Invasive Animals Cooperative Research Centre

*"Together, create and apply solutions"*

# Costing the impacts of invasive animals

## Proceedings of the Invasive Animals CRC workshop on social, economic and environmental impacts of invasive animals

*Andrew Norris, Wendy Henderson, Stuart McMahon and Elaine Murphy*

**Costing the impacts of invasive animals: Proceedings of the Invasive Animals CRC workshop on social, economic and environmental impacts of invasive animals**

Summaries of presentations and discussions held at the socio-economic workshop are included in these proceedings. The reader is advised that individual participants and organisations have not endorsed the summaries provided and interpretation of slides or transcripts may not be correct in some instances. Responsibility for the content of this report, including any errors, is accepted by the Invasive Animals Cooperative Research Centre.



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# Executive Summary

In 2004, the Pest Animal Control Cooperative Research Centre commissioned a 'triple-bottom-line' report on the economic, environmental and social impacts of invasive vertebrates in Australia. *Counting the Cost: Impact of Invasive Animals in Australia, 2004* (McLeod 2004) was designed to provide the basis for setting priorities for investment and outcomes for the succeeding Invasive Animals Cooperative Research Centre (IA CRC). The techniques applied in the report used existing but conservative estimates of the impacts of 11 major introduced pests. The impacts of these invasive animals on Australian agriculture and the environment were estimated by providing a national perspective, and totalled around $720 million.

The IA CRC is considering updating and expanding the Counting the Cost report. This workshop was held to highlight:

- gaps in current knowledge relating to impact assessment
- areas in which assessments can be improved
- potential techniques and indicators for assessing and reporting impacts.

Participants agreed that while economic impacts may be easier to assess, the IA CRC should investigate placing dollar values on some of the more qualitative impacts of invasive animals. However, any assumptions or biases would need to be made obvious in the reporting process. The CRC should also be prepared to remove dollar values where they do not adequately represent an issue.

If a dollar value is to be applied to environmental impacts, credible figures need to be obtained. Detailed research and conservative, systematic and transparent processes are needed to do this. If applying dollar values to individual impacted animals, caution must be taken in extrapolating these values, to avoid overestimating impacts. Cost figures need to be based on the impact on the whole ecosystem/species/population, rather than just the individual. Currently, estimating such values is hampered by a lack of knowledge of biophysical relationships and the long-term responses of the environment (eg changes in biodiversity) to invasive animals. It may be some time before we can readily place economic values on the environmental impacts of some vertebrate pest species. It may not even be appropriate to put a dollar value on biodiversity in some cases.

Information on the type and intensity of social impacts of invasive animals is currently limited. Workshop participants suggested a range of indicators that would be useful to monitor social impacts, at scales ranging from the national level all the way down to that of the individual. Potential indicators include media interest, ministerials, participation in forums and rural/regional health. The level at which social impacts should be measured needs to be related back to the scale of the investigated area. Case studies could highlight finer-scale impacts that might be missed at state or national scales of reporting. Incorporating existing

indicators from other programs (such as the National Land and Water Resources Audit's *Signposts of Australian Agriculture*) could be one cost-effective way to begin estimating social impacts.

Participants pointed out that a single social issue often has a cascading effect. Economic and environmental impacts can also lead to social impacts. The interrelationships between social, environmental and economic impacts will make it difficult to design a robust framework for social impact assessment.

Workshop participants agreed that reporting on economic impacts was the most advanced of the three forms of impact assessment. It was concluded that indirect and induced impacts must be considered with direct impacts when calculating economic impacts.

A variety of techniques can be used to produce reports combining environmental, social and economic impacts. The most popular of these techniques include benefit–cost analysis and multiple criteria analysis. Participants agreed that a report combining qualitative and quantitative analyses would provide the most accurate reflection of invasive animal impacts. It was acknowledged that there is a need for dollar-based reports to highlight the issues of vertebrate pests to government agencies, politicians and funding bodies.

## Recommendations:

The workshop participants recommended that the CRC:

1. Establish a research working group to examine current reporting methods for economic, environmental and social impacts. The group should determine the most appropriate methodologies for updating and expanding the Counting the Cost report.

2. Using the methods determined above:

   a) undertake research projects/case studies to gather more data on social and environmental impacts

   b) review and expand the Counting the Cost report, consulting with relevant agencies to provide more up-to-date data, including indirect and induced costs. Results from (a) should also be included.

3. Establish research projects to measure the marginal gains of CRC technologies, products or actions from an environmental, social and economic perspective — at the local, regional and national level.

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# 1. Background

## 1.1 Counting the cost

In 2004, the Pest Animal Control Cooperative Research Centre commissioned the review *Counting the Cost: Impact of Invasive Animals in Australia, 2004* (McLeod 2004). The aim of the review was to provide the basis for setting priorities and outcomes of the succeeding Invasive Animals Cooperative Research Centre (IA CRC). It provides existing and conservative estimates of the national impacts of 11 major invasive animals, from an economic, environmental and social perspective (a 'triple-bottom-line' or TBL perspective). The animals analysed are introduced pests of Australian agricultural industries and the natural environment.

Economic impacts were calculated from costs of production losses and pest management. Production losses were estimated for sheep, cattle and cropping industries from predation on livestock, competition for feed and crop damage. Pest management costs were estimated from baiting, fencing, shooting, and research on improved management of particular species.

Environmental and social impacts are more difficult to quantify and so were estimated in qualitative terms in the report. Environmental impacts were typically based on the impact of invasive pests on biodiversity. Where possible, these impacts were quantified in dollar terms, particularly from data available on feral cats, foxes and carp. However, accurate information on ecological cause-and-effect relationships, and communities' valuation of species preservation was not readily available.



## 1.2 Workshop objectives

One of the aims of the IA CRC is to periodically update the Counting the Cost report. Updates would try to fill many of the information gaps evident from the initial report, to provide a better understanding of the social, environmental and economic impacts of animal invasions. A more accurate and current view of the total impact of vertebrate pests would help the CRC to assess progress towards its operational goals.

This workshop was designed to help guide the CRC on the updating process. The four key objectives for the workshop were to:

- identify how the Counting the Cost report should be updated
- identify and discuss information gaps in the CRC's current understanding of the social, environmental and economic impacts of animal invasions
- identify realistic methods for valuing the social, economic and environmental impacts of animal invasions
- determine how the impacts of animal invasions from these three

perspectives can be combined to form a cohesive and meaningful valuation.

The workshop consisted of five sessions covering an introduction, environmental impacts, social impacts, economic impacts and triple-bottom-line reporting. Each session is described in further detail in the following chapters. Appendix 1 lists the workshop participants and Appendix 2 outlines the workshop's full agenda. Appendix 3 contains the participants' discussions.

