

Integrating values and disciplines: The Ecosystem Services Project in Australia

Dr Steven Cork¹ and Dr Wendy Proctor²

CSIRO Sustainable Ecosystems, Canberra

¹ *Currently on secondment at Land & Water Australia, GPO Box 2182, Canberra ACT 2601,
steve.cork@lwa.gov.au*

² *Now at Policy and Economic Research Unit, CSIRO Land and Water, GPO Box 1666,
Canberra ACT 2601, wendy.proctor@csiro.au*

Abstract

The Ecosystem Services Project ran from 1999 to 2003. It engaged community representatives in a set of case studies around Australia to explore the benefits to humans from natural ecosystems, and to encourage better acknowledgment of these benefits in policy and land management. Its approach was to develop true partnerships among researchers and between researchers and community representatives in which knowledge and understanding were shared across disciplines and backgrounds. The concept of ecosystem services was used as an integrating concept — it conceptualises the relationship between humans and nature in terms of a set of tangible services that all people can understand and recognise along side more familiar services from bakers, bankers, bookstores, doctors etc. In the first and most extensive case study, biophysical, economic and social analyses were brought together in a series of assessments of implications for ecosystem services under a set of scenarios for the future of the Goulburn-Broken Catchment, in northern Victoria. As a first-cut assessment of the key issues, a qualitative inventory of relationships between land uses and ecosystem services was performed. This was followed by more detailed analyses blending quantitative and qualitative information. The early phases of the study recognised that the value, or worth, of ecosystem services depends on people's understanding and perceptions of the services and their benefits, both of which are typically poorly informed. This led to the development and testing of a new integrative tool for participative research, which combined deliberative decision making with multi-criteria evaluation. This enabled decision-makers to consider the best available information in a user-friendly environment and to balance multiple, sometimes competing, values in a transparent and structured process.



INTRODUCTION

In 1999, CSIRO was awarded a \$1 million grant from The Myer Foundation as part of the Sidney Myer Centenary Celebration 1899–1999. This injection of philanthropic funds enabled CSIRO to initiate a project that it felt had great public importance but which it had not been able to fund through other processes (Abel et al. 2003). The original plan was to set up four case studies assessing benefits to people from nature in different ecosystems around Australia. In practice the project encouraged the development of 10 case studies in one way or another but provided substantial direct funding for only 3. Of these, one, in the Goulburn Broken Catchment of northern Victoria, was resourced more than the others in an effort to test the approach as fully as possible. Land & Water Australia joined as a major funder of that case study, and the Goulburn Broken Catchment Management Authority became a partner contributing substantially in kind. This was the beginning of the Ecosystem Services Project in Australia with the primary goal of changing the way Australians think about their environment. A popular definition of ecosystem services is:

“... the conditions and processes by which natural ecosystems, and the species that make them up, sustain and fulfil human life” (Daily 1997).

Examples are given in Figure 1

Production of Goods
<i>Food:</i> Terrestrial animal and plant products, forage, seafood, spice
<i>Pharmaceuticals:</i> Medicines, precursors to synthetic drugs
<i>Durable materials:</i> Natural fibre, timber
<i>Energy:</i> Biomass fuels, low-sediment water for hydropower
<i>Industrial products:</i> Waxes, oils, fragrances, dyes, latex, rubber, precursors to many synthetic products
<i>Genetic resources:</i> The basis for the production of other goods
Regeneration Processes
<i>Cycling and filtration processes:</i> Detoxification and decomposition of wastes, renewal of soil fertility, purification of air and water
<i>Translocation processes:</i> Dispersal of seeds necessary for revegetation, pollination of crops and native vegetation
Stabilizing Processes
Coastal and river channel stability, compensation and substitution of one species for another when environments vary, control of the majority of potential pest species, moderation of weather extremes (such as temperature and wind), partial stabilisation of climate, regulation of the hydrological cycle (mitigation of floods, droughts, salinity)
Life-Fulfilling Functions
Aesthetic beauty, cultural, intellectual, and spiritual inspiration, existence value, scientific discovery, serenity
Preservation of Options
Maintenance of ecological components and systems needed for the future, supply of goods and services awaiting discovery

Figure 1. A classification and examples of ecosystem services (adapted from Daily 1999)

We worked with our partners in the Goulburn Broken Catchment to interpret previous work on ecosystem services in ways that we thought made sense to a broader cross-section of stakeholders (Figure 2). The two key elements of our message were:

- Ecosystems provide services in much the same way as other service-providers like bakers, newsagents, chefs, hairdressers, book publishers etc.

