



National Environmental Science Programme

Final Report

Ex-post evaluation of an environmental auction: Legacy of the 2008 Lower Burdekin Water Quality Tender

Romy Greiner



Ex-post evaluation of an environmental auction

Legacy of the 2008 Lower Burdekin Water Quality Tender

Romy Greiner

The Cairns Institute, James Cook University



Australian Government



Supported by the Australian Government's
National Environmental Science Program
Project 1.5: Legacy of the 2008 Lower Burdekin Water Quality Tender

© The Cairns Institute, James Cook University, 2015



Creative Commons Attribution

Ex-post evaluation of an environmental auction: Legacy of the 2008 Lower Burdekin Water Quality Tender is licensed by James Cook University for use under a Creative Commons Attribution 4.0 Australia licence. For licence conditions see: <https://creativecommons.org/licenses/by/4.0/>

National Library of Australia Cataloguing-in-Publication entry:
978-1-925088-78-6

This report should be cited as:

Greiner, Romy (2015) *Ex-post evaluation of an environmental auction: Legacy of the 2008 Lower Burdekin Water Quality Tender*. Report to the National Environmental Science Program. Reef and Rainforest Research Centre Limited, Cairns (46pp).

Published by the Reef and Rainforest Research Centre on behalf of the Australian Government's National Environmental Science Programme (NESP) Tropical Water Quality (TWQ) Hub.

The Tropical Water Quality Hub is part of the Australian Government's National Environmental Science Programme and is administered by the Reef and Rainforest Research Centre Limited (RRRC). The NESP TWQ Hub addresses water quality and coastal management in the World Heritage listed Great Barrier Reef, its catchments and other tropical waters, through the generation and transfer of world-class research and shared knowledge.

This publication is copyright. The Copyright Act 1968 permits fair dealing for study, research, information or educational purposes subject to inclusion of a sufficient acknowledgement of the source.

The views and opinions expressed in this publication are those of the authors and do not necessarily reflect those of the Australian Government.

While reasonable effort has been made to ensure that the contents of this publication are factually correct, the Commonwealth does not accept responsibility for the accuracy or completeness of the contents, and shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this publication.

Cover photographs by R Greiner. Images: Aerial photo Lower Burdekin, tailwater runoff, large recycle pit, small recycle pit, stool splitter.

This report is available for download from the NESP Tropical Water Quality Hub website:
<http://www.nesptropical.edu.au>

CONTENTS

1 Introduction.....	1
2 Relevant context.....	3
2.1 The 2008 Lower Burdekin Water Quality Tender.....	3
2.1.1 Geographical scale of the Tender	3
2.1.2 Tender scope and process.....	3
2.1.3 Assessment of bids	5
2.2 Factors determining efficiency of public investment in environmental improvements using MBIs	6
3 Methodology	8
3.1 Ex-post program evaluation	8
3.2 Survey of Tender participants	8
3.2.1 Ethical conduct	8
3.2.2 Survey sample.....	8
3.2.3 Conducting interviews	9
3.2.4 The questionnaire.....	9
3.3 Coding and data analysis.....	10
4 Results.....	12
4.1 Sample, response rate and representation	12
4.2 Descriptive statistics of respondents.....	13
4.3 Completion and persistence of proposed activities.....	14
4.3.1 Contracted Tender activities.....	14
4.3.2 Unsuccessful Tender proposals	16
4.4 Respondents' recollection of and experiences with the Tender.....	17
4.4.1 Recollection of the Tender	17
4.4.2 Satisfaction with Tender	18
4.4.3 Reflections on the proposals	20
4.5 Changes attributable to the Tender	20
4.5.1 Changes to farmers' knowledge and farming systems.....	20
4.5.2 Additionality effect: Tender participation	22
4.5.3 Post-Tender additionality and crowding effects.....	23
4.5.4 Stated intention to participate in the Reef Trust Tender—Burdekin	25
4.6 Respondent suggestions	27
5 Discussion	30
6 Conclusions and recommendations	33

7 References 36

8 APPENDICES 39

 8.1 Appendix 1: Information sheet and informed consent form 39

 8.2 Appendix 2: Pre-survey letter mailed to Tender participants 41

 8.3 Appendix 3: Questionnaire of successful Tender participants 43

LIST OF TABLES

Table 1:	Survey participation: representation of Tender participants and bids	12
Table 2:	Comparison of activity and bid values in survey frame and survey	13
Table 3:	Respondents' socio-demographic attributes	13
Table 4:	Respondents' property characteristics and land uses	14
Table 5:	Completion rates of successful Tender proposals (%).....	15
Table 6:	Completion rates of unsuccessful Tender proposals (%).....	17
Table 7:	Respondents' recollection of the Tender.....	17
Table 8:	Respondent satisfaction with the Tender (proportion of respondents, %)	18
Table 9:	Changes to knowledge and farming systems (proportion of respondents, %)	20
Table 10:	Water quality action prior to Tender (proportion of respondents, %)	22
Table 11:	Post-Tender water quality and NRM action, by Tender success (proportion of respondents by category, %)	23
Table 12:	Number of Tender participants seeking subsequent NRM funding (count data)	23
Table 13:	Stated intention to participate in Reef Trust Tender—Burdekin (proportion of respondents, %)	26

LIST OF FIGURES

Figure 1:	Map indicating area covered by the Tender.....	3
Figure 2:	Tender bid values, landholder contribution and bid price, ranked by bid price	5
Figure 3:	Tender bid curve with cumulative bids and environmental benefits index	6

ACRONYMS and ABBREVIATIONS

Catalyst	Project Catalyst aims to promote the rapid adoption of innovative farm practices that improve water quality from cane farms impacting the Great Barrier Reef. It involves more than you cane growers in the GBR catchment (http://reefcatchments.com.au/land/project-catalyst/)
DOE	Department of the Environment
EBS	Environmental benefits score: the measure used to assess and rank bids submitted to the 2008 Burdekin Water Quality Tender (Rolfe et al., 2007c)
EOI	Expression of interest
GBR	Great Barrier Reef
BMP	SmartCane Principles of Best Management Practice: an industry led, government- supported best practice system for cane growing across Queensland (Schroeder et al., 2008)
GPS	Global Positioning System
MBIs	Market based instruments
N	Nitrogen, nitrate
NESP	National Environmental Science Program
NRM	Natural resource management
P	Phosphorus, phosphate
RRRC	Reef and Rainforest Research Centre Limited
Six Easy Steps	Nutrient management guidelines and training program for cane growers (Schroeder, 2009)
Tender	2008 Lower Burdekin Water Quality Tender
TWQ	Tropical Water Quality
WQ	Water quality

ACKNOWLEDGEMENTS

The contributions by Professor John Rolfe (Central Queensland University) and Dr Scott Crawford (NQ Dry Tropics) to the design of the ex-post evaluation and their comments on the draft report are gratefully acknowledged. David Olsen and Paul Duncanson (NQ Dry Tropics) provided valuable support for survey implementation. Logistical and operational contributions to the conduct of the research were provided by NQ Dry Tropics and River Consulting. The success of the research ultimately depended on the willing participation in the research by the landholders in the Lower Burdekin, which is gratefully acknowledged.

EXECUTIVE SUMMARY

An ex-post evaluation was conducted of the 2008 Lower Burdekin Water Quality Tender (Tender). The 2008 Lower Burdekin Water Quality Tender had been the first NRM program in the GBR catchment to allocate funding for on-farm projects delivering water quality improvements through a competitive tender process. The Tender had attracted 87 bids from 64 landholders for a range of water quality improvement proposals, mostly for reducing sediment, nutrient, herbicide and pesticide emissions from cane land. The funding scope of the Tender of approximately \$600,000 had been allocated to fund the top 33 bids, from 32 landholders. The allocative efficiency of the Tender has been assessed previously, based on the theoretical evaluation of bids (Rolfe et al., 2011b), but no retrospective assessment of tender efficacy has to date been conducted.

The ex-post evaluation pursued two principal objectives. It sought to explore the legacy of the Tender, in particular its enduring benefits for water quality in the GBR. It also sought to glean any other lessons that could inform the design of future tender-based environmental funding programs. The dual purpose required a structured collation of the experiences by Tender participants as they related to the Tender. It also necessitated a review of the implementation and longevity of investments, and an examination of additionality and crowding effects of the Tender.

For the ex-post evaluation, a survey was implemented using a mixed-method approach. Structured interviews were conducted of 42 Tender participants who had submitted a total of 64 bids. Respondents and their bids provided a good statistical fit with the Tender participants and bids. Of respondents, 22 received funding (no more than one successful proposal per respondent) while 20 respondents did not have a successful proposal.

The research found a high level of persistence of investments and continuing functionality, which means that water quality benefits continue to accrue. The Tender achieved additionality and crowding-in effects, which improved the efficiency of the investment. In particular, the research provided evidence that the Tender:

- Engaged in an information and communications strategy which generated high levels of participant satisfaction during Tender implementation, but once funding decisions were made the level of transparency and communication became less satisfactory;
- Incentivised the participation of many farmers who had not previously done anything about water quality or participated in any NRM programs;
- Effected learning about the impacts of agriculture on water quality—irrespective of success of proposals—and thereby generated intrinsic motivation for many Tender participants to be wanting to do more about improving water quality;
- Sparked a series of subsequent investments into water quality improvements, many of which were entirely funded by the farmers while others were undertaken with the assistance of other NRM funding programs; and
- Triggered and/or facilitated farming-systems change to more environmentally benign practices in some instances.

This report concludes with recommendations regarding the design and implementation of future competitive tenders, NRM programs and policies, and research.

1 INTRODUCTION

There has been growing interest in and application of ‘market-based instruments’ (MBIs) to incentivise pro-environment behaviour. MBIs, sometimes described as “economic instruments”, seek to bring market opportunities and processes into areas that have been traditionally managed by government regulation, information and education. MBIs are grounded in the notion that environmental problems, such as water pollution, biodiversity loss and climate change, are the result of market failure because many environmental goods and services are public goods. It is argued, that if it is possible to design and implement markets or market-like mechanisms, then this failure can be addressed in many situations (Lockie, 2010). The underlying belief is that MBIs will make conservation financially attractive to the private sector.

In comparison to traditional regulatory or command-and-control approaches, MBIs offer the potential to achieve environmental outcomes more efficiently by providing decision makers—individuals, households and firms—with a rationale on which to make decisions that are in both their own and the public interest (Lockie, 2013; Stavins, 2003). MBIs increase flexibility and adaptability to changes in conditions (Windle et al., 2005).

There is an extensive list of MBIs and they are typically classified into three types of mechanisms: market friction, price-based and rights-based (Lockie, 2013; OECD, 2007; Stavins, 1998).

In the context of water pollution from agricultural activity, price-based MBIs which provide financial incentives for land-use change are most likely to induce a decline in nutrient load (Armour et al., 2009; Hunter and Walton, 2008). From an investor perspective, the efficiency of investment can be increased if the level of financial incentive is determined in a competitive process, through a competitive tender or reverse auction (Windle and Rolfe, 2008). Scarce resources can then be allocated to those bids which provide the greatest environmental benefit per dollar of funding.

Environmental tenders are becoming an increasingly popular policy instrument, as evidenced by recent implementation of ‘reverse auctions’ to achieve water quality improvements in the GBR and reduction of greenhouse gas emissions. These tenders are designed and based on economic theory and in the absence of a comprehensive body of ex-post evaluations of past tender programs. This project reviews one environmental tender program, a water quality tender trial, so that lessons learnt from observations can complement economic theory and help inform the design of future tenders.

In 2007-08, a Water Quality Tender (Tender) was trialled in the Lower Burdekin River area. It was jointly funded through the National MBI program and the National Heritage Trust Phase 2. Significant in-kind investment was also provided by the Qld Department of Primary Industries. The Tender provided approximately \$600,000 in investment into water quality improvements, including infrastructure, machinery and other devices to help farmers reduce water pollution.

This report documents an ex-post evaluation of the Tender. The purpose of the evaluation was to ascertain:

- whether successful bids were fully implemented and have persisted and therefore continue to make a positive contribution to water quality in the GBR;
- whether proposed activities which did not receive funding at the time were implemented after 2008;
- whether participation in the Tender generated additional investment in water quality improvements and natural resource management more broadly; and
- what the experiences of participants were with respect to implementation and administration of the Tender.