# 2 Workshop introduction

## 2.1 Context and expectations

Dr Tony Peacock, Chief Executive Officer of the IA CRC, opened the workshop by welcoming participants and providing a brief presentation on the CRC. He outlined how the workshop would help update *Counting the Cost: Impact of Invasive Animals in Australia, 2004* (McLeod 2004) on the triple-bottom-line (TBL) impacts, and guide research to improve impact-valuation techniques.

Stuart McMahon introduced the workshop format by gaining agreement on the agenda and proposed outcomes. All participants then introduced themselves and outlined their expectations of the two-day workshop. These expectations were to:

- develop better economic estimates for the cost of animal invasions
- determine how to weight different impacts in TBL reporting, with regard to different interest groups
- determine how to incorporate monitoring and evaluation into reporting
- discuss methods for measuring and reporting impacts
- determine how to incorporate TBL information, at a project level, in applications to the CRC
- determine ways to ensure that economics is included in the range of factors that drive natural resource management, particularly social impacts
- identify an appropriate title for the updated Counting the Cost report.



Dr Andrew Norris provided a brief presentation on the Counting the Cost report. The intent of the report, basic principals used to derive the impact estimates and highlighted gaps in knowledge were outlined.

Stuart McMahon asked the group to develop a series of ground rules, to make sure that the workshop ran smoothly and that all participants were given the opportunity to contribute to and participate in discussions. The rules developed were:

- discussions are to be targeted at issues rather than disciplines
- persons or disciplines are not to be attacked
- participants are not to assume there is a mutual understanding of specific jargon or terms.

## 2.2 Objectives of an updated Counting the Cost report

The participants discussed the objectives and target audiences for the Counting the Cost report; both current and future editions. It was agreed that the main audiences for such reports would be funding bodies and

politicians. Reports should highlight the scale of the invasive animals problem, relative to other issues competing for funding and exposure.

An updated report should also allow prioritisation of resource investment. Identifying the relative size of animal impacts could help the CRC to direct resources into areas or species with the greatest impact. The participants were divided on how effectively impact analysis could achieve this. Several economists argued that resource investment and prioritisation should be based on the potential marginal gain of a project, rather than on the relative scale of the problem. They argued that for the same cost, the CRC would be better off investing in research where the gain will be greatest, as opposed to where the problem is largest. Others argued that although such an approach is fine in principal, it would mean that the CRC would be taking the 'easy way out' and not tackling the more difficult issues, where only a cooperative research effort is likely to make progress. They argued that smaller marginal gains made in more problematic areas may lead in time to greater marginal gains. Participants concluded that a balanced approach is needed, taking into consideration both the nature of the problem and the potential marginal gain of investment.

The group agreed that updating the Counting the Cost report should be an actual research project and not just a report of past impacts. For many invasive animal species, the impacts are not comprehensively understood, particularly the social impacts. The 2004 report dealt primarily with direct impacts, such as loss of livestock and crops. The revised report needs to better emphasise indirect impacts, such as non-tangible social impacts and their flow-on effects. Both the pros and cons of invasive animal impacts need to be carefully considered. The question of how to include community benefits from certain pest species (such as the value of pets) in an impact assessment was raised.

Participants concluded that an updated Counting the Cost report should ideally:

- identify links between biophysical, social and economic factors
- establish benchmarks to aid monitoring and evaluation
- provide information to leverage community attitudes
- be a community resource tool
- identify what will happen/change as a result of the CRC's research efforts — weighing up pros and cons against the costs
- identify the benefits of different research programs
- illustrate benefits of research programs through case studies
- help the CRC to secure funding for, and raise awareness of, invasive animal research.

# 3 Environmental impacts

Professor Jeff Bennett (Australian National University) and Dr Paul Downey (New South Wales Department of Environment and Conservation) spoke to the participants about environmental impacts of invasive animals. Workshop participants then divided into four groups to discuss focus questions; Appendix 3 outlines the groups' discussion points. This chapter contains a summary of the presentations and the group discussions on environmental impacts.

## 3.1 Presentations

### Estimating the values of the environmental impacts of pest animals

Professor Jeff Bennett

Markets are the most common mechanism for people to show what values they hold dear — expressed through their willingness to pay for or accept certain things. But many environmental impacts of pest animals exist outside markets. Integrating the values of these impacts into the economic analysis of pest control measures requires converting non-market values into dollars and cents. Economists have developed 'revealed preference' and 'stated preference' techniques to do this.

Revealed preference techniques involve the use of relationships between the impacts and related markets. The actions of people in related markets are used to infer their preferences and to estimate values. For example, the travel cost method uses the relationship between the expenses incurred by visitors to a particular environment and the benefits enjoyed from visiting. The hedonic pricing technique uses the relationship between environmental attributes (eg scenic view, noise pollution) and marketed goods, such as property values. Production function is another example of revealed preference techniques, where quantifiable environmental factors (such as water used for cropping, fertilizer microbes in soil) are used as inputs into a commercial production process.

Stated preference techniques use information provided by respondents to questionnaires asking about their willingness to pay for environmental improvement in a hypothetical 'market'. Questions may be based on contingent valuation (eg 'Are you willing to pay $x as an additional tax to have the feral cat exterminated?'), where the dollar value is varied and the number of 'yes' votes counted. Alternatively, questions may use choice modelling (eg 'Of the following four invasive animal management strategies, which do you prefer?'), where the choices are varied according to different environmental and monetary outcomes and responses are analysed.

Both good science and good economics are needed to properly analyse and use data. Good science should be able to predict the environmental

outcomes of proposed management strategies. Good economics should be able to estimate the full range of costs and benefits associated with each proposed strategy.

### Impact of pest animals on threatened biodiversity in New South Wales

Dr Paul Downey

Invasive species (including pest animals) have been recognised as the greatest cause of global biodiversity decline after land clearing. Currently, however, there is limited data on the biodiversity at risk from invasive species. Such limitations hamper management strategies for biodiversity conservation. The study described here provides a quantitative baseline of the impact of invasive species in relation to other causes of biodiversity decline in New South Wales.

The quantification was done by compiling a database of the threats to biodiversity listed under the New South Wales *Threatened Species Conservation Act 1995*. At 1 January 2005, a total of 945 native plant and animal species, populations and endangered ecological communities were listed as threatened in New South Wales. Invasive species pose the second greatest threat to biodiversity in New South Wales, after the destruction of native vegetation. Impacts include predation, grazing, habitat degradation, competition and control of introduced animals.

