

Acknowledgement

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“Designing auctions with outcome bonuses: An application to ground nesting birds in the Murray Catchment, NSW Draft Final Project Report

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USER FRIENDLY PROJECT SUMMARY

Nest Egg is a trial of a tender for ground nesting birds in the Murray catchment management area of New South Wales. It is a partnership between the Murray CMA and CSIRO and part of round two of the National MBI pilots program. The project began in June 2007.

The project is evaluating a new approach to conservation funding whereby landholders are rewarded for achieving conservation outcomes. To do this the Murray CMA is trialling a tender, called Nest Egg, for the conservation of three threatened ground nesting bird species: Bush stone curlew, Plains wanderer and Brolga. Landholder bid by specifying the upfront payment they require in order to enter into the contract. The landholder then chooses between two contracts. The contracts either pay annual bonus to landholder for achieving habitat benchmarks and bird species benchmarks (for outcome based contracts) or an annual management payment for undertaking certain conservation actions (termed input based contracts) for the three year term of the agreement.

The tender results indicated that:

- All landholders chose outcome based contracts.
- The use of outcome based contract saved at least 33% in comparison with the use of input contracts.
- Commercial landholders appear to value outcome based contracts as they reduce the risk that the conservation contract will impose unnecessary and costly restriction on how the land is managed.

Conservation contracts including outcome based payments are acceptable to landholders in practice and result in significant saving in public spending .Given these benefits, incorporating outcome linked payments into landholder contracts warrants serious consideration in future conservation tenders.

EXECUTIVE SUMMARY

Nest Egg is a trial of a tender for ground nesting birds in the NSW Murray catchment management area of New South Wales. It is a partnership between the Murray CMA and CSIRO and part of round two of the National MBI pilots program. The project began in June 2007.

This research project evaluates a new approach to conservation funding whereby landholders are rewarded for achieving conservation outcomes. The project involves designing and implementing a tender, called Nest Egg, for the conservation of three threatened ground nesting bird species: Bush stone curlew, Plains wanderer and Brolga. To allow evaluation of landholders willingness to accept contracts with outcome based payments, landholders were asked to choose between an input based contract and an outcome based payment contract. Landholder were also required to submit a bid for both contracts.

In the Nest Egg tender, landholder specify the amount of an upfront payment they require in order to enter into the contract. The contracts then either pay annual bonus to landholder for achieving habitat benchmarks and bird species benchmarks (for outcome based contracts) or an annual management payment for undertaking certain conservation actions (termed input based contracts) for the three year term of the contracts.

The tender resulted in 41 landholders expressing interest in the scheme, 32 attending workshops that outlined the structure of the program and provided information on the conservation requirements of bird species. There were applications for 23 sites from 17 separate landholders. The tender evaluation process resulted in 20 applications from 14 landholders being accepted. These figures were in line with participation targets.

The results of the tender include:

- All 23 applications selected outcome based contracts despite having the option of input and management action based contract.
- On average, the total expected payment to landholders to enrol in outcome based contracts were 23% less than they required to sign up to input based contracts.
- For the accepted applications, the use of outcome based contract saved at least 33% in comparison with the use of input contracts.
- Commercial landholders appear to have stronger preference for outcome based contracts than lifestyle landholders. Reasons given for this related to the need to maintain flexibility in production practices.
- Outcome based tenders provide landholders with incentives to reveal privately held information about the biodiversity assets on their land. This incentive appears to have resulted in landholders providing new and valuable information on bird populations.
- Preliminary evidence suggests that outcome based contracts motivate landholders to undertake actions that are difficult for governments to monitor, such as pest control.

The practical implications of this research for the design of conservation tenders are that we should consider incorporating outcome based payments into tender contracts. This research provides some

guidance on the potential scope for application of outcome based contract. Our findings are consistent with economic theory in suggesting that outcome based payments may be valuable when there is uncertainty and variability in the required management actions, when hidden actions are important in determining the outcomes, and when landholders have private information about the value of their management actions and biodiversity assets. However good contract design will require integration of contract design principles and expert knowledge of the natural system on a case by case basis.

Potential impediments to the use of outcome based contracts include long time lags between management actions and outcomes, the practicality and cost of defining and monitoring outcomes, and the willingness of landholders to bear the risk of outcome based payments.

When long time lags exist between management actions and outcomes, payment for intermediate outcomes or short term outputs that indicate appropriate management may be considered as part of the contract mix if hidden action or hidden information is important.

A practical problem is the difficulty in defining specific and quantifiable biodiversity conservation outcomes. Investing in a clear understanding of the objectives of public funding is a prerequisite for efficient investment. Clarifying the desired and monitorable outcomes of a program is therefore likely to be a good investment in terms of design ,delivery, engagement and measuring effectiveness.