The significance of the research lies in its contribution to evidence-based policy and program development. Ex-post evaluations are particularly important to enable adaptation of environmental policies and programs, with empirical observations offering an important counterbalance to theory-based predictions (Herrick and Sarewitz, 2000).

Insights and learning gleaned from empirical data can inform the design and implementation of future environmental tenders, MBIs and other policies and programs. This report summarises the research, providing a retrospective and systematic assessment of a “real-life” MBI based on empirical evidence. This evidence generates important understanding as it complements the theory about MBIs and tenders.

Section 2 of the report provides relevant context. The first part of this Section outlines the implementation process and theory underpinning the 2008 Lower Burdekin Water Quality Tender, and Tender outcomes. The second part introduces other elements of economic theory relating to the efficiency of public investment with specific reference to the use of competitive tenders as a vehicle for allocating such investment. This theory forms the basis for evaluating various facets that determine the efficiency of the Tender.

Section 3 of the report outlines the methodological approach taken by the research and details methods. Section 4 provides and interprets the results. Section 5 offers a discursive evaluation of the research and its findings and Section 6 offers conclusions and recommendations.

2 RELEVANT CONTEXT

2.1 The 2008 Lower Burdekin Water Quality Tender

The Tender is described in detail in a series of research reports and publications (Greiner et al., 2008; Hailu et al., 2008; Rolfe et al., 2007a; Rolfe et al., 2011a; Rolfe et al., 2008; Rolfe et al., 2007b; Rolfe et al., 2007c; Windle et al., 2008). The following provides a brief synopsis to give relevant context for the ex-post evaluation.

2.1.1 Geographical scale of the Tender

In 2007-08, a Water Quality Tender (WQT) was conducted in the Lower Burdekin area, which takes in the Lower Burdekin River, Barratta Creek and Haughton River precincts within the Burdekin River Catchment (Figure 1).



Figure 1: Map indicating area covered by the Tender

2.1.2 Tender scope and process

The Tender had a funding scope of approximately \$600,000, which included funding provided by the Australian Government through the National Market Based Instruments Program, with additional funding provided by the NQ Dry Tropics under its Regional Investment Strategy.

The roll-out of the Tender followed the stages established by Latacz-Lohmann and Van der Hamsvoort (1997) and Stoneham et al. (2003):

- Details of the Tender were publicised and promoted (August 2007).
- Landholders could register by completing an Expression of Interest form (September to November 2007).
- Landholders who submitted an Expression of Interest received a visit from extension and tender design staff to identify suitable projects and explain the process (September to December 2007).
- Landholders submitted bids (January 2008).
- Bids were evaluated and assessed (February to March 2008).
- Landholders were informed of the outcomes, and contracts drawn up with successful applicants (April 2008).

The Tender attracted 87 bids for a range of water quality improvement proposals. Bids were drawn from landholders across the sugar cane and grazing industries from across the entire Lower Burdekin area. The majority of submissions (78) were for activities on cane land, and a further nine were for grazing land management. Of the 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 water recycle pits. There were a variety of infrastructure, earthworks and machinery-related proposals, including:

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

There were 64 applicants. Some farmers submitted multiple bids, with ten farmers submitting two bids each, three submitting three bids each and one applicant submitted four and another applicant five bids.

Each bid contained a description of the proposed activity, total cost estimate and a dollar-value bid price. The bid price was the funding request. Bid prices ranged from \$1,500 to \$130,000, with an average of \$25,131 and median value of \$14,800. In total, the bids asked for \$2.2 million in funding and consequently exceeded available funding by almost four times. Figure 2 shows the bids in order of increasing bid price. The figure illustrates that landholder contributions varied widely with relative contributions ranging from zero to multiple times the bid price.

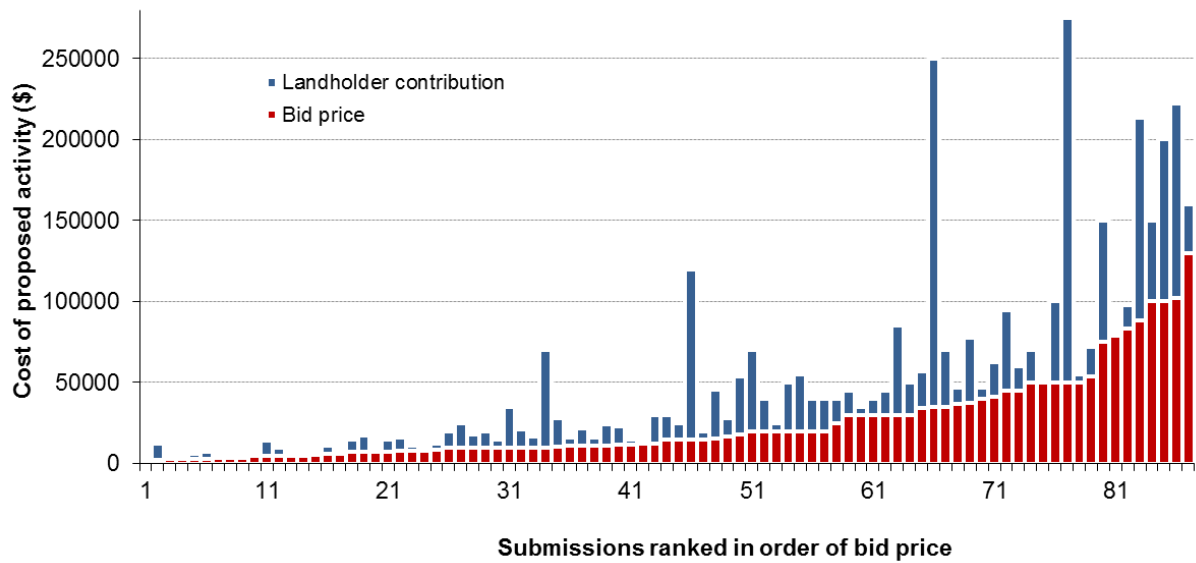


Figure 2: Tender bid values, landholder contribution and bid price, ranked by bid price

(Greiner et al., 2008)

2.1.3 Assessment of bids

To establish which bids should be funded, their relative merit was established. An evaluation process assessed each bid in terms of the marginal benefits in emissions that would result from the proposed action. Emissions included sediments, nutrients and herbicides/pesticides. Also considered were:

- area of land or drainage involved;
- soil type (cane only);
- rate of off-farm movement into ground water and surface runoff (cane only);
- fertilizer and pesticide application rates (cane only);
- capacity of recycle pits or other interception structures;
- number of years benefits would continue for (maximum of five);
- type of farming systems involved;
- future intentions of landholder;
- rainfall (grazing only);
- current land condition (grazing only); and
- slope (grazing only).

To assess the water quality benefit embodied in each bid, a metric estimated the pollution reduction for each bid by pollutant relative to the 2013 pollution reductions target for the Lower Burdekin. This resulted in an Environmental Benefits Score (EBS) for each bid. Bids were subsequently ranked in terms of their attractiveness, i.e. the estimated efficiency of investment as represented by unit of EBS per dollar of investment asked.

The cumulative bid curve (Figure 3) shows bids ranked in decreasing order of attractiveness. The curve exhibits the classic 'hockey stick' pattern as shown by Stoneham et al. (2003).

From the 87 bids received, 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 Tender were predicted to achieve the following emission reductions:

- 491.8 tons of sediment reduction for \$89.22 per ton,
- 96,207 kg nitrogen reduction for \$4.55 per kg, and
- 55.6 kg Pesticide reduction for \$2,221 per kg.

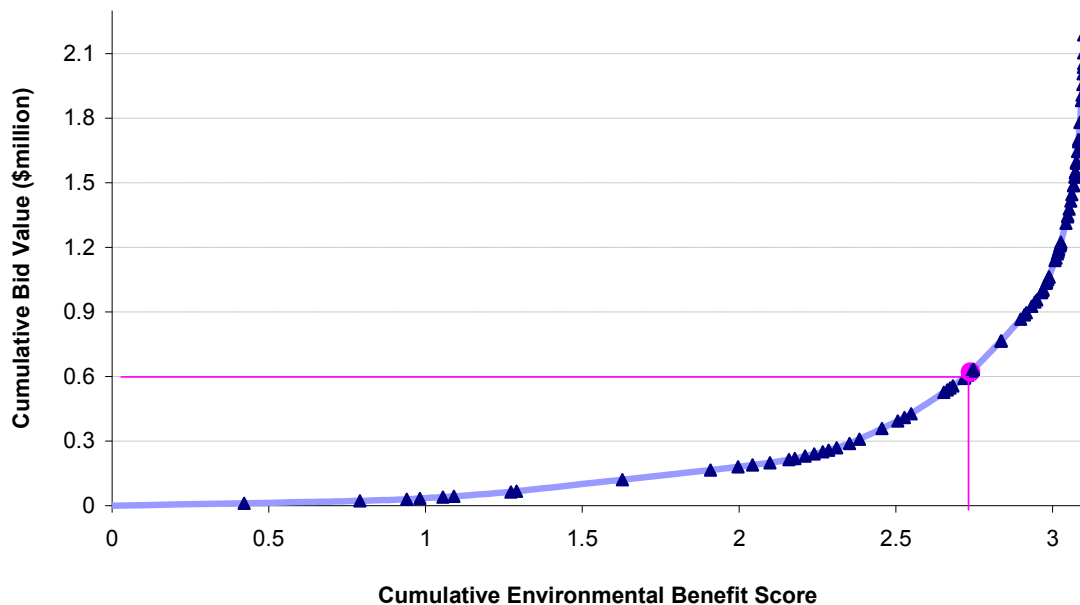


Figure 3: Tender bid curve with cumulative bids and environmental benefits index

(Greiner et al., 2008)

There was no clear pattern as to what type of proposed activities generated the lowest or highest bids, or what size bids provided the most attractive options.

2.2 Factors determining efficiency of public investment in environmental improvements using MBIs

Efficiency of investment is an important criterion for the evaluation of MBIs (Greiner et al., 2000). Among MBIs, competitive tenders are particularly geared towards maximising allocative efficiency. In the context of public investment into water quality improvement, tenders maximise allocative efficiency of investment by exploiting the heterogeneity of cost between farmers to deliver improvements (Rolfe et al., 2008). Put simply, tenders maximise the 'purchase' of environmental outcome per unit of investment by ranking bids according to their efficiency and choosing the most efficient bids for funding—as shown in Figure 3.

There are, however, other aspects to consider when assessing the efficiency of investment, in particular whether a program achieves additionality and generates crowding effects.

The efficiency of investment is increased if it achieves additionality. Additionality means that a policy or program achieves outcomes in addition to those that would have occurred in the absence of the policy or program (Sierra and Russman, 2006). The efficiency of incentive payments is diminished if payments are provided for practices that would have been adopted anyway (Sierra and Russman, 2006).

The efficiency of investment is also increased if the mechanism reinforces people's intrinsic motivation to contribute to making environmental improvements. In environmental economics literature there is ongoing debate whether MBIs serve to reinforce ("crowd in") or undermine ("crowd out") landholders' intrinsic motivations to invest in environmental improvements. Crowding out theory suggests that an external intervention via monetary incentives or punishments tends to undermine intrinsic motivation, i.e. that it reduces a person's inherent propensity to engage in socially desirable behaviour by introducing a financial motif (Frey and Jegen, 2001). Indeed, in a recent review of empirical studies into payments for biodiversity conservation, Rode et al. (2015) found more evidence of monetary incentives causing crowding out compared to crowding in effects.

In the context of conservation tenders, it has been experimentally shown that the introduction and subsequent removal of a conservation auction significantly reduces voluntary provision of environmental quality, compared to a control group that does not experience an auction (Kits et al., 2014).

3 METHODOLOGY

3.1 Ex-post program evaluation

To assess the legacy of the Tender, the research adopted an ex-post program evaluation approach. Program evaluation is the “systematic collection of information about the activities, characteristics, and results of programs to make judgments about the program, improve or further develop program effectiveness, inform decisions about future programming and/or increase understanding” (Patton, 2008, p.39). Evaluation is a process of systematic collation of information, focused on specific issues, for a variety of possible uses and judgements. Following Rossi et al. (2004), evaluation involves applied science using social research methods.