Pest animals threatened 38 percent of the biodiversity examined. The impact of pest animals was greatest on threatened fauna, with 179 of the 272 species identified as being at risk. The pest animals most commonly identified as posing a threat to biodiversity were feral cats (115 listings), foxes (108), feral goats (87), rabbits (80) and feral pigs (62). The quantification of impacts of specific pest species in three distinct geographical zones should allow for better targeted control aimed at biodiversity conservation.

## 3.2 Summary of environmental impacts discussion

Participants discussed the evaluation and reporting of environmental impacts of vertebrate pests based on the following focus questions:

- What are the options for environmental impact valuation?
  - What are the relative pros and cons of these options?
  - How can these options be used effectively?
- What are the merits of monetary versus non-monetary valuation?
- What are the existing gaps in our knowledge that need urgent attention?

Participants agreed that there is a long way to go before credible, accurate economic values will be able to be placed on the environmental impacts of many vertebrate pest species. In fact, it may not even be

appropriate to put a dollar value on biodiversity. Some intangibles may not be best represented by a financial figure; for example, the value of human life. This could be due to a lack of reliable methodology or the nature of intangibles.

Where dollar values are given, they have to be credible, and generally be obtained through conservative methodologies. Derivation of detailed dollar estimates using current methodologies would need significant investment (hundreds of thousands of dollars was one figure suggested) and the CRC may be better off investing its resources elsewhere.

The community can readily relate to the number of native species lost (or near extinction) and this may be an alternative measure of impacts from invasive animals that needs to be considered. Often, multiple species or ecological systems are being assessed together, and we need to determine how to separate out the impacts from various vertebrate pests. Perhaps a better approach would be to focus more on the geographic area, rather than on the impacts from individual species.

Monitoring impacts and responses needs to fit in with long-term national monitoring frameworks — for environmental, economic and social research. The length of time it takes for management actions to produce an environmental response (with regards to biodiversity outcomes) also needs to be considered.

One of the major factors limiting our current valuation of environmental impacts is the lack of knowledge on biophysical relationships. Detailed information on environmental impacts of many pest species is still lacking (eg information on density-dependent damage) and this needs to be a key research priority.

# 4 Social impacts

Dr Roger Wilkinson (Victorian Department of Primary Industries) introduced the session on social impact assessment and Dr Gerard Fitzgerald (Fitzgerald Applied Sociology, New Zealand) gave a presentation on social costs. Workshop participants then divided into four groups to discuss focus questions; Appendix 3 lists the groups' discussion points. This chapter contains a summary of the presentation and the group discussions on social impacts.

## 4.1 Presentation

### Counting the social cost

Dr Gerard Fitzgerald

The IA CRC is interested in developing a better picture of the impacts of invasive animals on human society (and perhaps, from there, quantifying the economic costs in order to judge the worth of developing and implementing interventions). However, identifying and evaluating human/social impacts presents a number of challenges, ranging from conceptualising the interrelation between the biophysical and human worlds through to what constitutes a human impact.

Social impact assessment (SIA) is the process of researching, analysing and managing intended and unintended consequences for people of planned interventions. It aims to anticipate and eliminate undesired consequences of such interventions in advance. SIA considers peoples' way of life, culture, community characteristics, quality of environment, health and well-being, and fears and aspirations. The process includes involving potentially affected people, profiling them, scoping the full range of impacts, and predicting the most likely issues. Responses to these impacts and ramifications of a proposed intervention then need to be predicted. Changes to the proposed intervention may be recommended to avoid or compensate for undesired consequences. Monitoring and evaluation of the intervention are then needed to check its progress and success.

We need to be explicit about the connection between the biophysical and human worlds and how changes in one bring about changes in the other. One model discussed in the presentation was based on the 'function evaluation' of nature. Functions of nature which people have deemed to be important include the production of natural resources, ecosystem supports (eg ground water levels, carbon sequestering), areas for human use (eg land for housing and agriculture, waterways for generating electricity) and landmarks or species of religious or heritage significance. A change in the biophysical world might only cause a social impact if it significantly affects one of these functions and threatens social structure. For example, foxes preying on rabbits would have little human impact, whereas preying on lambs would compromise human livelihoods and cause flow-on social effects.

Social impacts include impacts on the well-being of people at a personal, community, cultural and material level. They also include impacts on the liveability of the environment. Benefits and undesired impacts of invasive animals need to be considered from these perspectives. Proposed interventions also need to be assessed in the same light. Cause-and-effect pathways for changes in biophysical and human worlds need to be better understood. Dealing with dynamic situations and cumulative impacts presents challenges to any assessment. Fixing an accurate dollar value to every impact would be beyond the current ability of economics.

## 4.2 Summary of social impacts discussion

Participants discussed social impacts of vertebrate pests based on the following focus questions:

With regards to the impacts of vertebrate pests:

- What are the social impacts that we should be measuring?
- Why should we measure them?
- What would make a credible measure of social impact?

Participants agreed that currently, information on the type and level of social impacts of invasive animals is limited. The groups reported back on a wide range of potential impacts that could be measured, addressing individual, family, community and regional impacts. Indicators such as media interest, ministerials, participation in fora and rural/regional health levels could provide relatively easily measured gauges at minimal cost. The National Land and Water Resources Audit's *Signposts for Australian Agriculture*[1] could help provide some of this information.



Social, environmental and economic impacts are often interrelated. For example, economic issues can have a cascading effect, leading to social issues. Similarly, a single social issue can have a flow-on effect leading to other impacts. Much work is still needed to establish a framework to use for social impact assessment.

The participants found it difficult to come up with a list of general social impacts of pest species. Instead, they found it more productive to consider the impacts of specific pests. The concepts of 'well-being' or 'health' to describe the state of society, of individuals and of environmental systems were also discussed. A more personal way of expressing these concepts is needed.

One potential method for documenting social impacts would be to undertake before-and-after surveys. The changes in social impacts resulting from management interventions (eg IA CRC demonstration sites) could be recorded and the benefits documented. These benefits could then be enhanced using adaptive management techniques.

1 See http://www.nlwra.gov.au/topics.asp?section=56 (accessed November 2006)

# 5 Economic impacts

Dr Randall Jones (New South Wales Department of Primary Industries) gave a general introduction and then Dr Stephanie Shwiff (United States Department of Agriculture) and Dr Jim Smart (University of York) gave papers on economic case studies, involving pest species in California and south-east England respectively. Workshop participants divided into four groups to discuss focus questions; Appendix 3 lists the groups' discussion points. This chapter contains a summary of the presentations and the group discussions on economic impacts.