The cost of monitoring is unlikely to be an important consideration in the decision about the use of outcome based contracts, as the main cost of monitoring involves staff site visits and is independent of what is monitored. In addition the information gained by monitoring outcomes at the site scale is of value for monitoring program level outcomes and regional scale biodiversity conservation. Monitoring outcomes also reduces the need to invest in the more complex task of modelling the predicted outcomes from management actions.

The willingness of landholders to bear the risk of uncertain payments related to outcome based payments requires further investigation. However the feedback from landholders in this tender suggests that this is only one of the risks that landholders consider in entering a conservation contract. The potential restrictions that a conservation contract places on future management options and the uncertain liabilities associated with non compliance with input based contracts were other risks mentioned by participating landholders. The risk of non-payment is also a type of risk that landholders are familiar with, since it is similar to crop failure. In this trial, the combined impact of all these risks was that commercial agricultural producers favoured outcome based contracts.

The Nest Egg trial demonstrates that conservation contracts including outcome based payments are feasible to design and implement and acceptable to landholders in practice. For this case study, the use of outcome based contracts is estimated to have reduced the total landholder payment costs by at least one third of total expenditure compared with input based contracts. Other potential benefits of outcome based contracts to landholders and governments that we are continuing to examine as part of this trial include the incentives for landholders to innovate to improve biodiversity and production outcomes, and the value of ongoing flexibility provided by the contracts in when and how to invest in conservation. Given these benefits, incorporating outcome linked payments into landholder contracts warrants serious consideration in future conservation tenders.

1. INTRODUCTION

The report provides an overview of the findings from the project: “Designing auctions with outcome bonuses: An application to ground nesting birds in the Murray Catchment, NSW”. This research project is evaluating a new approach to conservation whereby landholders are rewarded for achieving conservation outcomes. The project involves designing and implementing a tender, called Nest Egg, for the conservation of three threatened ground nesting bird species: Bush stone curlew, Plains wanderer and Brolga. The project is funded by the National MBI Pilot Programme Round Two, the NSW Murray Catchment Management Authority and CSIRO. It is a partnership between the Murray CMA and CSIRO. The project and the Nest Egg tender began in June 2007. This research component of the project ends in June 2008. The Nest Egg tender runs for three years, ending in September 2010.

1.1 Background

Setting land aside for conservation is proving to be insufficient to achieve many biodiversity conservation objectives. Often active and ongoing management is required to manage restoration processes and threats from invasive species and feral predators. In addition there is potential for land to jointly support agricultural enterprises and conservation. However almost all biodiversity incentive programs in Australia are based on the concept of setting land aside combined with either payments for inputs (such as fencing grants) or on modelled outcomes of proposed input changes. Designing input based conservation contracts to motivate the required management on private lands can be difficult since the required management can be complex, uncertain and difficult to monitor.

The key hypothesis driving this project is that incorporating outcome based incentives into environmental policy mechanisms in a targeted way will improve the resultant environmental outcomes. In particular we focus on incorporating outcome payments into conservation auctions. Auctions have shown great promise in improving the overall efficiency of environmental programs, reducing costs to government of achieving specific outcomes, reducing risk to landholders, and fitting in with existing government programs and processes (Stoneham et al., 2003; Grafton, 2005). There are at least five reasons why it may be desirable for landholder payments from auctions to be conditional on the environmental outcomes achieved. These include:

- Motivating hidden action. That is the outcome payment may motivate landholders to undertake management activities that are difficult for governments to observe directly.
- Revealing hidden information: Providing incentives to landholders to reveal private information they have about conservation can help governments identify and implement more effective conservation policies.
- Providing flexibility to landholders in how outcomes are achieved.

- Encourage innovation in how landholders achieve conservation goals.
- Reduce the reliance on predictive modelling of conservation to allocate conservation funding.

While paying for conservation outcomes can potentially provide these important benefits, they also necessarily transfer risk to landholders. Latacz-Lohmann and Van der Hamsvoort (1997), find that the increased allocation of risk to risk averse landholders will induce higher bids. Upfront payments are a way to share the risk burden and provide incentives for capital investment. We therefore consider a one-off auction where the successful tenders are eligible for upfront payments as well as ongoing fixed price bonus payments for meeting certain benchmarks. This structure is designed to allocate risk in a structured way. It apportions risk to landholders for actions which they have strong control over and which are difficult to monitor. The risk for upfront capital investments for which resultant environmental outcomes are less certain is borne by the funding body.