The evaluation took place within the specific context provided by the Tender, and with specific emphasis on the permanency of change achieved and crowding-in or crowding-out effects generated. The evaluation specifically explored:

- whether successful bids were fully implemented and have persisted and therefore continue to make a positive contribution to water quality in the GBR;
- whether proposed activities which did not receive funding at the time were implemented after 2008;
- whether participation in the Tender generated additional investment in water quality improvements and natural resource management more broadly; and
- what the experiences of participants were with respect to implementation and administration of the Tender.

3.2 Survey of Tender participants

3.2.1 Ethical conduct

All aspects of survey design and implementation adopted social research best practice and adopted the five ethical responsibilities towards survey participants, namely voluntary participation, informed consent, no harm, confidentiality and privacy (De Vaus, 2002).

The Executive Review Committee of James Cook University granted ethics approval H6327 on 18 September 2015 for the survey to proceed. It approved the informed consent form and information sheet (Appendix 1).

3.2.2 Survey sample

The sample frame for the research was pre-determined to include the landholders in the Lower Burdekin region, who had participated in the Tender. NQ Dry Tropics, as the administrating body of the Tender and partner agency in this research, provided the contact details of 64 landholders to the researcher, including details of the proposals they had submitted to the Tender. Consequently, the sample frame was 64 landholders.

Given the small sample frame, the intention was to contact every Tender participant, provided they could be contacted by telephone. To maximise the likelihood of Tender

participants agreeing to participate in the survey and to address privacy law considerations, NQ Dry Tropics mailed an information letter to Tender participants to inform them of the research and advise them that they would be contacted by the researcher. A copy of the letter is shown in Appendix 2.

It was anticipated that a sample of 30 interviews would allow some basic descriptive analysis of structured response data and would also constitute an 'adequate sample size' from the perspective of qualitative research (Sandelowski, 1995) by achieving informational redundancy.

3.2.3 Conducting interviews

Interviews were conducted during November 2015. Tender participants were contacted by telephone if a contact telephone number could be established. For most participants, a contact number was given in the NQ Dry Tropics data base. A White Pages and Yellow Pages search of missing telephone numbers in the data base was conducted. If no contact telephone could be established, or if incorrect numbers could not be rectified, Tender participants were not contacted. No less than four attempts were made at contacting every Tender participant for whom a correct telephone number was available. Where possible, a voice message was left, but on no more than two occasions, with a call-back number.

If contact could be made, and Tender participants agreed to participate in the survey, they were given a choice between completing the survey over the telephone or by face-to-face interview. Mixed-mode methodology can help to increase the response rate of a survey (Dillman et al., 2009). If respondents chose telephone interview, a suitable time for the interview was established. If they chose face-to-face interview, the preferred interview location and a suitable time were arranged.

Telephone interviews took between 15—30 minutes to complete, face-to-face interviews between 30—45 minutes.

Given the 7-year interval between the Tender and this survey, it was important to maximise data integrity by ensuring respondents recalled the Tender in as much detail as possible. Respondents' recall and their ability provide accurate and useful information was enhanced by the mail-out information letter. In addition, at the beginning of each interview, the researcher confirmed with the respondent the accuracy of the data contained in the Tender data base relating to activities proposed and success of bid(s), and provided a summary of the key process elements and dates of the Tender.

3.2.4 The questionnaire

The survey was based on a questionnaire, which consisted of two sections. Section 1 explored aspects relating to the Tender. Section 2 established respondent-specific socio-economic and attitudinal information. Some questions in Section 1 only applied to successful Tender participants. A copy of the questionnaire is provided in Appendix 3.

The questions that applied to successful Tender participants only asked:

- Whether any difficulties were encountered in fulfilling the contract—specifically in relation to cost—and if and how these were resolved;
- How satisfied respondents were with the performance of the investment;
- Whether the investment had served as a learning opportunity for others; and
- Whether the investment had yielded financial benefits.

For unsuccessful Tender participants, the questionnaire explored, *inter alia*,

- Whether any of the proposed activities were undertaken in the absence of the requested payment.

The questionnaire also ascertained:

- Socio-demographic information of the respondent;
- Property and land-use related information;
- Whether respondents used the GBR for fishing or recreation;
- Stated intention to participate in the forthcoming nitrogen reverse auction; and
- Attitudinal responses to a variety of statements.

Principles of effective attitudinal survey design were followed in the construction of questions and response formats (Creswell, 2009; De Vaus, 2002; Krosnick and Fabrigar, 1997; Krosnick and Presser, 2010).

To enable descriptive and analytical statistics to be performed on the survey data, each question was initially asked by a closed question, which typically required binary (yes/no) or scaling responses. A five-point response scale was adopted for some questions to provide a good measure of intensity, extremity and direction and also enable treatment of variables as ordinal data for parametric data analysis (Zar, 1984). For example, respondents were asked to state their level of agreement from 1=strongly disagree to 5=strongly agree.

To maximise the explanatory power of the survey, most closed questions were followed by an open-ended question to prompt respondents to provide as much detail and illustration about any question as they were willing to share. The final survey question provided scope for respondents to provide suggestions they deemed relevant for policy and program development.

Due to the small sample frame no pre-testing of the survey was conducted and all responses were included in the data analysis.

3.3 Coding and data analysis

The surveys were coded in MS Excel©. Data verification was conducted on 100% of the sample. Descriptive analysis of quantitative data was performed in MS Excel© and/or Stata©, and advanced analysis was undertaken in Stata©.

Quantitative analysis of the data was undertaken within the constraints of the small sample size and with the intention of complementing the qualitative insights provided by survey respondents.

Key descriptive measures including minimum, maximum, median, average and frequencies are reported. Post-hoc comparison between the successful and unsuccessful Tender participants was done using t-test for continuous variables, Mann Whitney test for ordinal data and Fisher's exact test for binary data (Motulski, 1995; StataCorp, 2013a). Associations between variables associated with socio-demographic covariates were explored using correlation analysis for continuous covariates, Mann Whitney test for ordinal data and Fisher's exact test for binary data (Motulski, 1995; StataCorp, 2013a). Statistical analysis was conducted in Stata13[®] (StataCorp, 2013b).

The alpha level for interpretation of statistical significance was set at $p < 0.05$ unless otherwise stated. Testing for associations was undertaken systematically and results are reported where statistically significant results were found.

Qualitative data were grouped and organised to support interpretation of quantitative survey results. Respondent identifiers are shown where qualitative responses are shown in the report. Identifiers indicate the success of respondents in the Tender. A number commencing with '2' indicates that the respondent had one successful bid, '4' indicates one unsuccessful bid, '3' indicates multiple bids of which one was successful, '5' indicates multiple unsuccessful bids.

4 RESULTS

4.1 Sample, response rate and representation

Of the 64 Tender participants given in the data base, which formed the sample frame, 19 could not be contacted. Reasons for non-contact included: participant was deceased; no telephone contact number could be obtained; participant could not be contacted after at least four attempts. Of the 45 Tender participants who could be contacted, three declined to participate in the research.

The sample size was 42 respondents, or 66% of the tender frame, and the response rate was 93%. Of respondents, only two requested a face-to-face interview, the remaining 40 preferred to be interviewed over the telephone.

The survey participation statistics are shown in Table 1. The 42 respondents had submitted a total of 59 bids in the Tender, which was 68% of bids submitted in 2008. Of respondents, 33 had submitted one bid, five had submitted two bids, two had submitted three bids and one respondent, each, had submitted four and five bids. Of one-bid respondents, 15 had been successful and 17 had not received funding. Of respondents with multiple bids, two had all bids declined while seven had one of their bids funded.

Table 1: Survey participation: representation of Tender participants and bids

	Sample frame (Tender)	Sample (this research)	Survey represent- ation (%)
Number of bids	87	59	68%
Number of Tender participants	64	42	66%
One bid - successful	20	15	75%
One bid - not successful	29	17	59%
Multiple bids - all successful	1	0	0%
Multiple bids - one successful	10	7	70%
Multiple bids - none successful	4	3	75%

The 59 bids provided a representative sample, which included all types of water quality improvement measures that had been proposed, and including a majority of activities on cane farms and two on grazing land. The sample showed a very good match with the Tender on basic value statistics (Table 2). The average value of proposed actions in the sample was \$51,550, which was 4.5% higher than the average value of proposed actions in the sample frame. Average bid value in the sample was \$24,813, which was 1.3% lower than average bid value in the sample frame. Median bid value in the sample was \$15,000, which was 1.3% higher than the median in the sample frame.

Table 2: Comparison of activity and bid values in survey frame and survey

	Value of proposed activity (\$)		Value of bid (\$)	
	Tender (N=87)	Sample (N=59)	Tender (N=87)	Sample (N=59)
Average	\$49,310	\$51,550	\$25,131	\$24,813
Median	\$28,000	\$25,000	\$14,800	\$15,000
Minimum	\$2,700	\$3,000	\$1,500	\$1,500
Maximum	\$275,000	\$275,000	\$130,000	\$102,091

4.2 Descriptive statistics of respondents

Respondents were asked to provide basic socio-demographic details. The resulting overview is shown in Table 3. All respondents were male. The most prominent age bracket was 60-69 years old and all respondents were at least 40 years old.

Three quarters of respondents indicated that they had completed high school, and one-in-five had undertaken tertiary studies relevant to agriculture. More than 80% of respondents had completed agriculture-related technical training courses and industry-relevant courses such as “6 easy steps”.

Table 3: Respondents' socio-demographic attributes

Attribute	Category	Percentage of respondents (%)
Gender	Male	100.0%
	Female	0.0%
Age	Younger than 30 years	0.0%
	30-39 years	0.0%
	40-49 years	10.3%
	50-59 years	28.2%
	60-69 years	38.5%
	70 years and older	23.1%
Education (completed)	Primary school	97.6%
	High school	76.2%
	Tertiary education relevant to agriculture	21.4%
	Tertiary education -- other	2.4%
	Training and certificates relevant to agriculture	85.7%
	Land and water 'best management' course(s)	31.0%
	DPI / BSES and similar courses (e.g. 6 easy steps)	81.0%
Engaged in fishing / recreation in the GBR	Yes	71.4%
	No	28.6%

Almost three quarters of respondents indicated that they went fishing, at least occasionally, and/or diving and snorkelling in the GBR.

All respondents managed family farms, with one exception, which was a corporation-owned property (Table 4). Property size ranged from 35 to 3500 ha with a median of 200 ha. Most farms had been in the same ownership for more than 40 years, some since settlement of the district. With two exception (grazing properties), all grew cane. Of respondents, two were graziers who did not grow crops. Of respondents growing cane, approximately half did grow other crops, including break crops or other crops such as cereal grains and rice.

Table 4: Respondents' property characteristics and land uses

Attribute	Category	Value
Farm size	Average	467 ha
	Median	200 ha
	Minimum	34 ha
	Maximum	3500 ha
Percentage of respondent properties (%)		
Type of ownership		
	Family-owned	97.7%
	Corporation-owned	2.3%
Length of ownership		
	less than 10 years	17.1%
	10-19 years	14.6%
	20-39 years	7.3%
	40 years and more	61.0%
Land use		
	Sugar cane	95.1%
	Other crops (main and break crops)	43.9%
	Horticulture	9.8%
	Grazing	19.5%

4.3 Completion and persistence of proposed activities

4.3.1 Contracted Tender activities

Respondents were asked whether they had completed the proposed activities they had received funding for. Of the 24 funded proposals, 83% were completed as per the contract resulting from the Tender. Three activities, which received funding, were never implemented and one was partially completed (Table 5).

