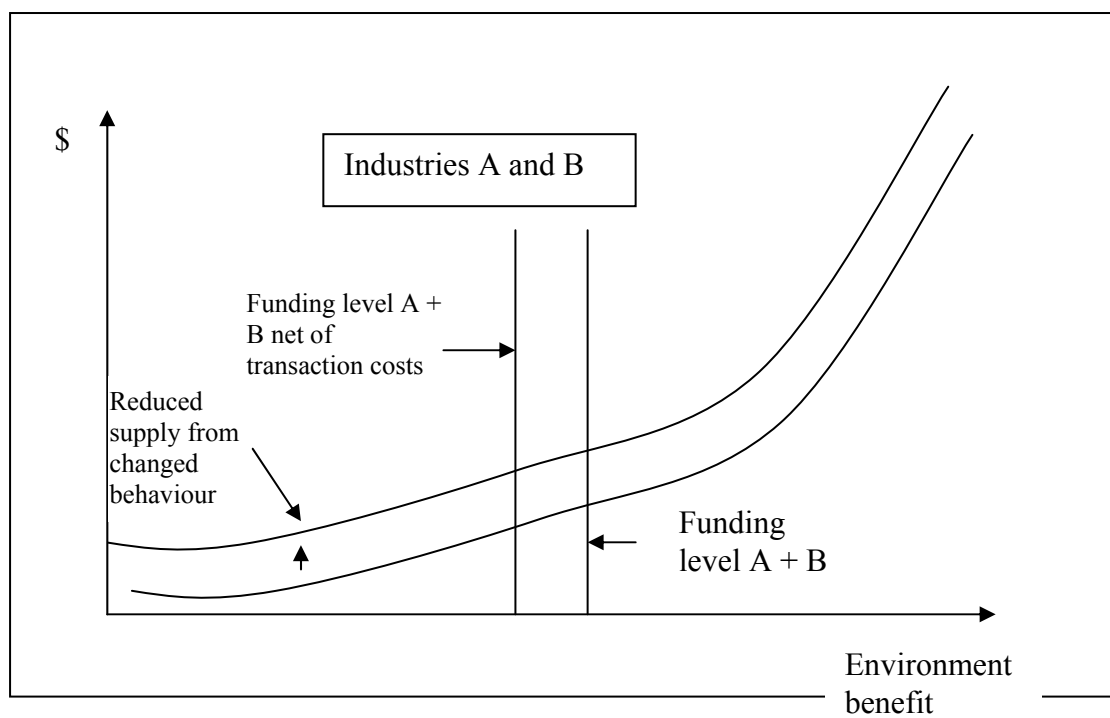
- Additional administration and transaction costs, which reduces net funding available for on-ground actions
- Changes in the supply offered by landholders
  - Changes in potential landholder participation
  - Changes in bid levels from landholders

When these potential offsetting costs are considered, the net efficiency gains may be positive or negative.

**Figure 1 Opportunity costs separately by industry**



**Figure 2. Opportunity costs jointly across industry**





## **2.2 Activities and methods**

The focus of the project was the evaluation of the research questions listed above. There were several key activities undertaken in the project to achieve this:

- Designing the water quality tender, including the auction design, contract design and metric design components, to incorporate tests of changes in scale and scope,
- Combining the original MBI project with an incentive program to improve water quality management in the cane industry, with additional inputs into the design and evaluation process,
- Implementation of the Water Quality tender in the lower Burdekin region,
- Conduct of experimental workshops with landholders,
- Survey of landholders participating in the tender,
- Performing agent-based modelling using data from the collection stages,

The key research questions were addressed in four main ways:

- Evaluation of the tender performance across different components of scale and scope,
- Bid experiments in the workshops,
- Results of attitudinal questions in the survey,
- Results from agent-based modelling trials.

## **2.3 Performance of the case study**

The Burdekin Water Quality tender was run by the Burdekin Dry Tropics Natural Resource Management Group in 2007 and 2008, with \$600,000 available for landholder incentives from government programs. A single tender was performed that invited water quality improvements across the two industries and three catchment areas of interest. The geographic and industry scope of the tender was chosen to test how funding and environmental outcomes may have changed if the tender had been split by industry type, geographic area or type of action targeted. Key aspects of the tender design and process are summarised as follows:

- Single bidding round,
- Sealed bids,
- Discriminatory pricing,
- An (unspecified) reserve price,
- Multiple bids allowed from landholders,
- No cap on bids,
- One year contracts for successful bidders,
- Two payment periods for successful bidders: 60% upfront and 40% on completion,
- Simple contracts used to secure agreements, and
- Simple monitoring and reporting processes.

The performance of the tender followed the stages outlined by Latacz-Lohmann and van der Hamsvoort (1998) and Stoneham et al. (2003):

1. Details of the tender were publicised and promoted<sup>1</sup> (August 2007).
2. Landholders could register by completing an Expression of Interest form (September to November 2007).
3. Those landholders received a visit from extension and tender design staff to identify suitable projects and explain the process (September to December 2007).
4. Landholders submitted bids (January 2008),
5. Bids were evaluated and assessed (February to March 2008).
6. Landholders were informed of the outcomes, and contracts drawn up with successful applicants (April 2008).

A key step in the tender was the development of the metric used to assess and rank the bids. In the water quality tender the challenge was to design an evaluation tool which could compare projects:

- Across different pollutants,
- Across different industries,
- Across different management activities,
- Across areas with different environmental pressure,
- Across type – where type can include infrastructure or land management, and where some projects are more verifiable and therefore the expected outcomes are more likely to be realised,
- Across time – where some project may provide more permanent structures that will continue providing environmental benefits well after the completion of the one year contract, and
- Across the scope of management approaches, i.e. from a single uncoordinated action to one that is part of a more integrated farming systems approach.

The estimated environmental benefits of proposals was measured as the environmental benefit score (EBS). The EBS was calculated in a 3-step process:

1.  $\text{Environmental Benefits} = \text{Reduced Emissions} \times \text{Effectiveness Adjustments (for each type of emission)}$
2.  $\text{Relative Environmental Scores} = \text{Environmental Benefits} / \text{GBRMPA targets (for each type of emission)}$
3.  $\text{Environmental Benefits Score (EBS)} = (\Sigma \text{Relative Environmental Scores}) \times \text{Farming Systems Score} \times \text{Future Intentions Score}$

The cost effectiveness of each proposal was then assessed on the basis of relative bid value.