This project investigates the value of effective performance bonuses (or mixed input and output contracts) in the context of a tender investing in the conservation of three ground nesting bird species: Brolga, Bush stone-curlew and Plains wanderer in the Murray catchment management area of New South Wales. These species are in decline in the sheep-wheat belt of south eastern Australia in response to habitat modification and predator introduction.

2. ACHIEVEMENT OF PROJECT OBJECTIVES

2.1 Project objectives

We identified six key questions that affect the practical usefulness of outcome based contracts:

1. Will outcome based contracts be feasible to design and monitor?
2. Are landholders willing to sign up to outcome based contracts?
3. Will outcome based contracts help reveal landholder private information about the value of sites?
4. Will outcome based payments motivate hidden or non-verifiable actions?
5. Will outcome based payments encourage innovation in how outcomes are achieved?
6. Will outcome based contracts affect the intrinsic motivation of landholders to undertake conservation?

This project addresses question 1 to 4. The last two question will be the focus of future work when data from the outcomes of the tender are available.

2.2 Activities and methods

This section describes the methods used to address the four questions about outcome based tenders identified above. The project carried out five main activities:

- (i) designing the tender structure, contracts and supporting tender scoring system and habitat and bird benchmarks,
- (ii) field testing the habitat metric and benchmark scoring systems;
- (iii) stakeholder workshops to communicate and refine the tender design;
- (iv) implementation of the Nest Egg tender; and
- (v) the first site inspections to evaluate if landholders meet the habitat benchmark.

Addressing the first question: “Will outcome based contracts be feasible to design and monitor?” involved economic modelling of how to design an outcome linked auction to maximise the conservation outcomes (Gorddard et al 2008a). The modelling considered how the optimal tender design is affected by a fixed total project budget, and how landholder decisions on bidding strategies and management effort respond to risk aversion and private information on site quality and management costs. This analysis provided a conceptual basis for designing the tender.

A second aspect of the feasibility of outcome based systems relates to the feasibility of defining and monitoring conservation outcome that can be used as the basis of conservation payments. Ecologists involved in the project developed habitat quality and bird presence benchmarks for the three bird species targeted in this project. The habitat benchmarks site characteristics that are critical to breeding success in ground-nesting bird populations. A photographic guide was prepared for each species in order aid landholders in assessing their site condition (NPWS 2002a, Tack 2007, Herring 2007). Field testing of these measures focused on their ability to consistently reflect desirable habitat attributes across a range of sites. The ability of these benchmarks to serve as the basis of outcome based conservation contracts will be analysed in research on future results of this tender.

Stakeholder workshops involved landholders and Catchment management authority personnel in tender exercises. These workshops provided feedback on aspects of the tender design and background information on landholder and catchment management attitudes towards various aspects of outcome based tenders.

The willingness of landholders to sign up to outcome based tenders was primarily assessed by offering landholder the choice of two contract options: called an outcome based contract and an input based contract. Both contracts consist of an upfront payment. The amount of this payment is specified by the landholder as their bid price. The outcome based contract offers additional payments as follows:

- **Habitat benchmark bonus:** Landholders are paid a fixed pre-specified per hectare annual bonus (following a monitoring visit) of between \$10 and \$30 (depending on location and bird species) providing habitat structure and quality benchmarks are achieved.

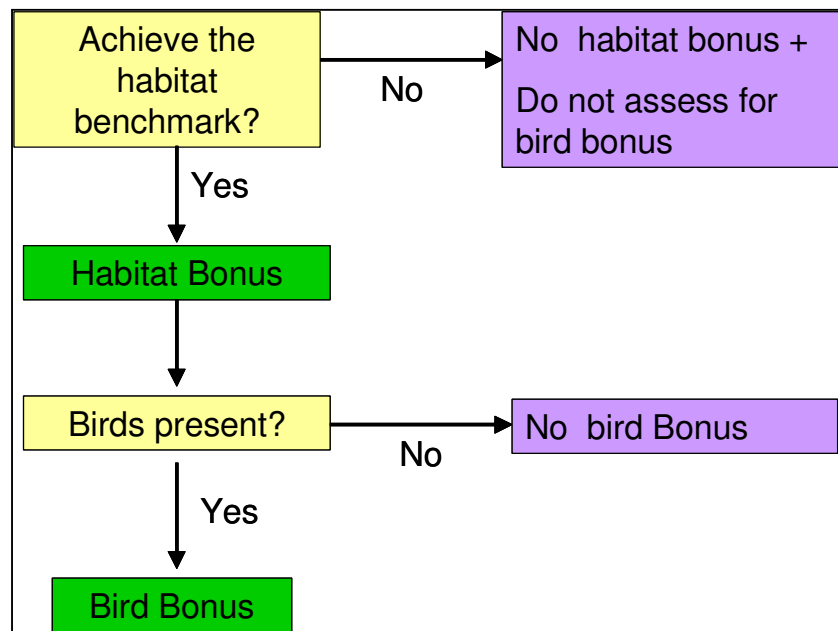
- **Bird Species outcome bonus:** Landholders are paid an annual, fixed, bonus of \$1500 each year for each site enrolled where observed population of target species are either presence or breeding success is demonstrated.