## 5.1 Presentations

### What can economics bring to the Invasive Animal Cooperative Research Centre?

Dr Randall Jones

The role of economic research as part of a scientific research program such as the IA CRC can vary depending on the particular issues or research questions to be addressed. To many biological researchers, the role of economics as part of a CRC may be unclear and the different types of frameworks and disciplines confusing. This presentation categorised economic research into three main areas: impact analysis, project evaluation and bio-economic modelling.

The goal of impact analysis is to determine the economic impact of an issue such as vertebrate pests (eg McLeod 2004). This can help set priorities within a research program and to allocate resources. More often these analyses are used to support lobbying for funds from government and research and development bodies. The disadvantages of an economic impact analysis are that it focuses on the size of the problem, does not tell us about future or avoidable costs and can give a false impression that a zero-pest scenario is feasible.

Project evaluation is another area of economics that can be used to assess research programs. Two of the criteria by which a CRC are assessed are whether: (1) outcomes will contribute substantially to Australia's industrial, commercial and economic growth, and (2) funding sought will generate a return and represent good value for the taxpayer. To meet these criteria, rigorous economic assessment is needed of the benefits and costs of proposed/completed science programs. These assessments can be undertaken at an individual project level (ie 'bottom-up') or on a broader research program level (ie 'top-down'). Other CRC's (Beef, Wool and Weeds CRCs) have invested in economic resources for program evaluations. The analyses have been presented as benefit–cost analyses. Results from the economic evaluation of the 'Outfox the Fox' project were discussed.

Bio-economic modelling can be used to determine optimal strategies for managing a pest problem. Although the term 'bio-economics' has come to mean different things to different people (a bit like sustainability) it can generally be viewed as a model that consists of a biological (biophysical) model that describes the behaviour of a living system, and an economic model that relates the biological system to economic and institutional constraints. Bio-economic modelling provides important tools for interdisciplinary analysis, particularly for the long-term management of complex dynamic and stochastic biological systems. It allows linkages between economic decisions and the biological states of a system. Benefits from technology can be measured and weaknesses or research priorities can be identified. This area of economics has credibility with research biologists. Several practical examples were discussed, including modelling of sustainable grazing systems, integrated weed management and water policy for crop irrigation.

## The economics of coyote (*Canis latrans*) predation on livestock: a case study from California using input-output modelling

Dr Stephanie Shwiff

The economic impacts of predation on livestock are often quantified as the direct effect of the number of livestock animals lost to the predating species multiplied by the market price. However, given the economic linkages between the agricultural sector and other sectors of the economy, this approach understates the total effect (direct + indirect + induced) on the economy. In 2003, a study was done by the National Wildlife Research Center, Wildlife Services (WS), United States Department of Agriculture to describe benefits and costs of WS operations in California. Part of this analysis focused on determining the indirect and induced effects of predation on cattle and sheep, measured by value added or revenue loss and job loss to the economy.



This analysis employed the input-output model IMPLAN ® (Minnesota IMPLAN® Group, Inc., Stillwater, MN) to determine these values. IMPLAN® uses extremely complex mathematical models that simulate the 'linkages' within a user-specified regional economy based on the most current economic and demographic data available. An input-output model is developed by constructing a mathematical replica of a regional economy (city, county, state, etc.) that contains all the linkages between economic sectors (eg agricultural, manufacturing and industrial) that are present in that economy.

The current use of IMPLAN® sought to quantify the economic effects that were likely to have occurred within the Californian economy as a result of predation by coyotes on cattle and sheep. The total estimated loss in value added or revenue for California in 2004 ranged from $5.5 to $9.6 million and between 250 and 450 jobs lost. The induced and indirect costs were larger than the direct effect (number of sheep lost multiplied by market value) of livestock predation. This emphasises the importance of including induced and indirect costs with direct costs in an impact analysis.

### Assessing the socio-economic impact of expanding deer populations in the east of England

Dr Jim Smart

A report on the economic impacts of deer in the east of England was funded by the United Kingdom's Forestry Commission and English Nature. A broad range of impacts were assessed for the report, but this presentation focussed on deer-related road traffic accidents (primarily an economic and social issue), and damage to natural heritage (an environmental issue).

An impact function approach was used to establish links between landscape characteristics, traffic flows, deer population densities and deer-related traffic accidents. Datasets available on road traffic accidents and casualties from different locations were used to estimate deer population densities. Predicted annual costs of deer-related traffic accidents were calculated using the United Kingdom's Department of Transport standard accident costs of (human) injuries and fatalities.

The impact of deer on natural heritage was also estimated by looking at an impact:density relationship. The condition of conservation sites in the English Nature database was found to be related to the density of deer populations and culling control practices. A questionnaire was sent out to managers of 44 conservation sites, asking them about relative deer abundance, intensity and type of damage caused by deer and costs of mitigation and control. Analysis of results showed a correlation between deer density and damage to conservation sites. It also showed a correlation between mitigation/control costs and damage scores. Damage scores, and thus costs were extrapolated to other sites across eastern England to estimate total costs to conservation woodlands. These costs were minimum estimates and did not consider non-market issues such as the value of biodiversity.

The advantages of the impact function approach include full integration into bio-economic models, good stakeholder engagement and transparent methodology. Disadvantages include a high reliance on data compilation and availability and a stylised representation of financial consequences.

## 5.2 Summary of economic impacts discussion

The economic impacts of vertebrate pests were discussed based on the following focus questions:

- What are the key CRC issues that require economic research/ analysis?
- What type of economics analysis do you think these issues need?
  - impact analysis?
  - research evaluation?
  - bio-economics?

  - others?
- What timeframe and data should be used?
  - When should assessment begin and who with?
  - When and how should targets be completed?
- What resources, data and science should be used?

Participants agreed that when calculating the economic impacts of invasive animals, the direct, indirect and induced costs all need to be considered. The original Counting the Cost report only dealt with direct costs and was an impact assessment. It therefore may not necessarily be the best starting point for judging the IA CRC's outcomes. Some participants suggested that the CRC should be looking at the impacts of its work, rather than updating the Counting the Cost report (ie What is the marginal effect of the CRC's technologies and products?).

It will be important for the CRC to determine the best way to monitor its programs and the impacts they are having. The CRC's scientific programs, information delivery, technologies and tools should provide end users with decision support and methods that create change.

The size of the financial impact (real, estimated or perceived) should not be the most important figure of such research, but to politicians and funding bodies such a figure seems to provide them with an easy way of comparing the relative importance issues. The CRC should investigate placing dollar values on some of the more qualitative issues, but any assumptions and biases need to be transparent. The danger is that a dollar figure may not always represent the issue. The CRC should be prepared to remove the valuation if it does not adequately represent the issue, leaving the assessment as a qualitative one.