Of ten recycle pits, which received funding for construction only seven were completed. One recycle pit was only partially completed, with the earthworks completed but the pump not operational:

"The pit is there but it [the pump] still needs hooking up. There have been problems with electricity." R366

Table 5: Completion rates of successful Tender proposals (%)

Types of work	Count	Fully completed	Partially completed	Not implemented
New recycle pit	10	70%	10%	20%
Recycle pit modification	5	100%		
Irrigation system	2	50%		50%
Machinery	7	100%		
Total	24	83%	4%	13%

Construction of two recycle pits never commenced, principally because cost projections, which had underpinned the proposals, were found to be too low:

“There was a cost blow-out. The power supply [to the pump] would have cost heaps more than planned.” R223

“There were two reasons why it [the recycle pit] did not go ahead. Before we began digging there was a massive cost blow-out and also the neighbour, whose water the pit was going to capture, put a pit in of his own”. R202

The installation of a lateral move irrigator also did not proceed following more detailed investigations into the proposed strategy.

“We did additional research asking people who had them [lateral move irrigators], which showed that they did not have very good experiences”. R211

The funded machinery included stool splitters, hooded sprayers, legume planters, a variable rate fertilizer applicator and GPS, all of which were purchased, and all of which are still in use.

There were cost over-runs associated with the construction of most of the recycle pits, with only three recycle pits reportedly completed on budget. This reveals a tendency of proposals to underestimate the cost of major infrastructure projects.

“It was twice as expensive [as planned].” R217

“We needed to fix some issues, which caused additional expenses.” R221

Of the funded and completed recycle pits and recycle pit extensions, all bar one were said to be operating as intended and to the satisfaction of respondents.

“It’s the best thing I could have ever done. It captures all the runoff water, and all nutrients and pesticides. They [recycle pits] should be mandatory.” R203

One recycle pit was not functioning well because it was losing water through deep drainage and not yielding recycled water. All of the machinery was said to be still in operation as intended, with one shielded sprayer requiring modifications initially to be functional.

Respondents who had constructed recycle pits noted a variety of benefits:

“I am fairly happy. It [recycle pit] is fully operational and I haven’t done any additional work to it. It ensures that no tail water is leaving the farm, and no nutrients and chemicals.” R370

"It [recycle pit] generates cost saving by being able to re-use the water you have already paid for. It also improves ease of management, you don't have to be worried about getting up at 4 am to turn off the pump." R366

"I recycle the whole lot. It delivers great water savings." R369

"It allows me to pump water from the pit cheaper than what I can buy water. I also get the waste water from other farms." R209

"It gives me 'insurance', most significantly in a dry year where I now have more options and am not 100% reliant on Sunwater." R217

"It has given us access to water that we would otherwise lose. It gives us more water, easier water management and improves farm productivity." R370

"The benefit [of the recycle pit] is not financial, but it has improved our farm sustainability." R212

Respondents who had purchased various types of machinery were also satisfied with their performance.

"It eliminates the necessity to use pre-emergent herbicides." R214 [shielded sprayer]

"I decreased chemical usage by LOTS, and it is more time efficient. We were the first to get one. Many farmers have bought one since then." R362 [hooded sprayer]

"I don't have to do as many passes and it causes less ground disturbance." R204: [stool splitter]

"The variable rate applicator is achieving what I was trying to achieve. It puts on the right amount of fertilizer to the right amount of yield." R371

Benefit rating of the funded activities was not statistically associated with whether or not their implementation had caused unexpected costs to the respondents.

Successful respondents who had completed the contracted activity were asked whether other people, including other farmers and extension officers, had ever inspected the activity. Of 18 responses, ten were in the affirmative. All types of investments were reportedly inspected. This indicates that the Tender served to progress the adoption of water quality improvement innovations.

4.3.2 Unsuccessful Tender proposals

Respondents were asked whether they had undertaken the activities contained in unsuccessful proposals to the Tender. Of 35 proposals, almost three quarters were nevertheless subsequently implemented, across all types of water quality improvement measures (Table 6).

Table 6: Completion rates of unsuccessful Tender proposals (%)

Types of work	Count	Fully completed	Partially completed	Not implemented
New recycle pit	9	67%		33%
Recycle pit upgrade/extension	6	50%	50%	
Irrigation system	2	100%		
Other infrastructure	4	50%		50%
Machinery	9	89%		11%
Other	5	100%		
Total	35	74%	9%	17%

Many of the proposals were re-worked and then re-submitted when other funding opportunities emerged, and some were subsequently funded under various Reef Rescue programs. Many respondents who did not receive funding, either in the Tender or in subsequent funding rounds, proceeded to implement the proposed activities anyway.

"I built it myself, a 10 ML [recycle] pit, and put the power to it. It cost me \$40,000 to build and \$150,000 to put the power in." R431

"I did it off my own bat. It is one of the best recycle pits around and people come to look at it." R432

4.4 Respondents' recollection of and experiences with the Tender

4.4.1 Recollection of the Tender

Despite the 7-year time lapse between the Tender and this research, all respondents indicated that they had at least a vague recollection of it, and more than 62% of respondents stated that they clearly remembered all or 'most aspects' of the Tender (Table 7). Indeed, in the majority of cases, respondents recalled key details of the process and their EOI(s), and the associated funding decision(s). However, approximately one quarter of respondents only had a vague recollection and required the interviewer to refresh their memories.

Table 7: Respondents' recollection of the Tender

Recollection	Proportion of respondents (%)
"Do not remember"	0%
"Remember vaguely"	24%
"Remember some detail"	14%
"Remember most aspects"	38%
"Remember clearly"	24%
Total	100%

One respondent specifically noted:

"I remember very clearly because at the time there was talk about government bringing in regulation. The tender was a great opportunity to prove things." R203

4.4.2 Satisfaction with Tender

Respondents were asked to indicate whether they were generally satisfied with the way the Tender had been administered, in particular in terms of implementation of a competitive tender concept, and regarding the communication and explanation of the funding decisions. The results are summarised in Table 8.

Table 8: Respondent satisfaction with the Tender (proportion of respondents, %)

Satisfaction	Implementation / administration of the Tender	Communication of Tender results
Number of responses	41	39
"Satisfied"	73%	28%
"Dissatisfied"	10%	44%
"Neither satisfied nor dissatisfied"	0%	3%
"Unsure"	17%	26%
Total	100%	100%

Of respondents, almost three quarters indicated that they were satisfied with the manner in which the Tender had been run though the competitive concept which was novel to many. The Tender aspect, which attracted most comment, of a positive kind, was the farm visit and one-on-one consultation offered in the preparation of tailored expressions of interest (EOIs). Most respondents commented favourably on the Tender process, as illustrated by the following quotations.

"I thought the tender was put together well." R541

"It was very good, straight forward. It was the first time I participated in a grant." R368

"Was run quite well, particularly given that it was the first time something like that was done." R222

"The people who guided me through it and filled out the paperwork were really good." R215

"People who had local knowledge helped put proposal together. They were not bureaucrats." R203

"The one-on-one was great. They looked at what I wanted to achieve and helped write the proposal." R371

"The one-on-one [was the best aspect]. The guy from Burdekin Dry Tropics was very practical." R436

"I liked the follow-up workshop and the \$50 voucher." R366

"It [requirements for funding] could have been a bit harder" R211

But not everyone had a positive recollection:

"The process was laborious." R440

"The guys who came out to look at the proposal weren't really interested in understanding the proposal. All they wanted to do was sit under a tree." R427

"Nobody came out to discuss the EOIs." R564

Respondent satisfaction with the way the funding decisions had been communicated and explained was low, with only 28% of respondents stating they were satisfied with this aspect of the Tender. In many cases, positive ratings appeared explicitly aligned with the outcome of funding decisions. The following comments are illustrative for many similar comments.

"I was happy that I got the money." R202

"My proposal was damn good. I would have been upset if I had not got the money." R203

Negative ratings tended to be given by respondents who had not received funding, or those who disliked other aspects of the Tender:

"The amount of information that we had to supply was onerous." R370

"There was no explanation given [why I wasn't successful]." R420

"There was no reason given why I didn't get the money." R416

"I didn't get an explanation why the other proposal was refused." R367

"I didn't get the funding and don't know why. Some people got a lot of money." R450

"There was no real feed-back, they just said it wasn't suitable. A lot of the money seemed to be going to the bigger growers." R432

"We got nothing. Nobody explained why not. I fail to understand how the [funding] decisions were made. It must have been political." R564

Some successful respondents were also critical of funding decisions.

"To my mind, as an industry representative, there was an awful lot of money wasted on projects that were on the margins, while other projects, which would have delivered better water quality outcomes, were not funded. For example, several proposals for recycle pits from small farmers were not funded while other people got GPS for their tractors, with a questionable benefit for water quality." R211

Fisher's exact analysis indicated that respondents with a successful Tender result were significantly more likely to be satisfied with both the process ($p=0.001$) and the communication of results ($p=0.045$). Respondents with a clearer recollection of the Tender were significantly more likely to state that they were satisfied with the Tender process ($p=0.039$).

The concept of a competitive mechanism for allocation funding did not agree with everybody, irrespective of whether they received funding or not, but a positive funding decision appeared to hold the key to an overall positive assessment of the Tender.

"It was a weird way of doing things; you got to bid for money." R208

"[I disliked] just the way it was done. You had to put in a figure. I didn't know what to put in. In the end, I was happy to get \$15,000." R208

But: *"There wasn't anything to dislike. We were getting help and money for little effort. It was a great thing." R362*

"It [the tender] helped us implement something we could not have done otherwise." R212

4.4.3 Reflections on the proposals

Respondents were asked whether, if they could go back in time, they would change their Tender proposal. A majority of respondents (60%) answered in the affirmative.

Of successful respondents, some indicated that they would increase their bids while others would have improved the technical specifications of their proposals:

"I would have been more adventurous and asked for more money." R208

"I could have got a better seeder, an air seeder, which would be more modern and versatile." R215

"I would have done a bit more investigation and gone for bigger storage." R217

"I would ask for more money because it cost a whole lot more than budgeted." R369

Of respondents who had not been successful, many said they would put more effort into tailoring and articulating their proposals, while others resented the effort they put into preparing the proposal(s):

"I would propose a different location." R416

"I would probably have more water capture, rather than just my own farm." R431

"I would employ a consultant to write a better proposal, and I would go for a bigger investment." R422

"I would lie about everything and not tell them the changes I had already made." R427

"I would not have wasted the time." R564

4.5 Changes attributable to the Tender

4.5.1 Changes to farmers' knowledge and farming systems

Respondents were asked whether they thought participation in the Tender had firstly, changed their understanding about the relationship between agriculture and water quality, and secondly, had changed their farming system. Less than half of respondents thought that they had acquired new knowledge about how agriculture affected water quality by participating in the Tender. A majority of respondents (56%) indicated that as a consequence of the Tender their farming system had changed permanently (Table 9).

Table 9: Changes to knowledge and farming systems (proportion of respondents, %)

Response	Changed understanding of 'agriculture and water quality'	Changed land management and/or farming system
Number of responses	37	39
"No"	51%	44%
"Yes"	46%	56%
"Unsure"	3%	0%
Total	100%	100%

Fisher's exact test found no association between respondents' success in the Tender and stated impact on understanding, but funding success was significantly positively associated with stated change of the farming system ($p=0.001$).