The decision tree for these payments is shown in Figure 2. Achieving the habitat benchmark is a prerequisite for being assessed for the bird bonus. This structure reflects the objective of maintaining both habitat structure and pest control on a given site. The input based contracts offer an additional payment as follows:

- **On-going management payments:** Landholders are paid an annual, fixed, bonus of \$8-\$24 per hectare each year for each site enrolled where they demonstrate that they have carried out the specified management actions. Management actions include control of grazing as agreed, control of weed, pest control as specified as well as any installation and maintenance of any fencing or other infrastructure as specified.

All agreements last for three years. This trial structure allows us to evaluate landholder

Figure 1 The decision tree for habitat and bird bonus payments



preferences with regards to contract type. In particular it allowed us to test if landholders prefer the theoretically more effective outcome contracts, and identify reasons why landholders may prefer one contract type over the other.

The call for EOI's for the Nest Egg tender was opened on the 11th of June 2007. This resulted in 41 expressions of interest and 32 landholders attending 3 workshops located in Howlong, Barham and Berrigan. The workshops resulted in 27 landholders electing to engage in site visits. Generally those who did not arrange site visits withdrew after discovering that their sites did not meet the criteria for the program. The tender period closed on the 14th November 2007. The tender resulted in 23 tenders received from 17 landholders. The tender evaluation meeting was held in Albury on the 27th November 2007. The tender panels' evaluation report was submitted to the Murray CMA on the 20/12/2007 for approval.

In all 20 Tenders from 14 different landholders were funded. Acceptance and rejection letters were sent to landholders on the 8th February 2008.

The final question : “Will outcome based payments motivate hidden or non-verifiable actions?” is addressed by assessing the landholder’s conservation management under the outcome based contracts. The first set of 18 site inspections for Bush Stone Curlew and Plains Wanderer habitat payments were completed in March 2008. These inspections assessed if the sites achieved the habitat benchmark and therefore were eligible for the first years habitat payments.

Results from these activities are presented next.

3. ACHIEVEMENT AGAINST M&E FRAMEWORK

3.1 Design and test

3.1.1 Tender design

To guide the design of the Nest Egg tender, an economic model was developed to analyse a tender based mechanisms where hidden actions, observable actions and variable and imperfectly observed site quality affect the environmental outcome, in this case bird breeding (Gorddard et al 2008a). This analysis indicates that:

- If landholders are risk neutral, then outcome payments should be set equal to the estimated opportunity cost of participation.
- Setting outcome payment too low may significantly reduce the benefits achieved by the tender. However setting the outcome payment too high is not likely have a significant effect on the outcome achieved.
- If landholders are risk averse, then imposing minimum input standards may reduce the cost of sharing risk with landholders.

These principles are applicable to tenders where hidden actions and hidden information are important. They were used to guide the design of the Nest Egg tender. Specifically they guided the development of the contracts, the specification of outcome payment levels, and the design of the metric used to evaluate bids.

3.1.2 Feasibility of monitoring outcomes.

The project demonstrates that it is possible to define measurable conservation outcomes that can be used as the basis of an outcome tender for bird conservation. Ecologists involved in the project were able to develop habitat quality benchmarks which set out the performance requirements for the three focal species targeted in this project (NPWS 2002a, Tack 2007, Herring 2007). In addition protocols to assess for bird presence and or breeding were established for each species.

In the Catchment management authority workshop survey, only 3 of 25 respondents agreed that “Benchmarks are too hard to measure for performance payments”. This indicates that biodiversity outcome measures are viewed by landholders and CMA staff as being feasible and credible.

The ability to define and monitoring conservation outcome that are robust enough to motivate the desired conservation management and outcome will ultimately be tested by the response of landholders to the outcome based contracts. The first site assessments of the habitat benchmarks indicated that the procedures were able to discriminate between successful and unsuccessful site management, and produced results that agreed with the subjective judgement of the site assessor. For the conservation of ground nesting birds, it therefore appears feasible to define practical outcome measures.

An important benefit of outcome based payments identified by the theoretical analysis is that it reduces the need to rely on metrics and models that predict the impact of management on future conservation outcomes in order to prioritise funding decisions. Assessment of value for money from input based or upfront payments requires assessment of the likely future stream of biodiversity values from the site given enrolment in comparison with the likely stream of future values given the management action if the site is not enrolled. This assessment therefore requires the ability to predict:

- likely management actions, with and without enrolment;
- ecosystem changes in the site given these management actions;
- changes in management and site attributes beyond the life of the scheme given future policy environments and land management actions.