A report of the style of Counting the Cost could come from a problem-oriented perspective rather than a species perspective, in order to better illustrate the inter-related impacts in areas where multiple invasive animal species occur. The interlinked relationships between social, environmental and economic impact due to invasive animals need to be considered as a whole. This bio-socio-economic modelling needs to be based on relevant variables for the model, to incorporate natural variations in the systems and correct biophysical relationships.

# 6 Triple-bottom-line reporting — bringing the impacts together

The final session of the workshop focussed on how the CRC could most effectively provide reports that considered the combined social, environmental and economic impacts of invasive animals. Dr Elaine Murphy (Department of Conservation, New Zealand) introduced the session. Professor Nick Fisher (ValueMetrics) , Mr Ashley Page (AEC*group*) and Dr Stefan Hajkowicz (CSIRO Sustainable Ecosystems) presented papers on the concept and application of triple-bottom-line (TBL) reporting. This chapter contains a summary of the presentations and the final group discussions on TBL reporting. Recommendations for the CRC are also given below.

## 6.1 Presentations

### What is a 'bottom line'?

Professor Nick Fisher

In its original usage, the term 'bottom line' referred to the last line of a company's profit-and-loss statement. In striking contrast, 'triple bottom line' measures seek to capture

> … the whole set of values, issues and processes that companies must address in order to minimize any harm resulting from their activities and to create economic, social and environmental value[2].

This presentation proposed an approach to address this issue based on the concept of 'value added', leading to bottom-line measures that are necessarily soft (perceptual), rather than hard numbers.

A framework for performance measurement was described. At an operational and tactical level, internal business activities can be measured. At a strategic level, success measures can be indicated by key performance indicators, a set of organisational-level measures used by the executive to help manage an organisation. In contrast to more quantitative measures of economic costs and benefits, success measures include measures of perception. They capture the value of the stakeholder's investment (resources, money or labour) in a given enterprise compared with an alternative investment. Stakeholders measuring success include community, customers, owners, employees and strategic partners. Success values need to be high for all stakeholders, to ensure the long-term sustainability of an enterprise.

How is success measured? A definition for 'value added' was discussed. For example, 'customer value added' quantifies the value an enterprise adds for its customers, based on the quality and price of products or services, relative to purchases from other competing suppliers. Other

2 From http:// www.o2.com/cr/glossary.asp, quoting http://www.sustainability.com

stakeholder values that can be added to measure success represent satisfaction with a variety of issues, including pricing arrangements, returns, perceived community benefits, remuneration and risks taken.

An example of linking value to business drivers was described using a case study from the Pest Animal Control CRC. A survey on the use of gene technology to control mice plagues was prepared to determine the level of community value (ie how worthwhile they considered the program to be). The objectives of the community value process were to:

- determine the key drivers of the community's satisfaction to the proposed control program — environmental, financial and farming benefits versus environmental and health concerns
- monitor the community's level of satisfaction to determine which drivers carry the most weight
- note any significant changes in the relative importance of these drivers to inform public awareness programs.

Business impact questions were asked, to determine the level of support for commercialising the mice control program. Willingness to use gene technology for other pest species was also gauged. Results were related to the community value score for the worthiness of the project, to identify how large a community value score is needed to proceed with commercialisation.

In conclusion, there are several bottom lines to accommodate when estimating the value of a program. Some of these measures are perceptual, although they may be able to be linked to hard numbers, typically financial.

## Economic evaluation of pest animal and non-market impacts

Mr Ashley Page

This presentation discussed where we are currently at regarding economic evaluation of pest animal and non-market impacts. It provided an overview of lessons from past research and what we should do in the future to achieve efficient investment in invasive animal control.

At the present stage, the majority of impacts to be assessed in TBL reporting have been identified. Most of the production impacts of invasive animals have been quantified, as have some social and environmental impacts (at least partially). We also now have a range of non-market evaluation methods. These include contingent valuation, hedonic pricing and travel cost methods (see Professor Jeff Bennett's presentation summary for explanations of these techniques). Other techniques include defensive expenditure (a change in expenditure to maintain an existing level — eg weed or pest control), change in cost (transactions before and after a change) and replacement cost methods.

Alternative social and environmental evaluation techniques are

being developed; asset and impact-based impact approaches, social accounting frameworks and data requirements for impact assessment are all being looked at. There is recognition of the interrelatedness of environmental assets, community capability and resource management.

We have learnt not to rely on old favourites for control measures and to concentrate on returns gained at the margin. The importance of collating data throughout a control process has also been established. There will never be enough money or resources to control all the impacts of invasive animals in Australia, so we need to focus on the best return for every dollar spent. A coordinated effort is needed to prioritise and invest resources.

For the future, we need to get baseline data to measure progress of control strategies and focus research actions on practical outcomes. This means investing efficiently and with commitment in the short, medium and long terms. It also means managing risks by diversifying research portfolios, maximising returns and minimising risks.

## Triple-bottom-line appraisal of pest animal control investments

Dr Stefan Hajkowicz



The limited resources for managing pest animals in Australia means there is a need for careful targeting and priority setting. This presentation explored investment appraisal techniques designed to determine which pest control options provide the best returns. The benefits arising from pest control are often intangible and not easily quantified in dollar units (eg biodiversity, public health). This calls for a mix of economic evaluation methods including approaches that go beyond conventional benefit–cost analysis. Cost utility analysis (CUA) and multiple criteria analysis (MCA) were discussed using case studies of a United States conservation reserve program and priority setting for the wet tropics of Queensland.

A framework for choosing an investment analysis method was presented. Environmental valuations should include monetary and non-monetary components. The latter involve multiple attributes and costs that are often not readily available in dollar units. CUA and MCA may be most useful for appraisals of pest animal control programs. We can learn from healthcare economics, where multiple weighted attributes are used to determine a numerical value — in this case, of quality adjusted life years.

In the MCA process, multiple criteria to be assessed are identified, then weighted and ranked to ultimately influence decision making. Funding for natural resource management (NRM) of different regions of Queensland was allocated using an MCA tool developed by CSIRO. Criteria and indicators of natural resource assets and threats were agreed to by the chairs of regional NRM bodies. More specifically, in the wet tropics region, assets and threats to NRM were weighted and ranked to set priorities of management strategies. Many other examples of applying MCA to make management decisions were cited, including the fields of

finance, energy, agriculture and military planning.

The CRC needs to use valuations which are not just limited to market techniques of cost savings and avoidance, and revealed pricing. Other non-monetary metrics and qualitative descriptions will have a greater impact on politician's and society's perception of the need for pest control. There has been considerable scepticism shown in the past on putting a price on the environment. Moving away from a focus on dollar value to a focus on choices may be a way to make better resource allocation decisions.