Respondents who indicated that the Tender increased their awareness and understanding:

"It helped me understand the downstream repercussions of on-farm action." R202

"It made me think about it [WQ]." R209

"Brought it [WQ] to the forefront of my mind." R211

"It made me understand the financial benefits of water recycling." R363

"It opened my eyes to how much water I could save. And all this water doesn't go out to the Reef." R369

"Yes, at the time. It was the start of a big push for water quality. I am still to be convinced that all this money government is throwing at people for shielded sprayers etc. is making a difference. None of my water is leaving the farm. So how do I affect the reef?" R368

Respondents who thought they had not learnt anything new commented:

"It has not changed my understanding. Water has always been a big issue." R212

"I have always tried to do the right thing and I got salty underground water, so I am very conscious [of WQ]. It [the Tender] reinforced what I knew." R431

"I have always been very aware [of the impact on WQ], but getting the funding was a step to conserving water and keeping it in-house." R221

"I have always understood it, but doing something [to improve water quality] was always out of grasp. I get a nice fuzzy feeling from doing something good." R362

"It might have been so for other growers. I read anything and everything." R420

"I am a firm believer in water quality, have been all along." R432

"Over time, more growers have become aware because of media, workshops and industry forums." R410

Respondents commented on how funding received under the Tender helped them change their farming system:

"You get into the mindset of WQ, next thing you start reducing fertilizer and use of pre-emergent [herbicides]..." R368

"My system is changing constantly. I learn something new every day. Participating in the Tender got me on the way to Catalyst accreditation." R221

"We were heading down this road [to improving our farming systems], so the money helped." R211

"It has helped us on the pathway to a more holistic approach to farming." R212

"By getting the sprayer we changed spraying practices. I am now part of project Catalyst and progress groups." R362

"We have put in additional recycling pits and enviro-scan, which helps with scheduling of irrigation and reduces deep drainage." R370

"We have done lots of things, including getting GPS and a shielded sprayer. We have also changed the planter which reduced the need for ground preparation for plant cane." R410

"I did the recycle pit, without funding, then bought instruments to measure N and P in my tail water." R420

"I am now doing 96% water recycling and also bought a GPS and new spray rig, so I use less Diuron." R215

"I spent \$400,000 on water quality improvements—all our own money. I replaced concrete pipes and generated large water savings. I am monitoring water outflow." R360

4.5.2 Additionality effect: Tender participation

To get an indication whether the Tender enticed people into taking water quality action, the survey ascertained whether proposals submitted to the Tender were the first water quality improvement activities that respondents had contemplated.

Approximately two thirds of respondents indicated that they had not undertaken any (deliberate) action on their property to improve water quality prior to the Tender (Table 10), and only 21% of respondents stated that they had previously participated in a NRM program. This indicates that the Tender drew people into participation in a NRM program, and specifically incentivised investment in water quality improvement.

"The subsidy gave an incentive to apply." R412

"Grants are a great way for people to do environmental improvements." R209

Table 10: Water quality action prior to Tender (proportion of respondents, %)

Response	"First" water quality improvement action	"First" NRM program participation
"No"	31%	21%
"Yes"	67%	79%
"Unsure"	2%	0%
Total	100%	100%

Comments offered by respondents who had undertaken prior water quality actions included:

"Not even close! I installed a recycling system 20 years ago and invested quite a bit of time and money since 1992." R367

"I implemented a recycle pit before it became fashionable and funding for this type of work became available." R424

"I had done a \$150,000 investment in water capture before and had gone away from using Atrazine, Diuron and other chemicals." R427

"I installed a recycle pit previously and fenced off some swamps and riparian vegetation." R433

"I bought the farm in 2006 and it already had two recycle pits on it." R217

Some respondent comments directly attested to of additionality effects of the Tender:

"It [the tender] helped us implement something we could not have done otherwise." R212

"I could not have done it [recycle pit] without the funding." R221

4.5.3 Post-Tender additionality and crowding effects

Respondents were asked to indicate whether subsequent to the Tender they undertook (further) water quality improvement activities on their property, or other natural resource management and conservation activities. The vast majority of respondents (88%) indicated that they undertook water quality improvement activities or investment following the Tender, while less than 30% of respondents engaged in other natural resource management or conservation activities since (Table 11). The rate of subsequent activity was not statistically associated with success in the Tender.

Table 11: Post-Tender water quality and NRM action, by Tender success (proportion of respondents by category, %)

Category: Success in the Tender	Subsequently undertook water quality measures (% category)	Subsequently undertook other NRM or conservation activities (% category)	Total (count)
One successful proposal	93%	21%	14
One unsuccessful proposal	82%	41%	17
Multiple proposals, one successful	100%	14%	7
Multiple unsuccessful proposals	67%	33%	3
Total	88%	29%	41

Many respondents who had to date not undertaken additional WQ improvement activities indicated that they were either hoping to do so at some point in the future.

Following the Tender, the vast majority of respondents (80%) participated in subsequent NRM and water quality programs and sought funding for (further) water quality improvement measures. There was no statistically significant association between success in the Tender and participation in subsequent funding programs (Table 12).

Table 12: Number of Tender participants seeking subsequent NRM funding (count data)

Success in the Tender	Did <u>not</u> seek further NRM funding	Sought further NRM funding	Total
One successful proposal	3	11	14
One unsuccessful proposal	4	13	17
Multiple proposals, one successful	0	7	7
Multiple unsuccessful proposals	2	1	3
Total	9	32	41

Statistical tests found only one relevant association with socio-demographic covariates. Respondents who had participated in industry-type training programs such as “Six Easy Steps” were significantly more likely to seek more NRM funding (Fisher’s exact test, $p=0.020$).

But not everybody was looking for funding. The above list contains many examples of water quality investments that respondents made without receiving any financial assistance.

"I would rather just tackle tasks on my own." R440

Respondents reported varying success to secure funding in subsequent NRM programs.

"I applied for funding under Reef Rescue together with my neighbour. We got funding for a minimum tillage stool splitter. This changed our farming practices and made us more aware of the impact of old farming practices." R412

"I applied for and got funding for a trash rake." R221

"I sought and got funding from Reef Rescue." R203

Not everybody was successful in their subsequent funding applications:

"I sought funding for a rotary-hoe type implement, but that was rejected." R410

"I tried once or twice to get money, but got knocked back again." R424

"I sought funding for a [precision] sprayer, which was also knocked back." R434

"Have tried several times to get more funding, but have never since been successful. I assumed because I had received the money back then [in the Tender]." R202

"I have sought, but not received any [other funding]." R360

Among subsequent actions and investments by respondents, additional recycle pits featured frequently, and machinery to assist with precision agriculture. The size and type of investment was not statistically associated with respondents' success in the Tender. Examples of additional investment in water quality improvements—in addition to those already mentioned in Section 4.5.1—included:

"I have put in additional recycling pits and enviro-scan, which helps with scheduling of irrigation and reduces deep drainage." R370

"I put in zonal tillage, for which I got a water efficiency grant." R419

"I have put in recycle drains since." R427

"I got funding for a GPS system and some laser levelling four years ago." R431

"I have bought a stool splitter and done wetland restoration, all on my own." R432

"I have done quite a bit off my own bat, including catching tail water." R436

"I have done quite a number: I bought a GPS and legume planter. I put in a pipeline and automated irrigation. I have set up the farm so it's easier to run." R542

"We put in pipelines, laser levelling, bought minimum tillage equipment and new fertilizer applicator." R202

"Put in another recycle pit, pipeline, GPS, trickle irrigation." R208

"We do continuous water sampling. We built more water captures, and recycling pits. We spent \$2.5 million." R203

"Put in another recycle pit, got a micro-organism spray and went certified organic." R204

"Stool splitter, GPS, more pipelines for better control of irrigation scheduling." R209

"We have put in two recycle pits since, all off our own bat." R211

"Long list: Installed drop irrigation; adopted fertilizer sub-surface application; increased efficiency of pumping; moved to certified organic farming on part of the farm." R212

"We have improved the farming system further, have implemented minimum tillage." R214

"We spent \$400,000 on water quality improvements—all our own money. I replaced concrete pipes and generated large water savings. I am monitoring water outflow." R360

"More recycle pits, bed forming." R362

"More recycle pits. Runoff monitoring." R363

"Built more recycle pits off my own bat, legume planter, GPS." R366

"I inserted GPS guidance and recently installed moisture sensors, which I am now in the process of calibrating." R367

"Bean planter, variable rate fertilizer, variable rate sprayer, GPS, minimum tillage system, zonal tillage, controlled traffic." R368

"I am putting a second [recycle] pit in right now." R369

"We have upgraded machinery, most of which relates to water quality." R410

"I built another pit, for which I got a small amount of funding from Reef Rescue, which is now 10 acres of wetlands." R416

"We have put in more recycle pits, all off our own bat. We have a policy of zero outfall from the farm. All our land is mapped, laser levelled and graded." R564

There were fewer examples of respondents undertaking other NRM and conservation activities (Table 11). Among actions undertaken were:

"I did some wetland regeneration." R212

"I have planted trees on my cattle property and created a wetlands sanctuary." R362

"Riparian rehabilitation: I planted trees and fenced it off to keep pigs out. I put in 20 km electric fences for grazing." R363.

Great care was taken to take note of any signs to indicate that participation in the Tender might have created a dis-incentive for undertaking subsequent water quality improvement or NRM activities. None were found. Respondents who had their proposals for funding under the Tender declined might have been discouraged to participate in other funding programs, but not necessarily in undertaking water quality improvement measures of their own.

"At the time it was all new to me. I got very disheartened when my proposal got knocked back. After getting knocked back, I swore I would never go into a scheme like that again. I haven't involved myself in any more grants. [...] I have bought a stool splitter and done wetland restoration, all on my own." R432

"We have put in more recycle pits, all off our own bat. We have a policy of zero outfall from the farm. All our land is mapped, laser levelled and graded." R564

4.5.4 Stated intention to participate in the Reef Trust Tender—Burdekin

At the time when the survey was conducted, preparations and landholder consultations had been ongoing in the Lower Burdekin as part of the rollout of a competitive tender program targeted at reducing nitrogen discharge from sugar cane farms in the Burdekin catchment. A question was included in the survey to ascertain respondents' intentions to participate in this new tender program.

Approximately one quarter of respondents were unsure of their intentions, they either had not heard about the tender or were unsure of the details. Of those respondents who had made up their minds, only one in four intended to submit an expression of interest (Table 13).

Table 13: Stated intention to participate in Reef Trust Tender—Burdekin (proportion of respondents, %)

Response	Proportion of respondents (%)
"No"	57%
"Yes"	19%
"Unsure"	24%
Total	100%

Reasons for a positive intention were focused on reducing financial risk from anticipated yield decline associated with a reduction in fertilizer application, and receiving funding for new precision farming machinery. The following comments illustrate key points made:

"I have scope for reducing N. I look at it as reducing the financial risk of applying less N from potential production loss. I will put in an EOI and think about the detail later." R366

"There are a few things I would like to change on the farm. I may adopt a new system if I can get some funding to reduce the risk. I am not prepared to spend my own money to change my farming system at this point in time." R416

"I have been considering buying a stool splitter—I have not been happy with a contractor and also not with the machine I hired, but would buy a new one if I can get funding." R416

Reasons for a negative intention were focused on the perceived scope and specifications of the new tender. A commonly raised concern was that the tender appeared to be aimed at those farmers who were applying fertilizer in excess of industry best practice, which disqualified many respondents from participating. Others were concerned that reducing fertilizer application would compromise cane yield. The following comments illustrate key points made:

"We already use less than their nominated amount of N." R360

"I looked into it. I am already below the benchmark." R362

"My fertilizer rates are at 200 [kg N/ha] already. The process seems to be targeted at growers who still use around 240 [kg N/ha]." R368

"Industry leaders have long reduced N rates. It is no good over-fertilizing; it's a waste of money. We need to re-look at all N and P rates." R363

"I have already reduced my N rates. I run at 180. I can't come down lower without sacrificing yield." R209

"Unfortunately, the Reverse Tender is a purely volume-based program. I am an early adopter apply fertilizer at below the 6-easy-steps recommendations (130-180kg N) but have generally higher production. The Reverse Tender program is a crazy way of doing it [reductions]. It's just all about statistics. There will be no incentive for ongoing change." R429

"The focus of this tender is all wrong. It won't achieve anything: It won't help producers increase productivity without causing environmental harm, and it's not

best for taxpayers. It's a one-size-fits-all and doesn't consider the soil characteristics." R203

"It's is not fair. It's only for the blokes who have not yet reduced their N application." R204

"I had ideas but they did not fit the guidelines." R424

"I don't like the concept of restricting nitrogen use." R217

"I looked into it. It's not beneficial. Reducing N by that much results in yield loss." R419

"This [tender] is bureaucracy running riot." R564

No statistically significant associations of intended participation were detected with any of the socio-demographic covariates, or success in or satisfaction with the Tender.

4.6 Respondent suggestions

The final question of the survey asked respondents their ideas and recommendations about the best ways for government to improve the health of the GBR.