The difficulty of this task has been identified as a key limitation on the use of tenders. For instance:

... it is difficult just to predict the biodiversity consequences of different interventions, let alone their values. If tenders are to really ... achieve their potential, we will need to greatly improve knowledge about cause and effect relationships for interventions and their consequences for biodiversity. I suspect that this may be the biggest single factor inhibiting improved purchase of environmental services, whether we use tenders or other approaches. (Pannell, 2007)

Outcome based tenders help overcome the difficult predictive task required to prioritize funding of input based payments by only paying for successful outcomes and by providing incentives to landholders to use their private held, as well as public knowledge to prioritize management and investment decisions. While there is still a need for knowledge of how to manage to improve biodiversity, outcome based biodiversity markets do not require intimate knowledge of the biodiversity “production function” to work. In addition they provide incentives for landholders and scientists to collaborate in generating it.

Contracting on biodiversity outcomes therefore overcomes a major obstacle to purchasing biodiversity and environmental services by reducing the reliance of the tender on information from ecological modelling to evaluate bids and allocate funds. Contracting on outcomes also

reduced the risk to government by requiring that at least some of the outcomes of the program are demonstrated.

3.2 Evaluate

3.2.1 Landholders choice and pricing of outcome and input based contracts

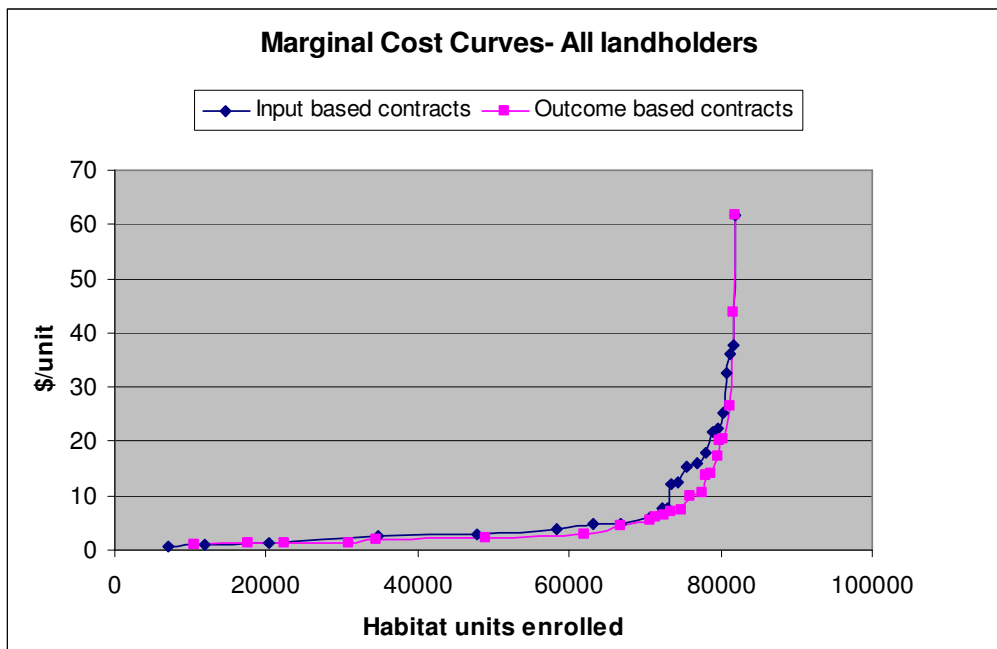
The Nest Egg tender resulted in 17 landholders submitting bids for a total of 23 sites. This number was in line with program expectations based on participation in previous tenders.

The key result is that in all cases the landholders selected the outcome based contract and specified a higher or equivalent bid price to be enrolled under an input based contract.

This result indicates that landholder are willing to enter into conservation contracts where a component of the payment is based on the achievement of conservation outcomes. In these contracts the outcome based payments represented on average 33% of the total possible payment. Since the outcome payment is set amount, this percentage varies with the tender price from a minimum of 8% to a maximum of 91%.

Figure 2 presents the landholders bid data for input and outcome based contracts as marginal cost curves, that is as the price required to purchase an additional habitat unit as a function of the amount of habitat purchased. The costs of the outcome contracts includes the expected payments of bird bonuses using a probability based on historical bird observation frequencies.