4.  $\text{Relative Bid Value} = \text{EBS} / \text{Bid Price (\$)}$

---

<sup>1</sup> Tender information could be viewed at: [www.burdekindrytropics.org.au/watertender/index.html](http://www.burdekindrytropics.org.au/watertender/index.html)

## 2.4 Performance of the workshops

Further tests for impacts of scale and scope on participation and bid levels were conducted through the use of workshops. In this project, two workshops were held in March 2008 with 36 tender participants, representing slightly over half of the landholders involved in the tender process. A key advantage of holding the workshop after the actual tender had been conducted was that participants were familiar with the process of developing a tender application.

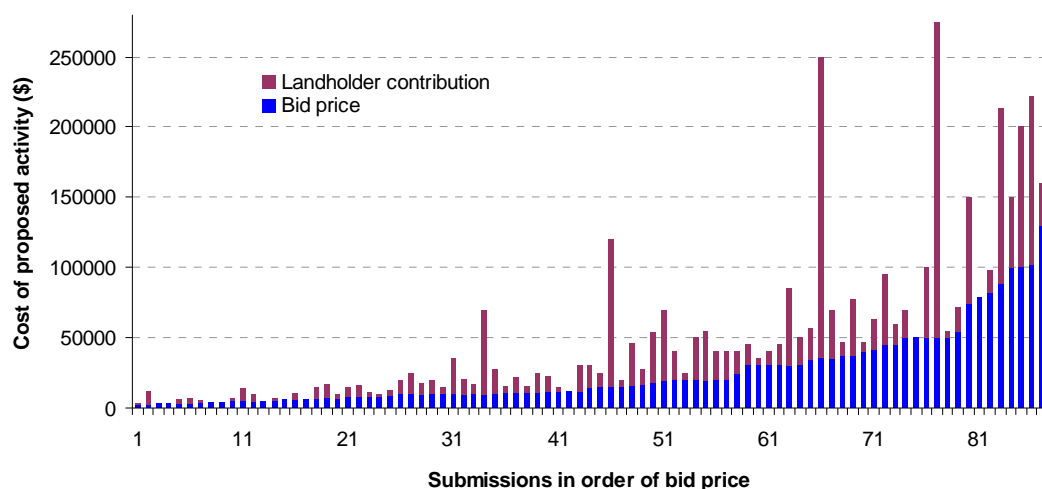
The first part of the workshop required participants to develop a desktop bid proposal to reduce their fertiliser application rates over a three year period. While the exercise was hypothetical, participants were asked to make their bids as realistic as possible as the results would be used to expand the information gathered in the trial tender. The second part of the workshop exercises focused on the effects that changes in scope and scale may have on participation and bid construction in a tender scheme. Keeping in mind their initial bid proposal to reduce fertilizer applications, participants were presented with a number of different scenarios and then asked about their likelihood of participating and whether they would adjust their bid price.

## 3. Achievement Against the M & E Framework

### 3.1 Tender performance and results

In the tender, 87 proposals from 64 bidders were received for a range of water quality improvement proposals, with a total of \$2.2 million in funding requested. Bids ranged from \$1500 to \$130,000 with a mean of \$25,131 and median of \$14,800. The proposed cost contribution ranged from 0% to 95% with a mean of 57% and median of 52%. The bids and cost contribution by proponents are shown in Figure 1.

**Figure 1: Bid values and self-funding components**



The majority of submissions (78) were for activities on cane land, and a further nine were for grazing land management. Of proposed activities on cane land, nine related to pesticide reductions, ten were about fertilizer management, 22 were about water

management and 41 related to the construction or expansion of a water recycle pit. There were a variety of hardware/earthworks related proposals, including:

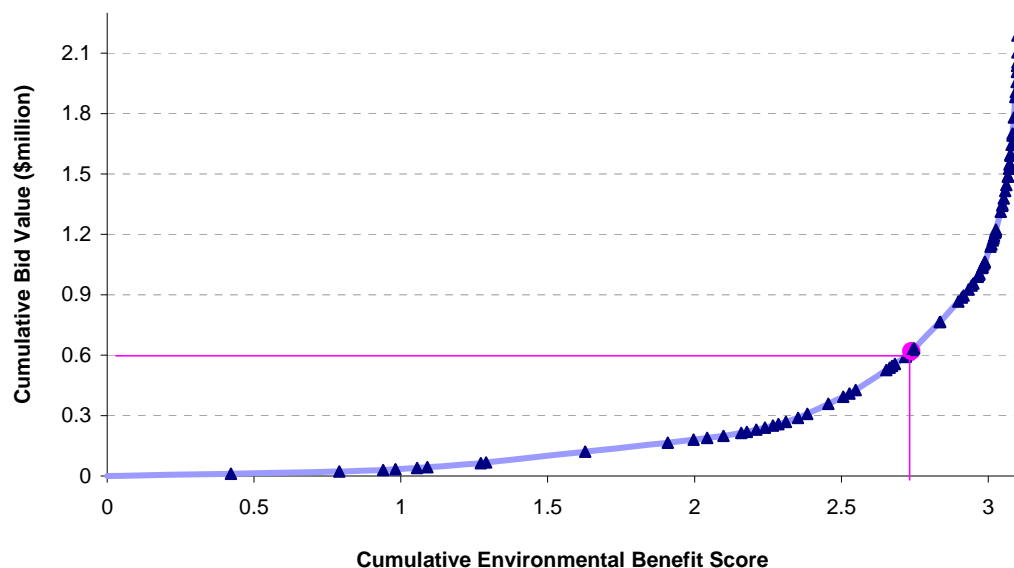
- pipes and drains
- tools: bedformers, legume planters, stool splitters
- improved information: GPS, enviroscans, weather station, satellite imagery, laptop computer, EM mapping
- irrigation technology: trickle and drip irrigation, centre pivot, lateral move irrigators
- pesticide applicators: shielded and hooded sprayers
- laser levelling.

There was no clear pattern as to what type of proposed activities generated the lowest or highest bids.

The cumulative bid curve (Figure 2), with bids ranked in decreasing order of attractiveness, shows the classic ‘hockey stick’ pattern as shown by Stoneham et al. (2003), although with a much higher proportion of bids in the ‘vertical’ part of the curve. From this pool, the 33 most cost-effective bids were selected for \$604,939 in total funding. These bids had a cumulative EBS of 2.73. The successful bids in the lower Burdekin water quality tender were predicted to achieve the following emission reductions:

- 491.8 tons of sediment reduction for \$89.22 per ton (0.04% of catchment load)
- 96,207 kg nitrogen reduction for \$4.55 per kg (1.7% of catchment load), and
- 55.6 kg Pesticide reduction for \$2,221 per kg (0.04% of application in catchment).