Some respondents called on government to continue incentivising on-farm actions in favour of regulatory approaches. They also pointed out the need for tailoring of on-ground actions:

"More people would go for it [take WQ action on their farms] if there was more funding. Low interest loans are also important. More people would do recycle pits. It would be more viable." R202

"Invest more money in farmers, and you will get [Reef] health benefits." R431

"Help fund more recycle pits. They are the only sure way of reducing runoff, and therefore N and herbicide and pesticide runoff. People have done the pits that make money. They need assistance with the [financially] marginal ones, particularly while cane prices are low." R366

"More money, more grants would get more people moving. If there is money involved, people will want to get involved." R436

"Continue Reef Rescue. Funding helps farmers modernise infrastructure. Many farmers would not be able to afford better machinery which helps improve water quality." R209

"Need to actively encourage water recycling and reduction of farm runoff to minimise [sediment/nutrient/chemical] export. But there is no one-size-fits-all. Different areas need to be treated differently, depending on soils and slope." R203

"Avoid regulation and penalties. There should be encouragement for farmers to adopt best practice. Financially support the on-ground change that you [government] think is required." R416

Respondents emphasised the role of education—of farmers and the community more generally—in achieving intrinsically motivated behavioural change. They expressed a preference for education over regulatory approaches. They also pointed to the need for more research:

"Encouraging and educating farmers is the best strategy. As they say, you catch more flies with honey." R215

"All regulation is about is to make it happen today. If you educate people and they understand WHY—the consequences of their actions—they will want to do the right thing. If you regulate, you will always require strong audits so that people don't regress." R429

"Need to find tools to measure [outcomes] accurately. Show people the results of their farming practices. 99 out of 100 [farmers] will change if you can demonstrate the [environmental] benefit." R203

"Education of everyone is the key, farmers AND townspeople." R217

"There needs to be an ever increasing education program about management of land across rural and urban communities." R429

"More research is needed, and more funding to help farmers control runoff." R222

"There are a few pig-headed farmers, but not many. You don't have to hit us with a stick. If something is causing harm, show us, give us proof, and we will change. We want the Reef to be there." R366

"I think they need to put it in plain English to farmers how practices affect water quality. I have nitrates in my water yet I put on less N than recommended and have higher-than-average yields. So how do I control that [nitrate]? R368

Respondents stressed the importance government consulting with industry. They emphasised the role of industry initiatives to improve productivity, and the environmental spin-offs, and pointed out that it was important to acknowledge the industry's environmental achievements. They also pointed to the opportunity provided by generational change in the industry:

"We need for the 'good news stories' to get out there, about Catalyst, Reef Guardian, Reef Rescue." R429

"Continue to work with industry." R410

"The BMP process in grazing and cane should be embraced by government. BMP is aiding businesses and helping the environment." R202

"Farmers are trying to reduce sediment. [Government needs to] open [its] eyes to what farmers are really trying to do." R370

"The average age of cane farmers in this district is well above 60 years. They don't want to change what they do. They haven't done any paperwork in 50 years and why would they want to start doing it now?" R368

"Generational change: support the change." R429

Respondents called for more grass-roots engagement in the development of policies and programs, and an appreciation of the realities of deriving a living from farming:

"Need to listen to farmers' perspective a lot more, on the ground, farmers in the field, not just the peak organisations, to appreciate the position that farmers are in." R211

"Our [farmer] experience is very different from those of people who look at things through the computer. R424

"Make the science that informs policy and shapes public opinion available to the agricultural community, then let's have a discussion, then we can decide a coordinated way forward. This needs an inclusive approach rather than an imposed process. R367

Some respondents acknowledged that regulation could play a role, too, provided it was designed in a sympathetic manner:

"We need carrots and sticks. Regulation should drive growers to sign up to the BMP process." R370

"We still have 20% cowboys in the industry. It will take regulation to bring them in line, but not too heavy handed—not like the previous Labour government!" R420

"Live on and run a farm for 12 months—then bring in the regulations!" R542

A consistent message was the perceived need for a comprehensive approach to pollution, which was not solely focussed on diffuse pollution from farms but also addressed urban and industrial pollution:

"Farmers are [policy] takers. We get frustrated because historically we are easy targets. We get blamed when blatantly big business including mines and cities must play a big part, too. Mines in particular seem to be getting preferential treatment because of the financial contribution they are making." R412

"We need to all work together, farmers and the community as a whole." R204

"It's a community problem. The cost burden needs to be shared, not just borne by farmers." R214

"Don't just look at the farmers, look at urban and industrial also. More can be done with water recycling, in particular of urban effluent." R363

"Farmers are singled out because they are an easy target. We need food and people have to live. People and cities have impacts, too." R427

"What happens with all the sewage from the towns and cities along the east coast? Why do they always pick on agriculture? What about the discharge from mines? I see dirty water running past my property after rain, which comes from cattle properties. What about fish farms? Their discharge water is black when it goes out. I can't see any dirt leaving my farm." R369

"What about the herbicides that come off ships hulls [antifoulants] and those used in urban gardens and parks?" R366

"Control runoff from the cities." R432

Other respondents noted the imperative to tackle climate change to safeguard the GBR:

"There are different factors affecting the Reef. Climate change in the long term is likely to destroy the Reef. If climate change is not addressed through emission reduction, what we are doing [about water quality] won't help." R450

"They should be controlling greenhouse gases more. Climate change is the real threat to the reef." R434

"Don't forget about climate change. What are we doing as a nation to combat climate change?" R370

There was a message that farmers cared, for the Reef and for their families:

"I snorkel with the fish out on the reef and it just blows my mind every time." R427

"I enjoy the Reef. My kids love it. We want them [kids] to enjoy it. [...] We [locals] use the Reef the most. We want to protect it the most. Every farmer has a boat. All go to the Reef." R362

"Our family has been here for 80 years and we want to be here for another 80 years." R211

5 DISCUSSION

This project undertook an ex-post evaluation of a NRM program, which had allocated funding for on-farm projects delivering water quality improvements through a competitive tender process. The 2008 Lower Burdekin Water Quality Tender was the first program of this type to be undertaken in the GBR catchment.

For the ex-post evaluation, a structured survey was conducted of 42 Tender participants, including 22 who had submitted successful bids and 20 whose bids had been unsuccessful. Respondents had submitted a total of 64 bids of which 22 had been successful. Respondents and their bids provided a good statistical fit with the Tender participants and bids.

The communications and mixed-mode survey approach taken successfully met the challenge of maximising survey participation from the small sample frame of Tender participants, securing a response rate of 93% of those who could be contacted. This was an exceptionally high response rate (Dillman et al., 2009), which also reflects favourably on Tender participants' memories of the program. It further serves to maximise the credibility of research results (Baruch and Holtom, 2008).

The sample was sufficiently large to allow descriptive analysis of structured response data and 'adequate' from the perspective of qualitative research to achieve informational redundancy. The methodological approach also effectively addressed potential data quality issues relating to the 7-year time lapse between the Tender and this research by maximising respondents' factual recall of the Tender.

The research found that the vast majority of investments contracted under and co-funded by the Tender had been implemented as proposed. In particular, all acquisitions of machinery to support precision farming and reduce water quality impacts had been completed, and the equipment was said to be being used as intended. Similarly, all new or modified recycle pits co-funded by the Tender were said to be working well and to the satisfaction of landholders, with one exception only. By achieving implementation of long-lasting improvements to land and water management, the Tender has proven to have been effective in achieving water quality improvements.

However, the Tender did not achieve its potential allocative effectiveness. It fell short of instigating all approved activities and achieving the associated water quality benefits, which had been as anticipated by the metric underlying the assessment of proposals (Greiner et al., 2008; Rolfe et al., 2011b). There was also evidence of infrastructure failure: One of the recycle pits that was constructed did not perform as intended and therefore delivered neither the anticipated water quality benefits nor the financial benefits that the landholder had hoped for. There was evidence of incomplete works: Another recycle pit was not fully completed and therefore lacked full functionality. In both cases the Tender funding clearly did not achieve the anticipated water quality benefit and was consequently neither effective nor efficient. Further, several proposed infrastructure projects did not proceed despite having been approved for funding: Construction of two recycle pits and one irrigation system did not

go ahead because either cost or technical assumptions in the proposals had proven false. As a result the opportunity to achieve water quality improvements was lost.

In terms of efficiency of the other investments, the research provides direct and indirect evidence of additionality, which enhanced the efficiency of the Tender. The Tender attracted proposals for water quality improvements which would not otherwise have been contemplated. The funding ensured that at least some investments proceeded which could not be afforded by landholders without external financial assistance.

The research delivers direct and indirect evidence of crowding in effects, which enhanced the efficiency of the Tender. The vast majority of Tender participants proceeded to undertake a variety of subsequent investments into water quality improvement activities—irrespective of whether they had received Tender funding or not. Many respondents reported to have gained a better understanding about the effects of agriculture on water quality as a result of participating in the Tender, which enhanced their intrinsic motivation to do more for water quality. For many of the successful Tender participants, the Tender investment helped them to change their entire farming system to be more environmentally benign. The research did not find any evidence of crowding out, but did find that most Tender participants continued to participate in NRM programs in the hope of securing funding for water quality improvement action or, to a lesser extent, other conservation activities.

The research illustrates that the Tender also served an education function beyond the realm of Tender participants. The majority of investments were inspected by other landholders and/or extension officers following their implementation. Field inspections are known to contribute to the diffusion of innovations (Somers, 1998). As many of the proposals funded by the Tender, in particular recycle pits and precision agriculture machinery, were novel in the Lower Burdekin, the Tender therefore served to progress the adoption of water quality improvement innovations.

The ex-post evaluation reveals that Tender participants were overwhelmingly satisfied with the way the Tender was implemented. What stood out in respondents' recollections were the one-on-one consultations they received from technical personnel in discussing and tailoring their expressions of interest, and translating their ideas into costed Tender proposals. The research results indicate that in many cases the budgets underestimated true investment costs. In most cases, this did not affect implementation of successful proposals as farmers were willing to bear the additional cost. In some cases, however, cost misspecification led to successful proposals being abandoned and potential water quality benefits being foregone. The effectiveness and efficiency of competitive tenders relies on the accurate quantification of opportunity costs of investment, and the variation of opportunity between agricultural producers, and across industries, catchments and pollutants (Rolfe and Windle, 2011). Consequently cost misspecification can fundamentally undermine the efficiency of tenders.

The ex-post evaluation reveals that Tender participants were overwhelmingly dissatisfied with the transparency of the selection process and the way the Tender results were communicated. While successful Tender participants were happy that they received funding, they remained unsure on what basis their proposals had been selected. Unsuccessful Tender participants in particular expressed frustration with not understanding the reasons

why their proposals had not been selected, and not understanding why others had been successful.

Tender participants were not very inclined to participate in a new tender program being offered in the Lower Burdekin, the Reef Trust Tender—Burdekin. The new tender program was generally regarded as being targeted at late adopters of established industry best practice, and many respondents questioned the rationale of financially incentivising laggards. Few saw how the new guidelines could help them improve their farming systems. In comparison, the 2008 Tender had been targeted at facilitating the adoption of (then) innovative water quality improvements.

Tender participants expressed views which support a diverse government policy approach to water quality improvement in the GBR. Respondents views mirrored scientists' calls for incentive instruments to be tailored to specific situations based on the characteristics of the pollutants and polluters, and the underlying ecological process (Greiner, 2014; Kroeger and Casey, 2007). There was hope that financial support programs would continue, particularly to reduce innovation risk for early adopters, and that preference would be given to education-based policy over regulation. This reflected a belief in education being able to generate intrinsic motivation for water quality protection by farmers, and a preference for positive over negative external motivators. However, there was support for some regulation to ensure a more comprehensive level of adoption of industry best practice standards for land and water management.

There were also calls for, firstly, a more comprehensive approach to water pollution reduction, involving non-agricultural industries and urban pollution, and, secondly, climate change action to stem the threat to the GBR arising from multiple detrimental effects of climate change.

6 CONCLUSIONS AND RECOMMENDATIONS

The ex-post evaluation of the 2008 Lower Burdekin Water Quality Tender yielded a series of relevant insights, which can help judge the program and elicit lessons for future tender-based NRM programs as well as NRM policy more generally.

The research established a high level of persistence of investment with all but one of the funded works and all machines and other implements being operational seven years after the Tender. This means that the benefits to water quality continue to accrue beyond the 5-year period, which was considered in the assessment metric used to rate and rank proposals to the Tender.