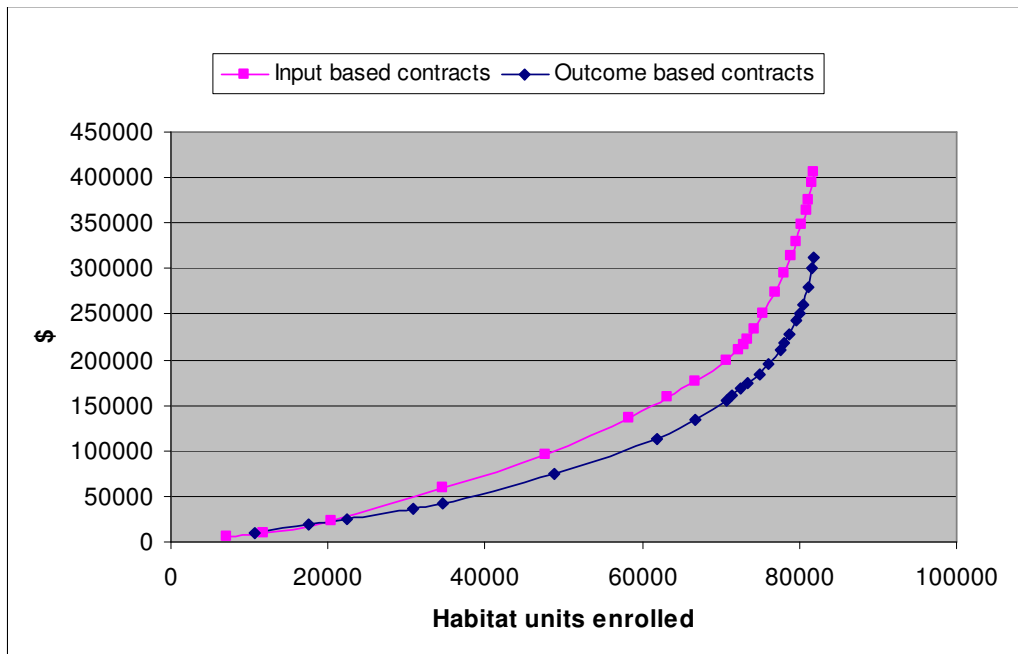
Figure 2 Marginal Cost Curves for Input and Outcome Based Tenders



Consistent with previous tenders there is a large variation in costs per unit, which translates into large variations in the potential value. This variation highlights the value of a competitive tender in setting the price and selecting bids. For example, if all outcome bids were funded, the most expensive three bids would deliver less than 2% of the total conservation benefit, yet cost more than 15% of the total budget.

Figure 3 shows the difference in the total costs of purchasing a specified number of habitat units under input and outcome based contracts. Based on landholder's stated bids for input based contracts, the expected total cost of the outcome based bids is on average \$4047 or 23% cheaper than the income based bids. For the actual number of habitat units purchased, (approximately 80000) the expected total cost is 33% cheaper if outcome based contracts are used instead of input based contracts.

Figure 3 Estimated total cost of the Nest Egg tender with outcome based and input based contracts



3.2.2 Factors influencing the preference for outcome based contracts

We expect that differences in the price of tenders of input or outcome based contracts to be driven by factors affecting risk preferences and management costs. The small sample size limits detailed analysis of the drivers of cost differences, however one potentially important result was identified.

Landholders were classified as either commercial agricultural, producers or as lifestyle (non-commercial) landholders on the basis of off-farm income, property size and retirement status.

In total eleven landholders were classified as commercial agricultural producers. Commercial agricultural producers required a larger premium than non agricultural landholder in order to enrol in input based contracts. For the 18 commercial landholder tenders, outcome contract bids were on average 33% (or \$5781) cheaper than their input contract bid.

In contrast three of the five landholders classified as non-commercial submitted the same upfront bid payment for the outcome and input based tender. This suggests that either the bonus payments were not of value to these landholders or, as is perhaps more likely that they simply forgot to factor in the value of the bonus when calculating bids. The average premium of the remaining two non-commercial landholders was \$2356 or 8% of their average input bid value. This difference between commercial and non-commercial landholders is statistically significant based on a two sided t-test ($p=0.015$)

Follow up phone interviews with commercial land holders with large bid discrepancies indicate that the preference for outcome contracts is due to a mix of risk and flexibility as discussed further below.

3.2.3 Revelation of landholder information on biodiversity assets.

The profile of participating landholders provides some anecdotal evidence about the effectiveness of outcome based schemes to attract appropriate landholders.

Of the 17 landholders who submitted tenders, 8 had not previously received government funding for conservation. This provides some indication that the scheme attracted some landholders who may not have enrolled for a standard input based contract.

There was also some evidence that the scheme attracted the appropriate landholders.