**Figure 2. Bid curve with cumulative bids and environmental benefits index**



## **3.2 Impacts of scale and scope changes on efficiency**

### **3.2.1 Variations in funding scale**

The cumulative bid curve (Figure 2) demonstrates that a close relationship exists between the funding scale and the cost-efficiency of the tender mechanism.

- If funding had been double (\$1.2 M), the EBS would have been 11% higher
- If funding had been halved (\$0.3 M), the EBS would have been 14% lower
- If funding changes, there is more effect on the marginal EBS/\$ funded than the overall EBS score.

The conclusion to be drawn is that if the financial scale is set too high in relation to the scope of the project, substantial inefficiencies may be generated.

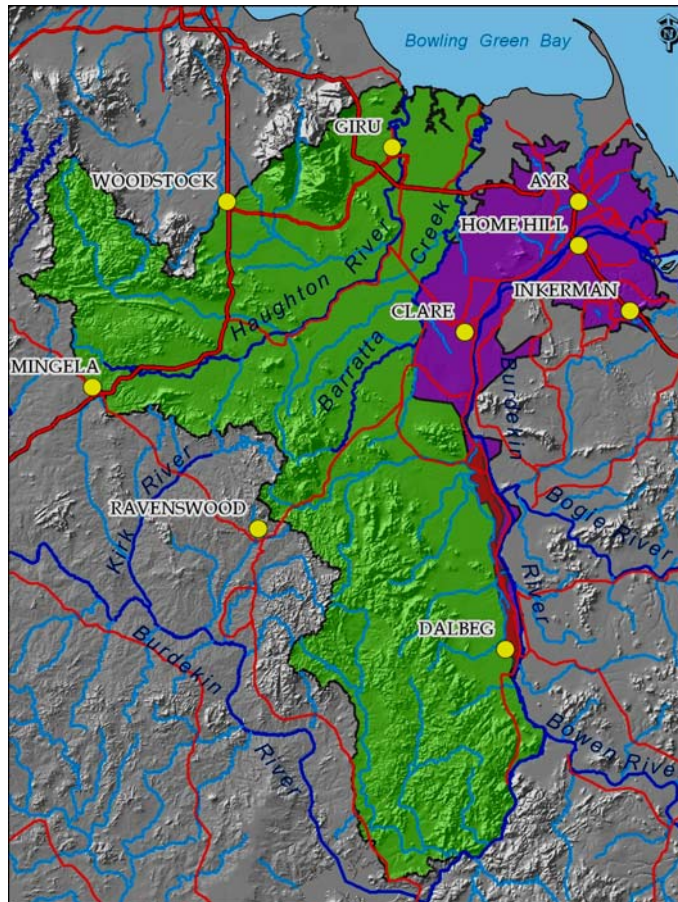
### **3.2.2 Variations in geographic scope**

To conduct the ex-post test relating to the geographic of tender, the submissions were split into two groups according to their location (Figure 3). A total of 25 submissions were located in investment area 1, compared to 62 submissions in investment area 2. Submissions were then ranked within their subregional groups on the basis of cost efficiency against a nominal allocation of \$300,000 for each area. The sub-regional bid curves are shown in Figure 5.2. The environmental benefit score associated with this investment is  $EBS_{IA1}=0.95$  for investment area 1 at a cost of \$303,775, and  $EBS_{IA2}=1.78$  for investment area 2, at a cost of \$298,204 (Figure 4).

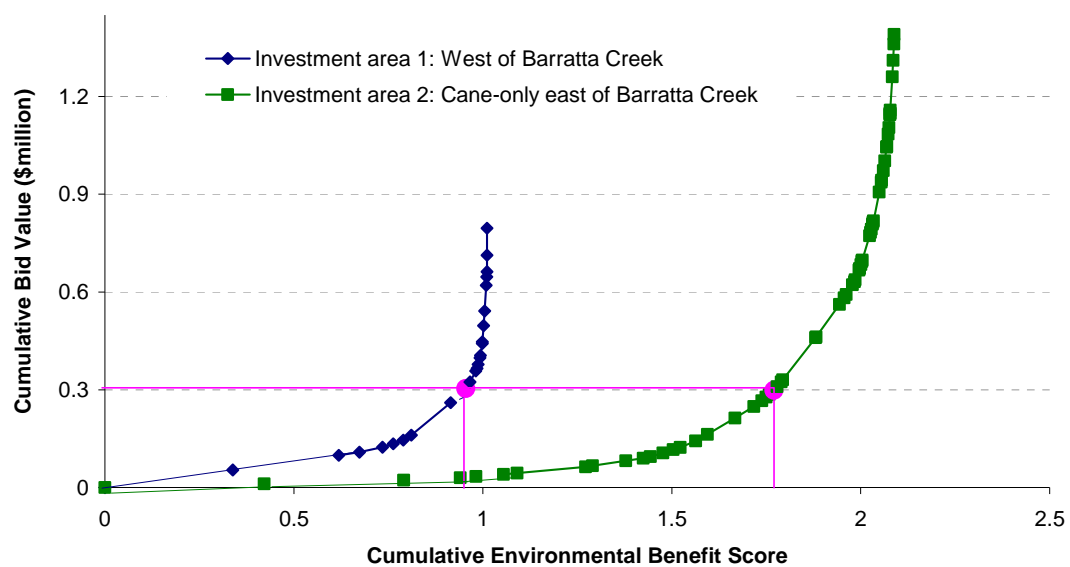
When compared to a total EBS of 2.73 in the joint pool, an allocation by regional area would have reduced overall efficiency by less than 1%.