The Tender achieved additionality and crowding-in effects, which improved the efficiency of the investment. In particular, the research provided evidence that the Tender:

- Incentivised the participation of many farmers who had not previously done anything about water quality or participated in any NRM programs;
- Effected learning about the impacts of agriculture on water quality—irrespective of success of proposals—and thereby generated intrinsic motivation for many Tender participants to be wanting to do more about improving water quality;
- Sparked a series of subsequent investments into water quality improvements, many of which were entirely funded by the farmers while others were undertaken with the assistance of other NRM funding programs; and
- Triggered and/or facilitated farming-systems change to more environmentally benign practices in some instances.

The Tender did, however, fail to achieve its anticipated effectiveness (total pollution abated) because some major projects which had been approved for funding did not proceed. While this resulted in cost savings, it also resulted in forgone water quality improvements. The principal reason for this was cost under-estimation during proposal preparation.

The research illustrated that the Tender's focus on information, education and one-on-one engagement with Tender participants in the preparation of proposals generated high levels of participant satisfaction. However, the same level of transparency and communication was not maintained after project selection, which resulted in some level of frustration and possibly diminished potential additionality and crowding-in effects.

The learnings from the research can be summarised into a series of recommendations to inform, firstly, the design and implementation of future competitive tenders, NRM programs and NRM policy, and secondly, future research. The following provides a listing of recommendations and articulation of the underlying rationales.

- Systematically build ex-post evaluations into all competitive tenders—indeed all NRM programs—by (1) stipulating the requirements in program guidelines, (2) allocating necessary funding and (3) compelling participation of program participants. Lessons can be learnt from all programs and a systematically assembled body of evidence is more useful than an eclectic mix of ex-post evaluations. Statistical strength of data sets increases with sample size, and response rate is particularly critical when the

sample frame is small (as is the case in this research). Flagging future evaluations during program implementation and contractually committing successful participants to participating in subsequent research can be helpful. Ensuring ethical conduct of research to safeguard program participants' anonymity and confidentiality of responses.

- Ensure ex-post evaluations cover participants' experiences with all aspects of process as well as effectiveness, allocative efficiency of funding and legacy—in particular ongoing incentive, additionality and crowding effects. Use structured survey and a combination of quantitative information for statistical rigor and qualitative information for narrative/illustration and depth of insights.
- Conduct two ex-post evaluations of a program, the first not long after program completion as participants' memory recall diminishes with time. The first ex-post evaluation can deliver high-quality insights into program participants' experiences with all stages of the program. The second ex-post evaluation, maybe three to five years after completion of the program, can explore longer-term additionality and crowding-in effects. The combined analysis of all data sets will maximise insights into program effectiveness and legacy.
- Complement ex-post program evaluations with research, which enables comparison of program participants with farmers who have not participated. Only by having an external reference group to compare program participants with is it possible to quantify the additionality and crowding effects achieved by a program.
- Treat funding program information sessions as an opportunity for educating landholders about the conservation issue at hand. Share the science. New understanding generates intrinsic motivation to 'do the right thing', which crowds in environmentally beneficial actions.
- Provide technical advice for bid development and maximise accuracy and realism of technical and costing assumptions. Bids are the corner stone of opportunity cost assessment in environmental tenders. Incorrect costing may lead to unrealistic bids. If wrong costing results in cost overestimation and bids are too high, proposals may be disadvantaged in the order of merit and may be eliminated from funding. If costs are underestimated and bids are too low, proposed actions may not proceed due to cost overruns. Poor costs specification may also cause some disillusionment with some successful participants, and acting negatively with respect to participation in future programs.
- Maximise transparency of process and communication of funding decisions, in both positive and negative funding outcomes. Proponents have invested time and effort, and often money, into developing proposals. They have earned the right to receive a detailed explanation why their proposal was funded, or what were the reason(s) why their proposal did not receive funding. This interaction presents a further opportunity for the program to generate learning and generate intrinsic motivation.

- When implementing competitive tenders, be prepared to deal with situations where participants struggle to implement approved activities. The first priority should be to offer assistance to try to overcome impediments to implementation. The second priority is to reallocate unused funding based on a contingency plan to allocate such funding to bids down the order of merit. While there may be a loss of theoretical allocative efficiency associated with this strategy, it provides a second-best solution by ensuring that program funding realises the maximum environmental benefit it can.
- Review the appropriate use of approved funding, and help proponents overcome difficulties with implementation and problems with functionality. While adding to the transaction costs of program implementation, overcoming technical difficulties can prevent efficiency loss caused by partial implementation or malfunction of the investment.
- Consider changes to environmental regulation as part of a comprehensive and systematic approach to environmental policy (Greiner, 2014). Regulation is a necessary foundation for well-functioning MBIs, and it can also provide a powerful external motivator for prevention of unwanted environmental behaviour, provided criteria of effective regulatory design are met (Greiner et al., 2016).
- Engage with industry at a grass-roots level in the design of new policies and programs. Insights can be gleaned that maximise program/policy effectiveness and efficiency by reducing the likelihood of causing unintended consequences and maximising industry acceptance and collaboration.

7 REFERENCES

- Armour, J., Hateley, L., Pitt, G., 2009. Catchment modelling of sediment, nitrogen and phosphorus nutrient loads with SedNet/ANNEX in the Tully–Murray basin. *Marine and Freshwater Research* 60, 1091-1096.
- Baruch, Y., Holtom, B.C., 2008. Survey response rate levels and trends in organizational research. *Human Relations* 61, 1139-1160.
- Creswell, J.W., 2009. *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage Publications, Inc, London.
- De Vaus, D.A., 2002. *Surveys in Social Research*. 5th edition. Allen & Urwin, Crows Nest (NSW).
- Dillman, D.A., Phelps, G., Tortora, R., Swift, K., Kohrell, J., Berck, J., Messer, B.L., 2009. Response rate and measurement differences in mixed-mode surveys using mail, telephone, interactive voice response (IVR) and the Internet. *Social Science Research* 38, 1-18.
- Frey, B., Jegen, R., 2001. Motivation crowding theory. *Journal of Economic Surveys* 15, 589-611.
- Greiner, R., 2014. Applicability of market-based instruments for safeguarding water quality in coastal waterways: case study for Darwin Harbour, Australia. *Journal of Hydrology* 509, 1-12.
- Greiner, R., Fernandes, L., McCartney, F., Durante, J., 2016. Reasons why some irrigation water users fail to comply with water use regulations: A case study from Queensland, Australia. *Land Use Policy* 51, 26-40.
- Greiner, R., Rolfe, J., Windle, J., Gregg, D., 2008. Tender results and feedback from ex-post participant survey. Research Report No 5, Using conservation tenders for water quality improvements in the Burdekin Research Reports. Central Queensland University, Rockhampton.
- Greiner, R., Young, M.D., McDonald, A.D., Brooks, M., 2000. Incentive instruments for the sustainable use of marine resources. *Ocean and Coastal Management* 43, 29-50.
- Hailu, A., Rolfe, J., Windle, J., Greiner, R., 2008. Auction scope, scale and pricing format: Agent-based simulation of the performance of a water quality tender. Research Report 6. Using conservation tenders for water quality improvements in the Burdekin. Central Queensland University, Rockhampton.
- Herrick, C., Sarewitz, D., 2000. Ex post evaluation: A more effective role for scientific assessment in environmental policy. *Science, Technology & Human Values* 25, 309-331.
- Hunter, H.M., Walton, R.S., 2008. Land-use effects on fluxes of suspended sediment, nitrogen and phosphorus from a river catchment of the Great Barrier Reef, Australia. *Journal of Hydrology* 356, 131-146.
- Kits, G.J., Adamowicz, W.L., Boxall, P.C., 2014. Do conservation auctions crowd out voluntary environmentally friendly activities? *Ecological Economics* 105, 118-123.
- Kroeger, T., Casey, F., 2007. An assessment of market-based approaches to providing ecosystem services on agricultural lands. *Ecological Economics* 64, 321-332.
- Krosnick, J.A., Fabrigar, L.R., 1997. Designing rating scales for effective measurement in surveys, in: Lyberg, L.E., Biemer, P., Collins, M., De Leeuw, E.D., Dippo, C., Schwartz, N., Trewin, D. (Eds.), *Survey measurement and process quality*. Wiley, New York, pp. 141-164.
- Krosnick, J.A., Presser, S., 2010. Question and questionnaire design, in: Marsden, P.V., Wright, J.D. (Eds.), *Handbook of Survey Research*. 2nd edition. . Emerald Group Publishing Ltd, Bingley, UK, pp. 263-314.

- Latacz-Lohmann, U., Van der Hamsvoort, C., 1997. Auctioning conservation contracts: a theoretical analysis and an application. *American Journal of Agricultural Economics* 79, 407-418.
- Lockie, S., 2010. Neoliberal regimes of environmental governance: climate change, biodiversity and agriculture in Australia, in: Redclift, M.R., Woodgate, G. (Eds.), *The international handbook of environmental sociology*. Edward Elgar, Cheltenham, UK, pp. 364-377.
- Lockie, S., 2013. Market instruments, ecosystem services and property rights: assumptions and conditions for sustained social and ecological benefits. *Land Use Policy* 31, 90-98.
- Motulski, H., 1995. *Intuitive Biostatistics*, 1st ed. Oxford University Press, Oxford.
- OECD, 2007. *Business and the environment: policy incentives and corporate responses*. OECD, Paris.
- Patton, M.Q., 2008. *Utilization-focused evaluation*. 4th edition. Sage Publications, Thousand Oaks (CA) and London (UK).
- Rode, J., Gómez-Baggethun, E., Krause, T., 2015. Motivation crowding by economic incentives in conservation policy: A review of the empirical evidence. *Ecological Economics* 109, 80-92.
- Rolfe, J., Greiner, R., Windle, J., Hailu, A., 2007a. Identifying scale and scope issues in establishing conservation tenders. Research Report No 1, Using conservation tenders for water quality improvement in the Burdekin Research Reports. Central Queensland University, Rockhampton.
- Rolfe, J., Greiner, R., Windle, J., Hailu, A., 2011a. Testing for allocation efficiencies in water quality tenders across catchments, industries and pollutants: A north Queensland case study. *Australian Journal of Agricultural and Resource Economics* 55, 518-536.
- Rolfe, J., Greiner, R., Windle, J., Hailu, A., 2011b. Testing for allocation efficiencies in water quality tenders across catchments, industries and pollutants: a north Queensland case study*. *Australian Journal of Agricultural and Resource Economics* 55, 518-536.
- Rolfe, J., Greiner, R., Windle, J., Hailu, A., Gregg, D., 2008. Testing for scope and scale efficiencies in water quality tenders. Final Report, Using conservation tenders for water quality improvements in the Burdekin Research Reports. Central Queensland University, Rockhampton.
- Rolfe, J., Muller, C., Greiner, R., Windle, J., 2007b. Overview of the Burdekin case study. Research Report No 2, Using conservation tenders for water quality improvements in the Burdekin Research Reports. Central Queensland University, Rockhampton.
- Rolfe, J., Windle, J., 2011. Using auction mechanisms to reveal costs for water quality improvements in Great Barrier Reef catchments in Australia. *Agricultural Water Management* 98, 493-501.
- Rolfe, J., Windle, J., Muller, C., Greiner, R., 2007c. Designing a metric for conservation tenders at different levels of scope and scale. Research Report No 3, Using conservation tenders for water quality improvements in the Burdekin Research Reports. Central Queensland University, Rockhampton.
- Rossi, P.H., Lipsey, M.W., Freeman, H.E., 2004. *Evaluation: A systematic approach*. 7th edition. Sage Publications, Thousand Oaks (CA) and London (UK).
- Sandelowski, M., 1995. Sample size in qualitative research. *Research in nursing & health* 18, 179-183.
- Schroeder, B., Calcino, D., Hurney, A., Smith, R., Panitz, J., Cairns, R., Wrigley, R., SAllsopp, P., 2008. *SmartCane principles of Best Management Practice*. BSES Limited.

Schroeder, B.L., 2009. Technical information supporting aspects of the 'Six easy steps' nutrient management package. BSES Limited, Brisbane.