The survey responses indicated that:

- Sixteen landholders indicated that finances were a constraint on conservation;
- Three of the eleven commercial landholders indicated they would like more off-farm income;
- Ten landholders agreed that they could advise their neighbours on how to manage biodiversity on their property;

- Twelve landholders indicate that they already managed the site to protect ground nesting birds; and
- All but one landholder indicated that they had previously carried out some conservation activities such as weed and pest control on the site.

The scheme therefore appears to target landholders where the financial incentives are important, who have high private values for managing for the birds and who have knowledge of the birds management requirements.

The call for expressions of interests also resulted in landholders applying who revealed there were locations with bird populations that were previously unknown to the Catchment management authority. It also revealed new locations of birds in areas that were known habitat area and of one person breeding populations of birds for release. The outcome based incentives therefore appears to have encouraged disclosure of private information on biodiversity assets.

In contrast, for one bird species (Plains wanderer) threatened species legislation had been enforced in recent years. This legislation effectively imposes costs on landholders who reveal that populations of birds are present on their land. It therefore provides an incentive not to reveal private information about the birds. Uncertainty about the future implementation and interpretation of threatened species legislation may have affect landholders views about the merits of revealing information within the current scheme. While there were several requests for information about the Nest Egg tender from landholders regarding Plains wanderers there was only 1 tender application from this group. The contrast with Stone curlew landholders indicates that the incentives provided to landholders regarding disclosure of private information on bird populations is important to their behaviour.

3.2.4 Effectiveness of outcome payments in motivating hidden actions

The first set of 18 site inspections for Bush Stone Curlew and Plains Wanderer habitat payments were completed in March 2008. These inspections indicated that 12 of the 14 landholders achieved the habitat benchmark and therefore were eligible for the first years habitat payments.

Landholders are required to maintain a diary of management actions affecting the site. All of the successful landholders indicated that they had carried out the suggested pest control activities that are likely to be required for successful bird breeding.

These two results provide some preliminary evidence that the outcome based payments motivates the desired hidden actions.

3.3 Communication

The results from this study are relevant to state and federal governments, catchment management authorities, and researchers.

The lessons about the benefits and potential scope for application of outcome based payments, is relevant to government and catchment management authorities considering the use of tenders for biodiversity conservation and other natural resource management issues.

However it should also be emphasised that there are limits to which we can develop general principles about how tenders (or indeed any policy) should be constructed. Good tender design needs to be done on a case by case basis and requires a mix of contract design expertise and expert knowledge of the natural system.

A key message for economic researchers is the acceptability of the outcome linked payments and the development of a framework developed to analyse it. The research also suggests areas for future research. In particular there are suggestions for future integrated economic and ecological research to help define outcomes, as define metrics in the presence of outcome linked payments. In addition the finding of the acceptability of outcome linked payments suggests future the need for future research in understanding the specific elements of the input and outcome contracts that are acceptable. These messages are being communicated via presentations and academic publications.

3.4 Priority knowledge gaps filled

This project focused on the development of auctions with incentive compatible performance bonuses based on habitat quality and presence (or if possible breeding success) of target focal species during the breeding season. The pilot trials the inclusion of appropriate outcome oriented performance bonuses within an auction structure in order to better manage risk and hidden action (moral hazard) issues to both proponents and landholders. This pilot directly addresses the question of “whether landholders [should] have rights or contracts over their actions, or whether the contracts are defined over environmental or natural resource management outcomes” (Grafton 2005). Specifically, the pilot focuses on applicability and design of a mixed action, output and outcome-based contract (paraphrasing Grafton 2005) to achieve the desired conservation outcome in the presence of moral hazard and adverse selection. This pilot project also demonstrates how outcome based payments can overcome the “information requirements of bio-physical models [that] makes it difficult to develop MBIs that are defined in terms of ambient or environmental outcomes rather than the measurable actions or inputs of landholders” (Grafton 2005).

4. IMPLICATIONS

The Nest Egg trial demonstrates that conservation payments that link landholder payments to achieving environmental outcomes are feasible and can provide significant benefits. They therefore deserve serious consideration in the design of new conservation programs. Specifically the research and applied tender demonstrates that :

- For the conservation of ground nesting birds, it appears feasible to define practical outcome measures.
- Outcome based tenders are conceptually sound. Economic analysis of the hidden information and hidden action problems provides a useful theoretical basis for tender design.