**Figure 3 Geographical stratification of the tender area**

Investment Area 1: West of Barratta Creek (green);  
Investment Area 2: Cane-only east of Barratta Creek (purple)



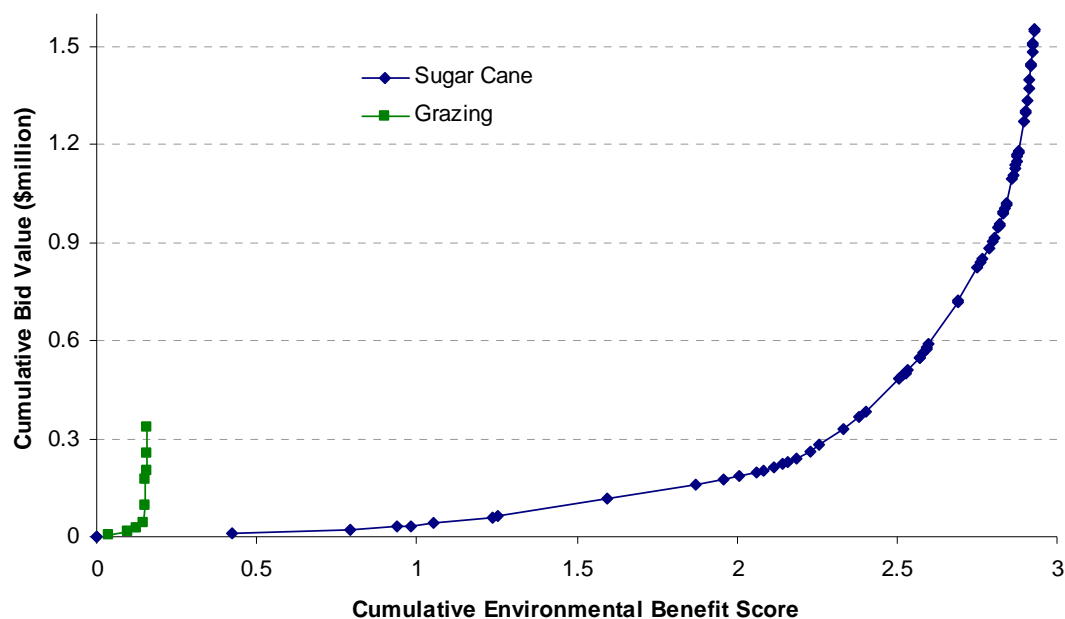
**Figure 4: Cumulative bid curves for sub-regional tender stratification**



### 3.2.3 Variations in industry scope

To conduct the ex-post test relating to industry participation, the submissions were split into two groups according to industry. Of the 87 submissions, the majority were from cane growers (78), compared to only nine grazier submissions. Grazer submissions had a total ask of \$337,000, compared to \$1.85 million for cane submissions. Submissions were ranked within their industry groups on the basis of cost efficiency. The resulting industry bid curves are shown in Figure 5.

**Figure 5: Cumulative bid curves by industry**



If the funding had been allocated equally between the two industries, a \$300,000 investment in grazing management would have generated a cumulative EBS of 0.156, while a \$300,000 investment in cane industry management would have generated a cumulative EBS of 2.258. When compared to a total EBS of 2.73 in the joint pool, an allocation by industry would have reduced overall efficiency by 17%.

### 3.2.4 Variations in emissions scope

To conduct the ex-post test relating to emissions type, the submissions were divided into the three main categories of Nitrogen, Pesticide and Sediment emissions. The bids were then ranked against a hypothetical allocation of \$200,000 for each pollutant type. This generated cumulative EBIs of 0.840 for Nitrogen emissions, 1.025 for Pesticide emissions (only \$45,863 in bids available for allocation), and 0.153 for Sediment emissions. The total cumulative EBS that is generated is 2.018, a reduction of 26% in efficiency. The efficiency of the allocation for Nitrogen reductions is more than five times the efficiency of allocations to sediments. The results demonstrate that substantial reductions in efficiency can be generated by focusing tenders within rather than across specific environmental outcomes. Allocating funds to specific environmental targets can generate significant efficiency losses.

### **3.3 Impacts of scale and scope changes on transaction costs**

The second key research question to be addressed was focused on potential increases in transaction costs associated with a competitive tender with increased scale and scope. Information on this question was collected through an analysis of the tender results and the conduct of the workshop and landholder survey. The results show that running a larger scale and scope auction led to some efficiency losses because of poorly constructed bids, impacts on landholder administration costs were slight.

The results of the tender suggest that moving to a larger scale operation generated a number of poorly constructed and targeted bids from landholders. A number of proposals were offered that generated very small environmental benefits and almost no improvement in the cumulative environmental benefits score, as shown by the number of bids in the almost vertical section of the cumulative bid curve. The auction process failed to some extent to attract effective bids from landholders, perhaps because landholders had poor information about how to structure environmental proposals or they were focused on associated production gains.

The results from the workshops reveal that many landholders could have submitted more cost-effective and competitive bids than what they submitted in the actual tender. In this project, the combination of a time constraints with a large scale application meant that there were a number of staff and agencies involved with limited training and only a minimal time for field visits, leading to a sub-optimal outcome. Time constraints, poor information transfer, increased complexity and the use of third parties for delivery may lead to ineffectual and sub-optimal bids being submitted.

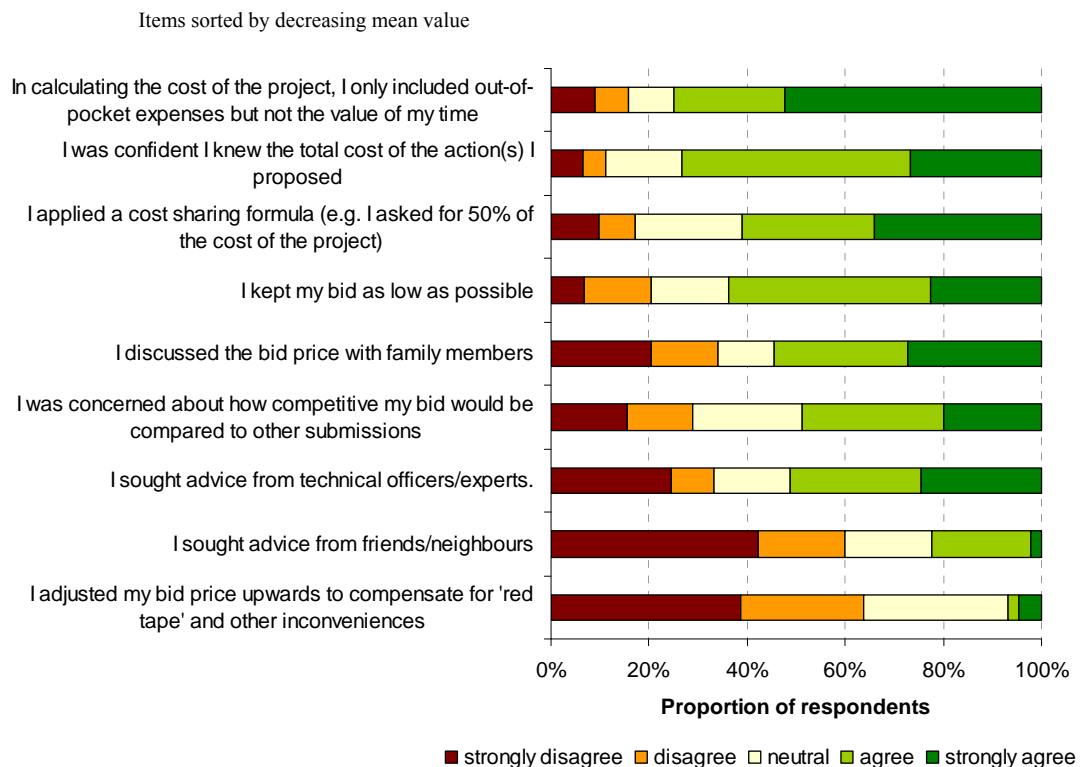
A key focus of the surveys was to collect additional information on the different transaction costs involved in the tender process. The data collected in the workshop generated the following results:

- The majority of participants did not include the transaction costs incurred in developing a bid in their bid price. These cost become part of a de facto cost-share arrangement.
- The average cost in terms of the time taken to develop a bid proposal was approximately \$220. The potential cost of monitoring activities averaged approximately \$640.
- Demographic and attitudinal variables did not appear to be related to bid construction, suggesting that bids are largely driven by farm characteristics and opportunity costs.
- Increasing monitoring requirements would lead to higher bid prices as landholders factor in those transaction costs.

Similar results about bid formation were gained from the general survey (Figure 6). The results show that many transaction costs were not included in bid prices, landholders were prepared to share costs, that bids were kept low, and landholders were generally confident that they knew the total cost of proposed activities.



**Figure 6: Level of agreement with various considerations in deriving the bid price for a submission**



### 3.4 Impacts of scale and scope changes on landholder incentives

The third key research question was focused on whether moving to larger scale and scope changed incentives for landholders to participate and set bid levels. This was tested using exercises in the workshops, where landholders first identified a realistic bid for reducing fertilizer use, and then identified how they would react to schemes with different funding scale and scope involved. Landholders were asked to indicate their changes in both likelihood of participation and their bid levels.

The baseline scenario outlined a proposal with a funding pool of \$400,000 (each year for three years) and was limited to Burdekin sugarcane growers. Other scenarios were then described to assess:

#### Changes in scale:

- Increasing the funding pool to \$600,000, and
- Decreasing the funding pool to \$200,000.

#### Changing the scope:

- \$400,000 funding but open to all primary producers, and
- \$400,000 funding but open to sugarcane growers in Mackay and Proserpine as well as the Burdekin.

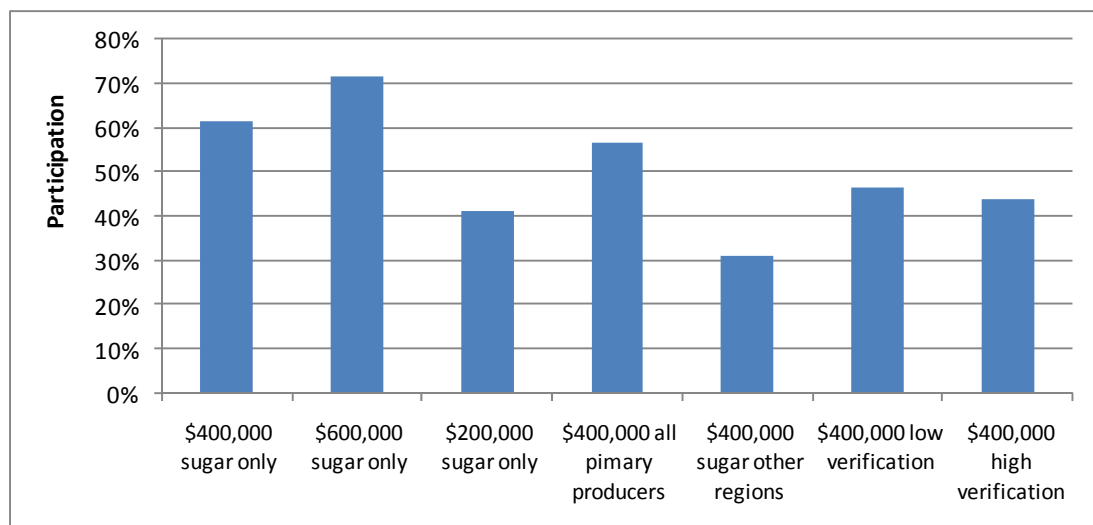
#### The influence of transaction costs in terms of verifying their actions:

- e) \$400,000 funding and a low level of verification with a requirement to undertake a higher level monitoring, such as having to take water samples after each irrigation event, and
- f) \$400,000 funding and a high level of verification with a requirement to undertake a higher level monitoring, such as having fertiliser purchases checked by an auditor.

To estimate the potential participation rates under the different scenarios any rating with a score of 5 or higher was considered a positive indication of participation. The results are presented in Figure 7. The results can be summarised as follows:

- Scale does have an impact on participation
  - Increasing funding by 50% increased nominated participation by 10.3%,
  - Decreasing funding by 50% decreased nominated participation by 20.5%
- Increasing industry scope (from sugarcane growers to all primary producers) had a small negative impact on participation (5.1% fall)
- Increasing the scope across regions had a large negative impact on participation (30.7% fall)
- Increasing verification procedures had a negative impact on participation (15.3% fall)