- Like other services, ecosystem services are about transformations of a set of inputs into a new output of greater value

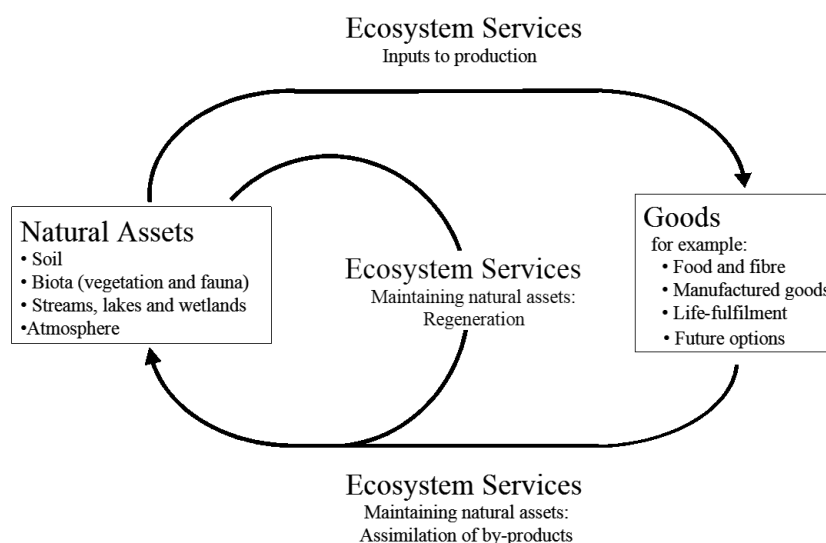


Figure 2. Conceptual framework defining ecosystem services in terms of three types of transformations: (1) Transformations of natural assets into products valued economically and in other ways by people in a catchment; (2) transformations of the by-products of Type 1 ecosystem services back into natural assets; (3) internal transformations among natural assets to maintain those assets.

This mix of funders, partners and researchers brought a range of social and scientific goals that defined the project as one requiring integration at a range of levels.

The social goals were about encouraging broader thinking about the environment and its benefits among Australians. This required us to integrate the thinking of ecologists and economists into clear and meaningful messages for a range of audiences and to put a major effort into two-way communication.

The scientific goals were about integrating across a range of biophysical sciences and between biophysical and social science to explore the economic and social implications of land use options.

Two integration tools loomed large in this project. One was an integrating concept—Ecosystem Services. The concept had been developing for several decades, largely in the USA, as a way to focus attention on human dependence on ecosystems for health, prosperity and well being (Daily 1997). Although it had mainly been used in academic analyses, we saw it as a potentially powerful tool for participative research because it simplifies the complexity of ecological processes into a small number of integrated benefits, or “services”, that all people are able to understand with minimal explanation. In this way, it had the potential to engage a wide range of people in dialogue about issues usually requiring specialist economic and ecological knowledge.

The project was set up at a time when there was a lot of talk about the value of the environment but a lack of clarity about the underpinning issues. There was an emerging tension between those who thought economic evaluation of the environment would improve the consideration of environmental issues in decision-making and those who considered that putting any monetary value on nature was ethically wrong (Pearce and Moran 1994). Both of these issues arise in part from poor understanding of economic theory and how it might relate to human welfare and ethics. We hoped that we could use the concept of ecosystem services to encourage dialogue among people from different background, including those without ecological or economic training.

The vast majority of previous ecological research had not been done with economic valuation in mind, with the result that key information for valuation did not exist. We hoped to use the concept of ecosystem services to focus dialogue among biophysical scientists and economists so that biophysical models could be developed that supported economic evaluations.