- Landholders are willing to enter into conservation contracts that include outcome based payments. All landholders in the Nest Egg tender selected outcome based contracts when an input based contract was also available.
- Tenders including outcome based contracts can be more cost effective than input based contracts. For the Nest Egg tender, the use of outcome based contracts is estimated to have saved at least one third of total expenditure compared with input based contracts.
- Outcome based contracts appear to be of most value to commercial agricultural producers. This appears to be driven by commercial producers valuing flexibility in management and the clearly limited liability associated with outcome based contracts.
- Outcome based tenders provide landholders with incentives to reveal privately held information about the biodiversity assets on their land. This incentive appears to have resulted in landholders providing new and valuable information on bird populations.
- Preliminary evidence suggests that outcome based contracts may motivate landholders to undertake hidden actions, such as pest control.

Other potential benefits of outcome based contracts to landholders and governments that were not examined include the incentives for landholder to innovate to improve biodiversity and production compared with predicted outcomes, and the value of ongoing flexibility provided by the contracts in when and how to invest in conservation.

Two potential impediments to the use of outcome based contracts may limit the extent of their application:

- the practicality and cost of defining and monitoring outcomes; and
- the willingness of landholders to bear the risk of outcome based payments.

The practicality of defining outcome based contracts in the context of natural resource management in Australia may be limited in general by two factors. First is the long time lags that may exist between management and outcomes. If hidden action or hidden information is important in achieving these outcomes then the use of outcome based payments should perhaps still be considered as part of the contract mix. Payment for intermediate outcomes or short term outputs that indicate appropriate management may also be considered. The Nest Egg tender demonstrated how properly specified annual incentives can provide incentives for the correct short term and long run management, in this case motivating management of both pest control and habitat structure. Given the importance of active, ongoing management to biodiversity outcomes in many instances, this model may be more widely applicable.

A second practical problem is the ability to define the desired biodiversity conservation outcomes in a specific and quantifiable way. This is related to the problem of defining what our conservation objective should be. The desired outcome needs to be informed by understanding of ecological processes, economic efficiency considerations and societal values. Investing in a clear understanding of the objectives of public funding is a prerequisite

for efficient investment. Clarifying the desired and monitorable outcomes is therefore likely to be a good investment.

The cost of defining and monitoring conservation outcomes was not studied in this trial. The small scale, novel methods, and research focus mean that costs from this trial are unlikely to be informative about larger scale tenders. Several points can be made however. First the main cost of monitoring involves staff site visits. The appropriate frequency of these visits will depend on the nature of the management problem and not the aspects monitored. For instance a focus on species breeding is likely to require seasonal visits regardless of if actions or outcomes are being monitored. While the duration of visits may depend on what is monitored, the “overhead” costs of travelling to the site make this cost difference relatively less important. Other factors also affect the relative costs and benefits of monitoring outcomes. The information gained by monitoring site-level outcomes is also likely to be of value for monitoring program level outcomes and regional scale biodiversity conservation. Site visits are also an important opportunity for landholders and conservation program officers to jointly learn about conservation management requirements, and can be an important part of landholder motivation to undertake conservation management. Finally monitoring outcomes also reduces the costs of the more complex task of modelling the predicted outcomes from management actions. These wider benefits and costs of the monitoring strategy need to be considered in deciding on the implications of monitoring costs for policy design. For issues similar to the ground nesting birds studied here, these wider considerations mean that the cost of monitoring is unlikely to be an important consideration in the decision about the use of outcome based contracts.

The willingness of landholders to bear the risk of uncertain payments related to outcome based payments requires further investigation. However the feedback from landholders in this tender suggests that this is only one of the risks that landholders consider in entering a conservation contract. The potential restrictions that a conservation contract place of future management options and the uncertain liabilities associated with non compliance with input based contracts were other risks mentioned by participating landholders. Management of these risks favoured outcome based contracts.

The practical implications of this research for the design of conservation tenders are that contract design matters, and we should consider incorporating some outcome based payments into the tender contracts. There are limits to which we can develop general principles about how contracts should be constructed, ultimately good contract design needs to be done on a case by case basis and requires a mix of contract design expertise and expert knowledge of the natural system. However, the current research is consistent with economic theory in suggesting that outcome based payments may be valuable when there is uncertainty and variability in the required management actions, when hidden actions are important in determining the outcomes, and when landholders have private information about how the value of their management actions and biodiversity assets.

5. CONCLUSIONS AND RECOMMENDATIONS

The Nest Egg trial demonstrates that conservation contracts including outcome based payments are acceptable to landholders in practice. For this case study, the use of outcome based contracts is estimated to have reduced the total landholder payment costs by at least

one third of total expenditure compared with standard input based contracts. These savings may be greater given:

- a) potential positive selection effects of outcome based contracts; that is improved targeting of the appropriate landholders;
- b) incentive for landholder to innovate to improve biodiversity and production outcomes; and
- c) the flexibility provided by the contracts in when and how to invest in conservation.

Given these benefits, incorporating outcome linked payments into landholder contracts warrants serious consideration in future conservation tenders.

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