## 6.2 Summary of final discussion

One of the key points for discussion was how the CRC should produce and use an updated Counting the Cost report. A report focussing on impact analysis would provide a snapshot of impacts at any given time and be useful in highlighting issues that need to be addressed. A report focussing on research areas or applications that potentially give the CRC the best marginal gain would be more useful for priority setting. Participants decided that the CRC may need to produce two reports — one using a financial-impact approach for government agencies and funding bodies, and another report including both qualitative and quantitative techniques that more accurately describe non-tangible impacts. Participants generally agreed that decisions on whether reporting should be based on species or geographic location should be made on a project-by-project basis. No consensus was reached regarding the format of a national-scale report.

The CRC needs to determine what people value. The social value inputs to combination socio-economic reporting include a combination of dollar and community-value ratings. Community values can relate to social, environmental and economic impacts, including for example, public perception and satisfaction, which are core drivers of decision making.



The CRC has the opportunity to assemble scientists from a range of disciplines from its participating organisations, to bring together impact reporting. Although not all projects will need upfront economic analysis, all possible impacts should be considered at the start, to avoid missing important inputs to analyses. The CRC also needs to ensure that all relevant disciplines are involved in a project from the planning phase. The CRC demonstration sites provide ideal scenarios for information to be gathered for TBL reporting and to clearly demonstrate the implications of management. These sites could be used as case studies in an updated Counting the Cost report, highlighting the impacts and effects of management that may not be evident on a national scale.

## 6.3 Recommendations of the workshop

The workshop participants recommended that the CRC:

1. Establish a research working group to examine current reporting methods for economic, environmental and social impacts. The

group should determine the most appropriate methodologies for updating and expanding the Counting the Cost report.

2. Using the methods determined above:

    a) undertake research projects/case studies to gather more data on social and environmental impacts

    b) review and expand the Counting the Cost report, consulting with relevant agencies to provide more up-to-date data, including indirect and induced costs. Results from (a) should also be included.

3. Establish research projects to measure the marginal gains of CRC technologies, products or actions from an environmental, social and economic perspective — at the local, regional and national level.

# 7 References and further information


Adamowicz, W.L. (2004). What's it worth? An examination of historical trends and future directions in environmental valuation. *The Australian Journal of Agricultural and Resource Economics* 48:3–419.

Bennett, J. (2005). Australasian environmental economics: contributions, conflicts and 'cop-outs'. *The Australian Journal of Agricultural and Resource Economics* 49(3):243–261.

Branch, K., Hooper, D. A., Thompson, J. and Creighton, J. (1984). *Guide to Social Assessment: A Framework for Assessing Social Change*. Westview Press, Boulder.

Burdge, D. A. and Vanclay, F. (1995). Social impact assessment. In F. Vanclay & D. A. Bronstein (eds), *Environmental and Social Impact Assessment*. John Wiley & Sons, Chichester.

Burdge, R. (2004). *The Concepts, Process and Methods of Social Impact Assessment*. Social Ecology Press, Middleton, Wisconsin.

Engeman, R., Shwiff, S., Smith, H. and Constantin, B. (2004). Monetary valuation of rare species and imperilled habitats as a basis for economically evaluating conservation approaches. *Endangered Species Update* 21(2):66–73.

Finsterbusch, K., Llewellyn, L. G. and Wolf, C. P. (1983). *Social Impact Assessment Methods*. Sage Publications, Beverley Hills, California.

Fitzgerald, G.P, Fitzgerald, N.P. and Wilkinson, R. (2002). Social acceptability of stoats and stoat control methods: focus group findings. *Science for Conservation 207*, Department of Conservation, Wellington.

Fitzgerald, G.P., Saunders, L. and Wilkinson, R. (1996). Public perceptions and issues in the present and future management of possums. *MAF Policy Technical Paper 96/4*. Ministry of Agriculture and Forestry, Wellington.

Hunsaker, C. T. (1998). Cumulative Effects Assessment. In: A. L. Porter and J. J. Fittipaldi (eds.), *Environmental Methods Review: Retooling Impact Assessment for the New Century* (pp. 100–112). Armey Environmental Policy Institute and the International Association for Impact Assessment, Fargo.

International Association for Impact Assessment (2003). *Social Impact Assessment: International Principles*. Fargo. http://www.iaia.org (accessed August 2006).

McLeod, R. (2004). *Counting the Cost: Impact of Invasive Animals in Australia, 2004*. Pest Animal Control Cooperative Research Centre, Canberra. Executive summary available at http://www.invasiveanimals.com/images/pdfs/Pac_ExSum6.pdf or full document available at http://www.invasiveanimals.com/images/pdfs/CountingTheCost.pdf (accessed August 2006).

Porter, A. L. (1995). Technology Assessment. In F. Vanclay & D. A. Bronstein (Eds.), *Environmental and Social Impact Assessment* (pp. 67–81). John Wiley & Sons, Chichester.

Queensland Environmental Protection Agency (2003). *Techniques for Environmental Economic Evaluation*. Available at http://www.epa.qld.gov.au/publications/p00710aa.pdf/Techniques_for_environmental_economic_valuation.pdf (accesed August 2006).

Queensland Environmental Protection Agency (2003). *Environmental Economic Evaluation: An Introductory Guide to Policy-Makers and Practitioners.* Available at http://www.epa.qld.gov.au/publications/p00870aa.pdf/Environmental_economic_valuation_an_introductory_guide_for_policymakers_and_practitioners.pdf (accessed August 2006).

Sinden J. and Griffith G. (in press). Combining economic and ecological arguments to value the environmental gains from control of 35 weeds in Australia, *Ecological Economics*.

Sinden J., Jones R., Hester S., Odom D., Kalisch C., James R., Cacho O. and Griffith G. (2005). The economic impact of weeds in Australia, *Plant Protection Quarterly*, 20 (1):25–32.

Slootweg, R., Vanclay, F. and van Schooten, M. (2003). Integrating environmental and social impact assessment. In: Becker, H. A. and Vanclay, F. E. (2003). *The International Handbook of Social Impact Assessment: Conceptual and Methodological Advances*. Edward Elgar, Cheltenham.

Taylor, C. N., Bryan, C. H. and Goodrich, C. G. (2004). *Social Assessment: Theory, Process and Techniques*. Middleton, Social Ecology Press, Wisconsin.

van Schooten, M., Vanclay, F. and Slootweg, R. (2003). Conceptualising social change processes and social impacts. In: Becker, H. A. and Vanclay, F. E. (2003). *The International Handbook of Social Impact Assessment: Conceptual and Methodological Advances*. Edward Elgar, Cheltenham.