The other tool—Deliberative Multi-Criteria Evaluation—combined stakeholder deliberation with a multi-criteria decision tool for simplifying complex, multi-objective decision-making. Such a tool was needed for two primary reasons. Firstly, since making decisions about ecosystem services requires consideration of a wide range of biophysical, social and economic data, by people with sometimes differing values and beliefs, a method was needed to make these tradeoffs clear to decision makers. Secondly, since the value, or worth, of ecosystem services depends on people's understanding and perceptions of the services and their benefits, both of which are typically poorly informed, a method was needed to help decision makers become informed by the best available information.

POLICY, MANAGEMENT AND DISCIPLINARY CHALLENGES

Prior to commencing the project, we interviewed a range of policy makers, land managers and scientific researchers to understand the key problems that they faced with respect to human-environment interactions in rural Australia.

At the time the project began, the term “ecosystem services” was not used widely in policy circles. However, policy makers had been grappling for decades with economic concepts like how to bring the external impacts of land use, such as salinisation of other parts of the landscape, chemical pollution of downstream waters, and offsite effects of soil erosion, into the same market as the costs of inputs to that land use (such as costs of fertilisers, pesticides, machinery and labour). This was commonly called “internalising externalities”. For these policy makers the key questions were how to measure externalities both in space and time and how to determine who was causing them and who was being affected.

A related issue was how to promote understanding of these issues in a way that fostered productive dialogue across communities of interest. It was widely recognised that the language and assumptions of economics were not well understood by non-economists, but that approaches to dealing with the economic analysis of externalities did exist.

Many argued that what was most needed was the biophysical information on relationships between management and externalities and the social information on how those externalities impacted on communities and individuals.

Land managers also called for believable and understandable information on the impacts of management practices. Typically the questions they most wanted us to address were: (1) “what benefits will we, or society, get from conserving the environment/ biodiversity?” and; (2) Who gets these benefits and who pays?” While there were data indicating that many management practices potentially produced adverse environmental impacts, there was not a clear classification of the benefits lost or gained and seldom were there data that allowed the impacts to be quantified. Another major issue for land managers was the perception by city people that farmers selfishly degraded the land for their own benefit.

Integration of ecology and economics was a hot topic at the time, but few examples of effective integration existed. We commenced the project with a 2-day workshop between economists and ecologists to identify what each discipline would need for integration. A number of key issues emerged:

- Economics is not a single discipline. If you ask several economists “how do you value the environment?” your question will be interpreted very differently by each depending on their background and disciplinary interests
- The issue of “value” is dealt with very differently by different economists
- Economic analyses usually require information about rates of change in something being valued as the actions being taken change—yet ecologists often investigate impacts in terms of a set of discrete treatments that often do not allow response (change) relationships to be derived. For example, an ecologists might investigate the impacts of fire on forest animals by having treatments that either have fire or don’t have fire, or they might have two or three levels or types of fire, whereas an economist would want to see a response curve that might require many more 2 or 3 points on it.
- Where ecologists do get interested in responses they usually find non-linear relationships (i.e. rates of change are different under different resource conditions) and economics finds it hard to deal with non-linear change
- While all participants recognised that people’s perceptions of the value of the environment would be different from place to place and time to time depending on what social processes and institutional arrangements were in place, we struggled with how to integrate the social science dimension into a projects that seemed too complex already.

STUDY AREA

This paper deals with one case study from the Ecosystem Services Project, that was situated in the Goulburn Broken Catchment of northern Victoria (Figure 3).



Figure 3. Location of the Goulburn Broken Catchment in Victoria.

The Catchment is diverse in terms of landuse, consisting of an irrigated region in the north (270,655 ha in size) primarily made up of horticulture (fruit) and irrigated dairy pasture, a central dryland grazing and cropping region (1,397,130 ha in size), and a southern high country area valued for its timber, tourism and recreational uses (690,603ha in size). Approximately two-thirds of the catchment has been cleared for agriculture with 190,000 people calling the Catchment home, of which 17,000 are employed in agriculture and associated industries.