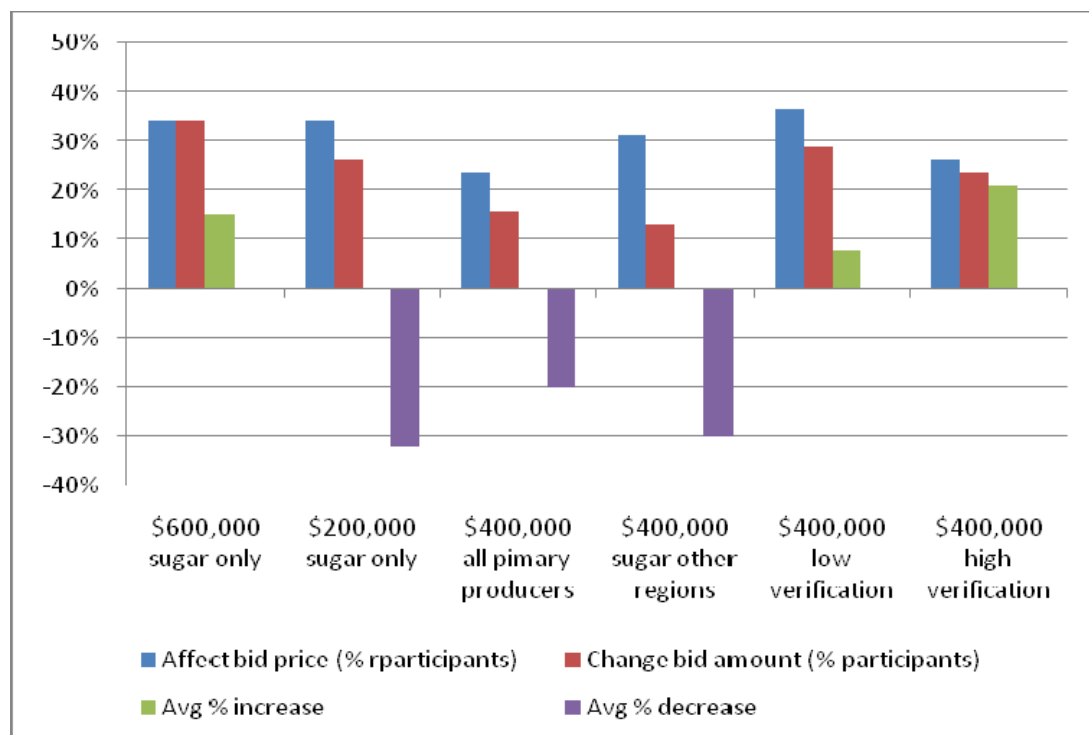
**Figure 7. Impacts of scope and scale on participation rates**



Approximately one third of respondents indicated that the change in tender scenario would affect their bid price. The changes can be summarised in two ways, by the proportion of the bids that would change, and the average change in bid amount (Figure 8).

- Decreases in scale, and increases in scope reduced bid amounts (increasing competitiveness)
- Increases in scale increased bid amounts (reduced competitiveness)
- Increases in verification requirements increased bid amounts (reflecting increased transaction costs)

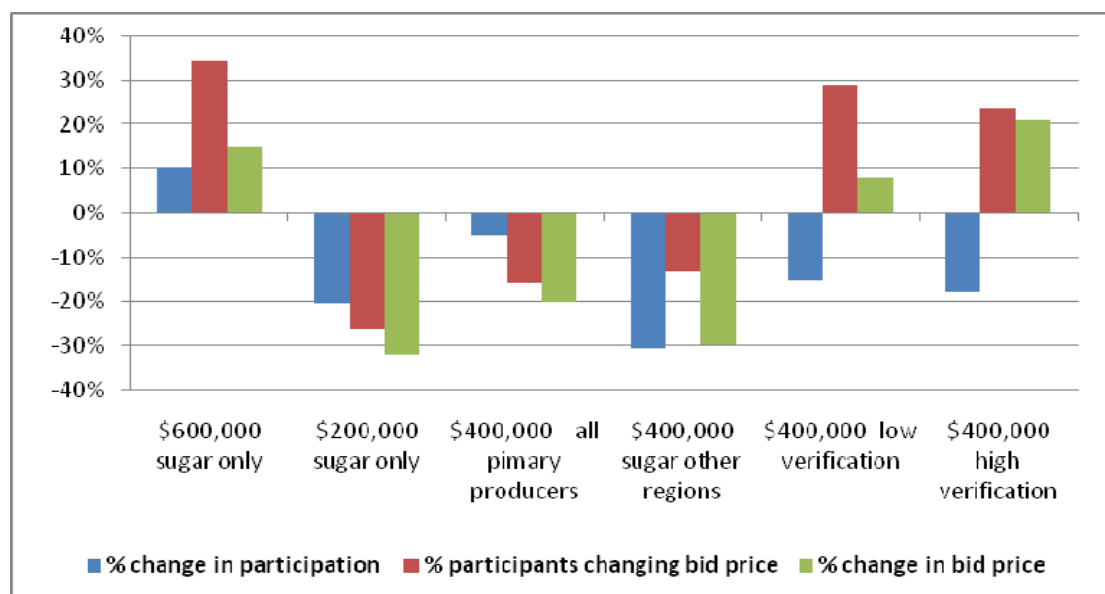
**Figure 8. The influence of scope and scale issues on bid prices**



Changes in bid amounts and bid behaviour were sometimes offsetting (Figure 9).

- Increasing scale leads to both increases in participation and bid levels
- Decreasing scale leads to lower participation and lower bid levels
- Increasing scope across industry leads to slightly lower participation and lower bid levels,
- Increasing scope across regions leads to lower participation and bid levels.
- Increasing monitoring and verification requirements leads to lower participation and higher bid levels.

**Figure 9. The tradeoffs between impacts on participation rates and bid prices**



### 3.5 Priority knowledge gaps filled

The focus of this study has been at the framing and design stage of a competitive tender, where decisions have to be made about the level of funding involved and the ‘coverage’ of a tender mechanism. The water quality tender that has been implemented as a part of this research project has directly addressed two important recommendations made in the review of the MBI Round 1 projects (Grafton 2005). The first was focused on how MBI applications should be framed:

*Priority should be given to testing whether a mix of MBIs offers a more cost effective approach to conservation than a single MBI approach*

The second was focused on how MBI programs could be designed to account for the heterogeneity involved in larger trials:

*The choice of pilots in a second round should involve a ‘natural’ experimental design to provide information on how robust MBIs are to successful implementation by explicitly accounting for differences in landscapes .....*

## 4. Implications

The scale and scope of tender mechanisms for purchasing environmental services have impacts on efficiency through both direct and indirect impacts. The direct scale effects means that the funding allocated to a tender proposal has to be tailored to the extent and the cost-effectiveness of the proposals that will be received. The direct scope effects mean that efficiencies are likely to be generated by increasing the geographic, industry and environment target scope of a tender mechanism. The results of this study suggest that the largest efficiency gains are to be found in increasing scope across the type of environmental services required and the industries involved, rather than across broad geographic regions.

Increasing the scale and scope of tender mechanisms will not automatically generate net efficiencies because of the potential offsetting impacts of the indirect effects, particularly in terms of changes in participation and bid prices. The results of field experiments with landholders in this study suggest that increasing the funding scale of a tender may increase participation but at the potential cost of higher bid levels. Increasing the scope of a tender leads to decreased participation and lower bid prices, while increasing monitoring and verification requirements leads to decreased participation and higher bid prices. As well, larger scale and scope tenders may be associated with higher administration and transaction costs, and may require more detailed assessment to evaluate proposals across different regions, industries and activities.