Wilkinson, R. and Fitzgerald, G.P. (1998). Public attitudes to Rabbit Calicivirus Disease in New Zealand. *Landcare Research Science series 20*. Manaaki Whenua Press, Lincoln.

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# Appendix 2 Workshop agenda

## Monday 7th November

9:00 **Introduction**

Tony Peacock — Welcome

9:15 Stuart McMahon — Housekeeping

9:45 Andrew Norris — Counting the cost

10:00 Morning tea

10:15 **Environmental impacts**

Jeff Bennett (Chair) — Estimating the values of the environmental impacts of pest animals

Paul Downey — Impact of pest animals on threatened biodiversity in NSW

10:50 Breakout groups discuss different methods, make recommendations for priority research

12:15 Lunch

13:00 Summary from breakout groups

14:00 **Social impacts**

Roger Wilkinson (Chair) — General remarks

Gerard Fitzgerald — Counting the social cost

15:00 Afternoon tea

15:15 Breakout groups discuss different methods, make recommendations for priority research

16:30 Summary from breakout groups

17:00 End Day 1 sessions

19:00 Workshop dinner

## Tuesday 8th November

8:20 Housekeeping

8:30 **Economic impacts**

Randall Jones (Chair) — What can economics bring to the Invasive Animals Cooperative Research Centre?

Stephanie Shwiff — The economics of coyote (*Canis latrans*) predation on livestock: a case study from California using input-output modelling

Jim Smart — Assessing the socio-economic impact of expanding deer populations in the East of England

9:45 Morning tea

10:00 Breakout groups discuss different methods, make recommendations for priority research

11:30 Summary from breakout groups

11:45 Lunch

12:30 **Triple-bottom-line reporting**

Elaine Murphy (Chair)

Nick Fisher — What is a bottom-line?

Ashley Page — Economic evaluation of pest animal and non-market impacts

Stefan Hajkowicz — Triple-bottom-line appraisal of resource investments

13:15 Breakout groups discuss different methods, make recommendations for priority research

14:30 Afternoon tea

14:45 Summary from breakout groups

15:15 General discussion

16:15 Close of workshop

# Appendix 3 Group discussions

## 3A.1 Environmental impacts discussion:

### Group 1 report

The first group suggested that a range of topics must be considered. The pest species or areas in question need to be taken into account when choosing options for environmental impact evaluation. The cost of monitoring, control and research and development needs to be incorporated in any value estimate, as well as the benefits of a reduction in incursions. It is highly important that the benefits be estimated at a pragmatic level of reduced animal impacts and not from the complete absence of invasive animal impacts, which would lead to benefits being overstated. Relating the impacts to zero percent damage will only be relevant if eradication of the animal is the objective and probable. Other issues to be considered include the type of valuation to be used, the biophysical dynamics of the system, available technology, and the probabilities and risk of incursions, market closure and climate.

### Group 2 report

This group came to the consensus that choice modelling (CM) and contingent valuation (CV) were of limited use. The main reason given was the difficulty in valuing something with which people are not familiar with. CM and CV can incorporate hidden value judgements by researchers, producing somewhat biased or subjective figures. The group also questioned the need to place a financial value on environmental impacts. Qualitative measures can be used within a portfolio, but may not be able to infer across portfolios. Such qualitative assessments of environmental impacts are currently being used in New Zealand and are starting to be used in the United Kingdom. It is important to note that society does place value on some issues without applying a dollar value. For example, the national defence budget is huge and many people do not question its size. The peace of mind from the knowledge that they are protected against invasion is seen as more important than the financial impedance. The group also raised the issue of where and how we measure cultural (indigenous and non-indigenous) values. These will be closely linked with any valuation of the environment and the impact of invasive animals, and perhaps the issue should be considered as a socio-environmental impact evaluation. The question of how the scientific information will be used was raised — how it could be put into a national framework and provide baseline data for a policy context. It is critical to decide which areas need baseline data. There is also a need to communicate with policy people to ensure that the right and effective areas are targeted.

### Group 3 report

Revealed preference values are currently used in the United States because they are believed to be more objective and thus more easily defended than stated preferences. The United States has developed

databases on investment levels/values for restoration attempts in order to provide revealed preference value estimates for other environmental remediation projects. These values are used to assess the likelihood of success of projects having a significant impact, and also for project investment prioritisation. Group 3 believed that contingent valuation has too many spatial and temporal issues to be considered reliable or accurate. A lack in knowledge on cause-and-effect relationships for invasive animal impacts makes it difficult to estimate environmental impacts, let alone value them. The group recommended that more research is needed in the area. There also needs to be greater investment in science/ecological research to determine the environmental indicators to use and what to measure. The group cautioned that estimates and valuations need to be conservative in order to maintain credibility.

### Group 4 report

Group 4 concluded that although economic values are important, they are not the sole measure of impact or importance. A portfolio of studies based on issues, case studies and national frameworks needs to be considered. Some potential environmental measures include replacement cost and rehabilitation cost; protection cost and opportunity cost. When developing a blueprint for valuing environmental impacts, advantage needs to be taken of existing programs (eg Southern Ark and Western Shield projects) and knowledge gaps identified and addressed.



## 3A.2 Social impacts discussion:

### Group 1 report

*What are the social impacts we should be measuring?*

- Level of trust with institutional decisions
- Commercial versus recreational activities
- Regulatory obligations
- Companion animals issues (eg feeding wildlife)
- Humaneness versus control efficacy
- “White anting” — social erosion at the community level
- Heritage value (eg grazing alpine cattle and galloping brumbies)
- Minor disruptions to lifestyle (eg kangaroos eating plants in the garden)
- Effect of information transfer on a particular invasive species — effect on perceptions, emotions (eg cane toads)
- Localised impacts leading to devastation, social isolation and the possibility of depression
- Scale of social impact
- Health — both physical and mental

*Why should we measure them?*

- They form the social drivers of the need for research and management
- They set priorities
- Social impacts drive control method development

*Credible measures*

- Ministerials before, during and after an event (eg cane toads)
- Meeting attendance and participation (eg workshops, focus groups)
- Public outcry and associated media interest (eg foxes in Tasmania)
- Note the need to ensure consistency in the terminology used

Taking deer hunting as an example:

- What social impacts should be measured?
  - Commercial and recreational usage
  - Hunting—social benefit (ie people value deer hunting)
  - Displaced native species—cost (ie native vegetation impacts, travel costs)
- Why should we measure these impacts?
  - People value deer hunting
- Credible measures
  - the number of hunters, measured by deer licenses
- People value pristine native habitats