Sierra, R., Russman, E., 2006. On the efficiency of environmental service payments: a forest conservation assessment in the Osa Peninsula, Costa Rica. *Ecological Economics* 59, 131-141.

Somers, N., 1998. Learning about sustainable agriculture: the case of Dutch arable farmers, in: Roling, N.G., Wagemakers, M.A.E. (Eds.), *Facilitating Sustainable Agriculture: Participatory learning and adaptive management in times of environmental uncertainty*. Cambridge University Press, Cambridge (UK), pp. 125-134.

StataCorp, 2013a. *Stata 13 Base Reference Manual*, College Station (TX).

StataCorp, 2013b. *Stata Statistical Software: Release 13*, in: StataCorp (Ed.), College Station, TX.

Stavins, R.N., 1998. Market-based environmental policies, *Public policies for environmental protection*. Resources for the Future, Washington.

Stavins, R.N., 2003. Chapter 9: Experience with market-based environmental policy instruments, in: Maler, K.G., Vincent, J.R. (Eds.), *Handbook of Environmental Economics*, pp. 355-435.

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

Windle, J., Rolfe, J., 2008. Exploring the efficiencies of using competitive tenders over fixed price grants to protect biodiversity in Australian rangelands. *Land Use Policy* 25, 388-398.

Windle, J., Rolfe, J., Greiner, R., Gregg, D., 2008. Results from experimental workshops. Research Report No 4, Using conservation tenders for water quality improvements in the Burdekin Research Reports. Central Queensland University, Rockhampton.

Windle, J., Rolfe, J., O'Dea, G., 2005. Selecting market-based incentives for natural resource management, Report prepared for the Burnett Mary Regional Group. Central Queensland University, Rockhampton, p. 44.

Zar, J.H., 1984. *Biostatistical Analysis*. Prentice-Hall International, Englewood Cliffs (NJ).

8 APPENDICES

8.1 Appendix 1: Information sheet and informed consent form



INFORMATION SHEET

PROJECT TITLE: "Legacy of the Lower Burdekin Water Quality Tender"

You are invited to take part in a research project about the Water Quality Tender, which was conducted in the Lower Burdekin region in 2008, and in which you participated.

The research seeks to establish whether the investments made into water quality improvements in 2008 have had a lasting effect and explore the how this is so—or the reasons why there may not be a lasting effect. It also invites any feedback you may wish to provide about the 2008 Water Quality Tender.

The study is conducted by Prof. Romy Greiner from James Cook University in collaboration with NQ Dry Tropics, which administered the 2008 Water Quality Tender.

If you participated in the 2008 Water Quality Tender, you are invited to be participate in this research through an interview. The interview should only take approximately 3/4 hour of your time. The researcher will visit you on your farm, or meet you at a place preferred by you, on a date and at a time nominated by you.

Taking part in this study is completely voluntary and you can stop taking part in the study at any time without explanation or prejudice.

Your responses and contact details will be strictly confidential. The data from the study will be used in research publications and a report to the National Environmental Science Program's Tropical Water Quality Hub. You will not be identified in any way in these publications.

If you have any questions about the study, please contact the Principal Investigator.

Principal Investigator:
Prof. Romy Greiner
The Cairns Institute
James Cook University
Mobile: 0418 242 156
Email: romy.greiner@jcu.edu.au

If you have any concerns regarding the ethical conduct of the study, please contact:
Human Ethics, Research Office
James Cook University, Townsville, Qld, 4811
Phone: (07) 4781 5011 (ethics@jcu.edu.au)



INFORMED CONSENT FORM

PRINCIPAL INVESTIGATOR: Prof. Romy Greiner

PROJECT TITLE: Legacy of the Lower Burdekin Water Quality Tender

COLLEGE: The Cairns Institute

I understand that the aim of this research study is "to establish whether there have been lasting benefits generated by the investments made into water quality improvements through the Water Quality Tender in 2008".

I consent to participate in this project, the details of which have been explained to me, and I have been provided with a written information sheet to keep.

I understand that my participation will involve a half-hour interview and I agree that the researcher may use the results as described in the information sheet

I acknowledge that:

taking part in this study is voluntary and I am aware that I can stop taking part in it at any time without explanation or prejudice and withdraw any unprocessed data I have provided;

any information I give will be kept strictly confidential and that no names will be used to identify me with this study without my approval.

I consent to be interviewed

Yes

No

Name (printed):

Signature: Date:

8.2 Appendix 2: Pre-survey letter mailed to Tender participants

15 October 2015

«First_name» «Surname»
«Postal_address»
«Suburb» «State» «Postcode»



Dear «First_name»,

Your experience matters, your opinion counts

In 2008, NQ Dry Tropics (then: Burdekin Dry Tropics) ran a water quality tender in the Lower Burdekin. You were an integral part to this ground breaking event because you submitted a bid and proposed to implement activities on your property to help improve water quality.

We are now asking you to cast your mind back to your experience with the Tender, and to share these recollections with independent researchers.

NQ Dry Tropics and the James Cook University's Dr Romy Greiner are combining efforts to review the experiences of participants in the 2008 tender. Funding has been made available by the National Environmental Science Program to interview participants. The research is very important because the experiences of participants will help inform future investments, including a nutrient tender that is being rolled out by NQ Dry Tropics in the lower Burdekin over the next few months. The way in which this current tender is administered can greatly benefit from your experiences with the earlier 2008 tender.

This letter is to inform you to expect to receive a phone call from Romy, who will ask whether you are willing to participate in the review. Participation is entirely voluntary; however, I would be very grateful for your input and the opportunity to learn from your experiences.

Romy was involved in the tender design and subsequent assessment of proposals in the 2008 tender. Romy is now an adjunct professor with James Cook University and has an excellent track record of scientific research conducted in collaboration with farmers and graziers. She is highly respected by clients, stakeholders and other researchers for her ethical conduct, and the integrity and quality of her work.

If your tender proposal in 2008 received funding, Romy will ask to visit you to conduct a 30-45 minute face-to-face interview at a time convenient to you. If your proposal in 2008 did not receive funding, Romy will ask to have a 15 minute chat over the telephone. If you did not participate in the 2008 Tender and receive a phone call, it indicates that the previous owner of your property was a participant and Romy would like to have chat about the legacy of the activity undertaken by your predecessor.

Greiner, R.

I want to personally assure you that:

- participation in this research is entirely voluntary;
- your consent will be sought before any questions are asked;
- information about your participation in the 2008 Water Quality Tender, and your responses to this survey are entirely confidential and anonymous. The research is subject to protocols of ethical conduct of research, which means that data will only be accessible to Dr Greiner, only aggregate data will be published, and any verbal quotations will not be attributed to you personally;
- the research is extremely valuable because it is the first time that somebody explores the legacy of this type of investment in the Great Barrier Reef region.

If you have any concerns or questions about the project, you are welcome to contact Paul Duncanson, who was the administrating officer during the 2008 Tender, or Dave Olsen, from our sugar team, on telephone 4724 3544.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'SCC', with a long horizontal line extending to the right.

Scott Crawford
CEO
NQ Dry Tropics

8.3 Appendix 3: Questionnaire of successful Tender participants

Note: The visual layout of the questionnaire was altered for inclusion in the report.

1. On a scale from 1 to 5, how clearly do you think you recall the Tender and its outcomes?

Do not remember	Remember vaguely	Remember some detail	Remember most aspects	Remember clearly
1	2	3	4	5

2. Was this the first time you were wanting to undertake a WQ improvement activity?

₁ Yes ₂ No ₃ Cannot recall

3. Was this the first time you participated in a NRM program?

₁ Yes ₂ No ₃ Cannot recall

4. To what extent did you implement the proposed/contracted investment?

Did not implement	Implemented partially	Implemented in full
0	25	50
75	100%	

Proposal [investment]	Funded	Completion rate	
.....	Y/N	%
.....	Y/N	%
.....	Y/N	%

Respondents with successful proposals only [other: go to Q9]

5. Was the [investment] completed within the nominated cost?

₁ Yes ₂ No ₃ Cannot recall

6. On a scale from 1 to 5, how satisfied are you with the performance of the [investment] ?

Extremely dissatisfied				Extremely satisfied
1	2	3	4	5

7. Have other people (farmers, extension people) ever inspected the [investment]?

₁ Yes ₂ No

8. **Has the [investment] generated a financial benefit for the farm?**

₁ Yes ₂ No

.....

All respondents

9. **If you could go back in time, would you change your proposal?**

₁ Yes ₂ No

.....

10. **Were you generally satisfied with the way the WQ Tender was run?**

₁ Yes ₂ No ₃ Neither ₄ Unsure

.....

Were you generally satisfied with the way the outcomes of the Tender were explained?

₁ Yes ₂ No ₃ Neither ₄ Unsure

.....

Were there any aspects that you particularly liked?

.....

Were there any aspects that you particularly disliked?

.....

11. **Has participation in the Tender changed your understanding about the relationship between agriculture and water quality?**

₁ Yes ₂ No

.....

12. **Has participation in the Tender changed the way you do things on your property, or anything else?**

₁ Yes ₂ No

.....

13. **Have you undertaken other investments into water quality improvements since 2008?**

₁ Yes ₂ No

.....

14. Have you undertaken other NRM activities since 2008?

- ₁ Yes ₂ No
-

15. Have you sought or received funding from other NRM programs since 2008?

- ₁ Yes ₂ No
-

16. Do you intend to participate in the upcoming Nitrogen (Reverse) Tender in the Lower Burdekin?

- ₁ Yes ₂ No ₃ Uncertain
-

18. What is your age group?

- ₁ < 30 years
₂ 30-39 years
₃ 40-49 years
₄ 50-59 years
₅ 60-69 years
₆ 70 years and older

19. What is your gender? ₁ male ₂ female

20. What is the area size of the property? acres OR hectares

21. What is the ownership structure of the property?

- ₁ family owned
₂ corporation owned
₃ other: (specify).....

22. How long have you/your family owned the property?

- ₁ less than 10 years
₂ 10-19 years
₃ 20-39 years
₄ 40 years and more

23. What are the land uses?

- ₁ sugar cane area..... 2014 average crop yield.....
₂ other crops area..... (specify).....
₃ fallow area.....
₄ grazing area.....
₅ wetlands area.....
₆ other area..... (specify).....

24. Which of the following education and training options have you completed?

- ₁ Primary school
- ₂ High school
- ₃ Tertiary education—relevant to agriculture
- ₄ Tertiary education—other
- ₅ Training and Cert course(s) relevant to agriculture
- ₆ Land and water 'best management' course(s)
- ₇ DPI / BSES(SRA) or similar course(s)

25. Do you go fishing/boating on the Reef? ₁ yes ₀ no

**26. How strongly do you agree or disagree with the following statements?
Please rate your level of (DIS) AGREEMENT on a scale from 1 to 5.**

Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
1	2	3	4	5

1. I understand the science which explains the link between farming, water quality and health of the Great Barrier Reef. _____
2. Farmers and other businesses who operate in the GBR catchment have a duty of care to the Reef. _____
3. Many farming and land use practices are causing increased levels of sediments, nutrients and pesticides. _____
4. The wetlands and waterways in the Lower Burdekin are in good health. _____
5. Water quality is a minor threat to the GBR compared to other pressures such as climate change, crown-of-thorn star fish, shipping, etc. _____
6. Farmers should be left alone to get on with growing crops and food. They should not have to worry about the environment. _____
7. Scientists exaggerate the threat that bad water quality poses to the Reef. _____
8. It is important that governments invest public money to help farmers improve the way they operate and manage the land. _____
9. Water quality is a talking point among farmers. _____
10. Governments are not investing enough money and effort in water quality and the GBR. _____
11. Contributing to water quality improvements (through making on-farm changes) makes me feel good about myself. _____
12. There is a need for some environmental regulation, and penalties for non-compliance, to ensure that all farmers are "doing the right thing" by the GBR. _____
- 13.*There is more that I can do on my property to improve water quality. _____

27. If there was one recommendation that you could give to the Qld and Australian Governments about improving the health of the GBR, what would it be?

.....

End of Survey. Thank you very much for your time and collaboration! ☺



www.nesptropical.edu.au