The results of this study have implications for the design and implementation of tender mechanisms to purchase environmental services from landholders. It is clear that focusing the scope of tenders too narrowly, or misjudging the scale of funding relative to scope, can generate substantial inefficiencies. At the same time, policy makers have to also consider the design costs, transaction costs and indirect impacts

that may counterbalance efficiency gains in moving to larger scale and scoped tenders.

Many tenders in Australia to date have been focused and smaller in scale, in line with the exploratory nature of these mechanisms. There is potential for larger scale tenders to be applied in an effort to streamline administrative and transaction costs. The key implications of this study in the policy context is that larger scale tenders may generate major efficiency gains if there is a broad scope of activities across different contexts, and care is taken to maintain landholder participation and avoid excessive bid levels.

## **5. Conclusions**

The following messages to policy makers can be drawn from the results of the project:

- Running fewer and larger tenders will generate efficiency gains in some circumstances.
- The largest efficiency gains regards scope are to be found in increasing the type of environmental services required and the industries involved, rather than across broad geographic regions,
- Increasing the scale and scope of tender mechanisms will not automatically generate net efficiencies because of the potential offsetting impacts of the indirect effects (e.g. changes in participation and bid prices). There are large efficiency gains from ensuring the funding scale is tailored to adequate levels of competition.
- Increasing the scope of a tender may lead to decreased participation and lower bid prices, while increasing monitoring and verification requirements leads to decreased participation and higher bid prices. Larger scale and scope tenders may also be associated with higher administration and transaction costs, and may require more detailed assessment to evaluate proposals across different regions, industries and activities.
- Increasing the scope may be counterproductive if there is not a specific effort to ensure participation and provide appropriate monitoring.

## **Acknowledgements**

This research reported in this paper has been funded by the Australian Government's Market-Based Instruments Programme with additional support from the Burdekin Dry Tropics NRM. Acknowledgement is made of the additional contributions to the project made by the Bureau of Sugar Experiments Stations (BSES) and the Queensland Department of Primary Industries and Fisheries (DPI&F).

## References

- Beare, S., Bell, R., Blas, A., Gooday, P., Heaney, A., Hooper, S., Langenkamp, D., Love, G., Levantis, C., Mues, C., Qureshi, E. and Riley, C. 2003. *Natural Resource Management in the Burdekin River Catchment: Integrated Assessment of Resource Management at the Catchment Scale – A Case Study*, Australian Bureau of Agricultural Resource Economics Report 03.18, Canberra.
- Bryan, B., Gatti, S., Connor, J., Garrod, M. and King, D. 2005. *Catchment Care - Developing an Auction Process for Biodiversity and Water Quality Gains*, CSIRO Land and Water, Australia.
- Cason, T. N. and Gangadharan, L. 2004. Auction design for voluntary conservation programs. *American Journal of Agricultural Economics* 86: 1211-1217.
- Cason, T., and Gangadharan, L. 2005. A laboratory comparison of uniform and discriminative price auctions for reducing non-point source pollution." *Land Economics* 81: 51-70.
- Cason, T., L. Gangadharan, and Duke, C. 2003. A laboratory study of auctions for reducing non-point source pollution." *Journal of Environmental Economics and Management* 46: 446– 71.
- Eigenramm, M., Strappazzon, L., Landsdell, N., Beverly, C. and Stoneham, G. 2007. Designing frameworks to deliver unknown information to support market-based instruments, *Agricultural Economics*, 37: 261-269.
- Ferraro, P.J. 2008. "Asymmetric information and contract design for payments for environmental services", *Ecological Economics*, 65(4): 810-821.
- Furnas M. 2003. *Catchments and Corals: Terrestrial Runoff to the Great Barrier Reef*, Australian Institute of Marine Science, Townsville.
- Great Barrier Reef Marine Park Authority (GBRMPA), 2001. *Great Barrier Reef Catchment Water Quality Action Plan: A report to the Ministerial Council on targets for pollutant loads*, Great Barrier Reef Marine Park Authority, Townsville.
- Klemperer, P. 2002. What really matters in auction design? *Journal of Economic Perspectives* 16: 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: 407 - 418.
- Latacz-Lohmann, U. and 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.
- List, J.A. and Lucking-Reiley, D. 2002. Bidding behavior and decision costs in field experiments. *Economic Inquiry* 40: 611-619.
- List, J. and Shogren, J. 1998. Calibration of the difference between actual and hypothetical valuations in a field experiment. *Journal of Economic Behavior and Organization* 37: 193-205.
- 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.

- Morgan I (ed.), 2007. *Australian Sugar Year Book 2007*, Rural Press Qld, Ormiston
- Stoneham, G., Chaudhri, V., Ha, A. and Strappazon, 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.
- Wolanski, E. and De'ath, G. 2005. "Predicting the impacts of present and future human land-use on the Great Barrier Reef", *Estuaries, Coastal and Shelf Science*, 64: 504-508.

## Appendix 1: Reports for this project

Rolfe, J., Greiner, R., Windle, J. and Hailu, A. 2007 *Identifying scale and scope issues in establishing conservation tenders*, Using Conservation Tenders for Water Quality Improvements in the Burdekin Research Report 1, Central Queensland University, Rockhampton.

Rolfe, J., Muller, C., Greiner, R. and Windle, J. 2007 *Overview of the Burdekin Case Study*, Using Conservation Tenders for Water Quality Improvements in the Burdekin Research Report 2, Central Queensland University, Rockhampton.

Rolfe, J., Windle, J., Muller, C. and Greiner, R. 2007 *Designing a metric for conservation tenders at different levels of scope and scale*, Using Conservation Tenders for Water Quality Improvements in the Burdekin Research Report 3, Central Queensland University, Rockhampton.

Windle, J., Rolfe, J., Greiner, R., and Gregg, D. 2008. *Using conservation tenders for water quality improvements in the Burdekin. Results from experimental workshops*. Using Conservation Tenders for Water Quality Improvements in the Burdekin Research Report 4, Central Queensland University, Rockhampton.

Greiner, R., Rolfe, J., Windle, J., and Gregg, D. 2008. *Tender results and feedback from ex-post participant survey*, Using Conservation Tenders for Water Quality Improvements in the Burdekin Research Report 5, Central Queensland University, Rockhampton.

Hailu, A., Rolfe, J. Windle, J. and Greiner, R. 2008 *Auction scope, scale and pricing format: Agent-based simulation of the performance of a water quality tender*, Using Conservation Tenders for Water Quality Improvements in the Burdekin Research Report 6, Central Queensland University, Rockhampton.