## Group 2 report

*What are the social impacts we should be measuring?*

Individual impacts:

- physical health
- mental health
- empowerment
- sense of well-being/identity
- time consumption
- frustration
- attitudes
- motivation
- ownership

Family impacts:

- family function or dysfunction
- financial security
- inheritance
- family time
- lost opportunity
- enterprise change

Community impacts:

- cohesion
- deprivation
- diversification (flow on from enterprise change)
- conflicting values of what are pests
- totem animals (eg camels and donkeys)

Regional impacts:

- tourism
- frustration/stagnation
- management of multiple issues

National impacts:

- cultural heritage
- national identity
- national pride

*How to measure and why*

- Use existing independent measurements

- Media both positive and negative — shows level of concern
- Parliamentary discussion — shows levels of concern
- Rural community health measurements — shows individual/ community well-being
- Participation in community groups/Landcare/burnout — measures social capital
- Direction of government funding for social issues related to invasive animals — measures societal values
- Demographic change — measures community capacity to management issues
- Changes in services— measures communities needs/choices/ pressures

## Group 3 report

*What are the social impacts we should be measuring? (in order of importance)*

- Way of life
- Impacts that change social capital
- Livelihoods
- Public perceptions about control
- Health
- Indigenous cultures
- Leisure activities
- Tourism expectations
- Recreational opportunities
- Leisure time
- Public safety
- Flow-on effects of impacts on an industry
- Quality of life
- Neighbour disputes
- Employment/income security

*Why measure these impacts?*

- Maximises community welfare
- Monitors progress
- If you can't measure it, you can't manage it effectively
- Balances economic and environmental arguments
- Personalises the problem
- Helps public relations, advocacy, communications, inform political decisions and manage relationships
- Informs interventions at a detailed level

*Credible measures*

- Measures of people's perceptions
- Non-market valuation techniques
- Participation rates in pest animal discussion groups

Group 4 report

*What are the social impacts we should be measuring?*

- Health and well-being
- Quality of the living environment
- Sense of identity and mental health
- How can you use people's fears to our advantage — but still be credible!
- Letters to newspapers reflect peoples concerns
- Western Australian vertebrate pest contact database
- Frequency of calls to pest information services
- ABC Pest Search
- Ministerials
- Urban concerns are different to city
- Likelihood × severity × fear
- Who is affected by invasive animals? — What is the effect and how big is it?

*Why measure these impacts?*

- Acknowledging people's concerns
- Provide information to policy, farmers, funding bodies, etc

*Credible measures*

- Get a group of social scientists to meet and discuss the above
- Pick an animal or area for a case study
- Use demonstration sites to gather this information

## 3A.3 Economic issues discussion:

### Group 1 report

*Key CRC issues*

- Identify data gaps — use the 80:20 principal (ie can analyse a scenario if you can get 80 % of data)
- Greater collaboration between existing data sources
- Data collection built into projects

*What types of economics do these issues require?*

- Appropriate
- Economic input — prior, during and post
- Direct and flow-on impacts

*Timeframe and data*

- Collate existing data (Australian Bureau of Agricultural and Resource Economics, Bureau of Rural Sciences, state data, other) as soon as possible
- Incorporate data gathering processes in existing and future projects as soon as possible
- Dedicate resources, possibly including a full-time in-house economist within six months

### Group 2 report

*Key CRC issues*

- Outcomes of the CRC that require demonstration of economic related gains
- What new tools and technologies are to be designed/developed by the CRC?

- Product assessment and subsequent resource allocation are competing ideas
- Recognise the research portfolio of the CRC — failure in one should not detract from the overall benefits (reprioritisation)
- Portfolio has a mix of low and high-risk projects — must handle that risk with respect to strength of returns

*What type of economics do these issues require?*

- Dependent upon issue — case studies might at one point require impact analysis, while elsewhere bio-economic modelling would be most appropriate
- If the CRC wants to sustain itself, it probably should commit to economic analysis; otherwise it might be a seven-year wonder!
- How does the CRC work out what is an optimal allocation and what will be seen to be a good decision (~ 5 % of total budget?)
- Investments are small and risk low, but some need could be argued for some ex-ante studies
- Issues of scale — high probability versus low probability — ground truthing
- Quality of data and minimising errors before expenditure on one or other pest
- Likely to be a mix of economic tools, used variously and dependent on the questions asked.
- What is the value of the CRC and the program it is delivering? How does the CRC make top-down, bottom-up decisions about optimising allocation of resources?
- If the CRC is not looking to run beyond seven years, why bother?
- Top-down decisions probably have no relevance — this decision in the context of CRC not continuing beyond the current seven year program
- Aim for bottom-up studies to reinforce the value of what the CRC is doing
- Gather funding mainly from non-government sources (eg research and development agencies/industry)
- Demonstrating relevance and high priority to industry sectors will assist in maintaining funding flows for social research

*Timeframe and data*

- Early rather than late
- Demonstration sites should be used as case studies as they are ‘close’ to end users

- Needs reports to funding agencies coupled to an uptake/extension/ transfer marketing process planned for when deliverables come on-stream
- Counting the Cost report was an accounting not an economic instrument. CRC must now decide if it wants to invest in serious economic studies

## Group 3 report

*Key CRC issues*

- Need to target outcomes
- Need to compare the use of different methods over time
- Cost sharing—public and private interests and relative investments

*What type of economics do these issues require?*

- Need to include written qualitative studies and information
- Use a toolbox of tools
  - define/justify the context in which the tools are being used
  - if you need a hammer, use a hammer (ie use the right tool for the task)
- Don't get hung up on the method but be transparent

*Timeframe and data*

- In the beginning — social, bio-economic
- Must be planned for and the implementation done during rather than retrospectively
- Utilise demonstration sites

## Group 4 report

*Key CRC issues and techniques*

- Identify species/problem where input/output analysis can be done easily and is appropriate
- Note where indirect and induced costs were not considered — need to update the Counting the Cost report
- Identify species/problems where road traffic accident (RTA) type spatial approach can be used and is appropriate
- Pair regional management action plans with economic impact analysis
- Any issue that involves management and a resource requires economic input
- Important questions:
  - Where do you place investment?
  - How much do you invest?
  - What are the economic consequences?
- Incorporate benefits of 'pests'
- If possible approach from problem end — not species end

*Timeframes and data*

- Begin with induced/indirect approach with a few species
- Take a commodity-based approach
- Use sheep as a case study; for example, a participatory approach, one state, six representatives, five staff over a five-year timeframe.