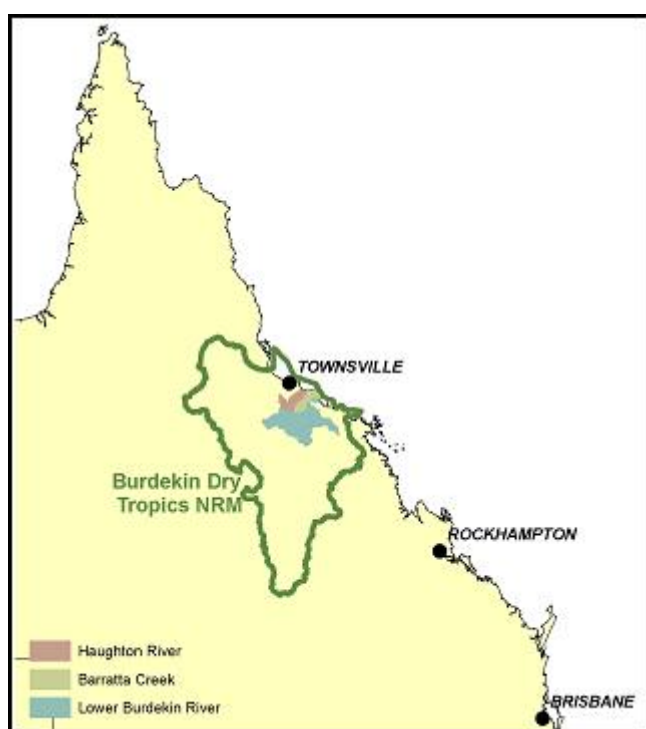


## **Appendix 2: Water quality issues in the Lower Burdekin region**

These design issues are applied in a case study application, where a water quality tender has been implemented within the Lower Burdekin catchment in northern Queensland, Australia. The tender area covers different catchment areas with a specific focus on two main agricultural industries (cattle grazing and sugarcane production) (Figure 3.1). The Lower Burdekin region includes the lower part of the Burdekin catchment, which is below the Burdekin Falls Dam, as well as two smaller coastal catchments: the Haughton River and Barratta Creek catchments. The three adjacent waterways share the coastal floodplains and are hydrologically linked through the Burdekin Irrigation Area. Land use in the Haughton and Barratta catchments are similar to the Lower Burdekin, with grazing and sugarcane production the dominant agricultural land uses. The study area of interest covered approximately 7,500 km<sup>2</sup>, with sugarcane grown on 725 km<sup>2</sup> and low value grazing occupying much of the rest of the region.

There are a number of linkages between agriculture and water quality issues. The application of nutrients and pesticides in sugarcane farming in the floodplain areas has increased the risk of offsite contamination in surface and groundwater resources (GBRMPA 2001). The presence of elevated nutrient levels has reduced water quality within groundwater aquifers and the unmetered extraction of groundwater for agricultural production has led to saltwater intrusion (GBRMPA 2001). Excessive grazing has led to soil erosion and the movement of sediments into waterways. A total of 868, 000 hectares within the Lower Burdekin and Haughton Barratta catchments have been deemed 'hot spot' locations, on the basis that they are contributing one tonne or more of sediment per hectare a year to the coast (Beare et al. 2003). Only a small percentage of land within the catchments is under any form of conservation protection, accounting for one per cent of the entire Burdekin and eight per cent of the Haughton and Barratta systems (GBRMPA 2001).

**Figure 3.1. Lower Burdekin Region**



The aspects of water quality which are most important to the health of the Great Barrier Reef are suspended sediment as well as nutrient and pesticide concentrations. Quantifying the exact contributions to the Great Barrier Reef lagoon from catchments and establishing targets for these contributions is a complex task given the variables to be addressed (Furness 2003). The best available guidelines are those set by the Great Barrier Reef Marine Park Authority (GBRMPA 2001) in a report to the Ministerial Council on targets for pollutant loads. Pesticide application rates in the catchments are recorded in Table 3.1, with target reduction levels set at 50%. The current and targeted sediment and nutrient contributions from the catchments are detailed in Table 3.2.

**Table 3.1 Pesticide application rates (Kg active ingredient/yr)**

Pesticide	Lower Burdekin Catchment	Haughton and Barratta Catchments
Atrazine	19, 300	24, 299
Diuron	3, 272	4, 123
2-4D	5, 465	6, 887
Chlorpyritos	207	285
MEMC	196	247

Source: GBRMPA (2001)

**Table 3.2 Sediment and nutrient exports and targets for the catchments**

	Burdekin Catchment			Haughton and Barratta Catchments		
	2001 Tons/year	2011 Target Tons/year	Reduction Target	2001 Tons/year	2011 Target Tons/year	Reduction Target
Sediment export	2, 442, 232	1, 221, 616	50%	172, 454	115, 544	33%
Total N export	11, 134	7, 460	33%	801	401	50%
Total P Export	2, 438	1, 219	50%	175	88	50%

Source: GBRMPA (2001)

There are a number of activities and management changes that landholders can undertake to reduce water quality impacts. Based on the recognised best management practices to improve water quality leaving farms, in this case study the types of actions that can be considered to improve water quality in the Burdekin can be summarised into the following broad groups:

1. Nutrient management
  - *such as better nutrient budgeting and fertiliser application processes leading to lower application rates and reductions in N and P.*
2. Waste water management
  - *such as recycle pits, sediment traps, drain design, road design, tailwater management, riparian and wetland management, buffer zones.*
3. Pesticide management
  - *such as reductions in the application of key herbicides and pesticides*
4. Sediment management
  - *such as improved ground cover, minimum tillage, reduced stocking rates.*

The groups of actions that are relevant to sugarcane growers are nutrient management, waste water management and pesticide management. As sugarcane is cultivated in very flat areas of the Burdekin, soil erosion is not considered to be an issue of environmental concern. For grazing enterprises, sediment management is likely to be the only action that will be relevant as soil erosion and associated sediment (and phosphorus) loads are the key impacts on water quality. There are very low levels of nitrogen and pesticides emitted from grazing.

A policy maker designing a water quality tender in the region faces substantial choice about the way in which a tender could be scoped. Separate tenders could be run across the different industries, with approximately 700 sugar cane growers and 30 beef cattle producers in the area of interest. Separate tenders could also be run across the different catchments, with an approximately equal number of producers in the lower Burdekin compared to the combined Haughton and Barratta catchments. Alternatively, tenders could be run for each specific issue being addressed, such as the four key areas of action outlined above or the key environment targets of nutrient, pesticide and sediment reduction.