The population of the Catchment is predicted to grow to approximately 210,000 by 2021, especially in areas within two hours drive of Melbourne. This is leading to increased interest in the land for rural lifestyle living, cheaper housing and new industries, making it less cost effective to purchase land for traditional agricultural enterprises. Some of the increased land value is attributable to retained native vegetation, giving value to this component of biodiversity not recognised in the past.

Leaders of the community have established an ambitious vision for the catchment. Research is seen as a cornerstone to achieving this vision. The community and agencies in the catchment have extensive experience in developing and applying innovative approaches to natural resource management and the region has previously been the focus for numerous pilot programs. The catchment is also a major contributor of salt and nutrients to the Murray River and improved management of natural resources in the catchment has important implications for down stream users.

RESEARCH FRAMEWORK

The objectives of the Ecosystem Services Project in the Goulburn Broken (Cork et al. 2001, 2002) were to:

- engage policy developers, decision makers, and implementers throughout;
- assess what ecosystem services are provided by a range of ecosystems;
- assess who benefits from the services, where;
- explore and analyse change under different future scenarios;

- investigate new institutional, market, and policy structures to encourage accounting of, and investment in, natural assets; and
- develop and test guidelines for performing such assessments in Australia and elsewhere.

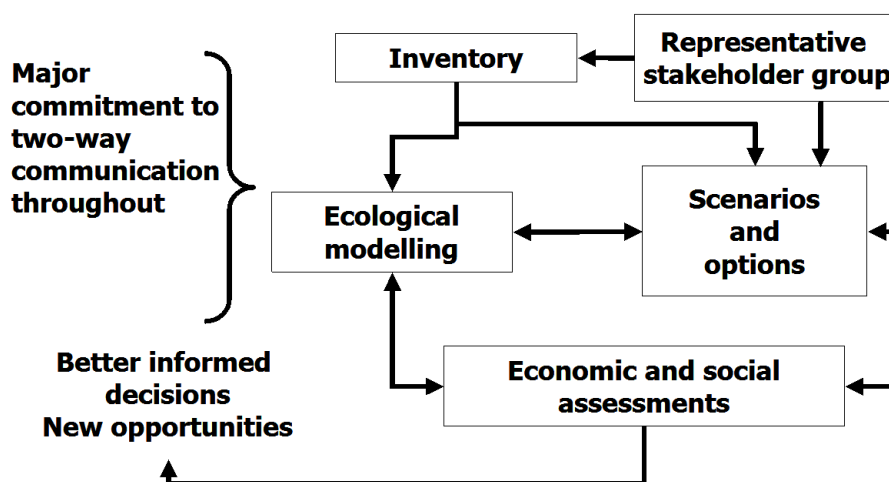


Figure 4. Key elements of the approach to assessing and valuing ecosystem services as applied by The Ecosystem Services Project.

A multi-phase approach was used in addressing these objectives and included (Figure 4): the engagement of a representative stakeholder group; an initial qualitative inventory (Binning et al. 2001); leading to the identification of a set of scenarios and options for the future of the catchment; followed by ecological, social and economic analyses to explore the implications for ecosystem services; and the integrations of analyses and stakeholder values to lead to better informed decisions and new opportunities; and finally, a major commitment to communication throughout the project. (Abel et al. 2003). Each of these phases are now explained in greater detail.

Representative stakeholder group

The project ended up having a total cash budget approaching \$2 million, and involved CSIRO, The Myer Foundation, Land & Water Australia and the Goulburn Broken Catchment Management Authority as major partners. Over 40 community representatives took part regularly in planning and assessment workshops and these people represented a range of industries, land uses and government and non-government organisations (Binning et al. 2001; Abel et al. 2003; www.ecosystemsproject.org).

Half of the project steering committee was community representatives from the catchment, including the chair.

The nature of the partnership between the research team and the community representatives was defined in a two-day workshop at the beginning of the project, attended by around 40 people. The participants were asked to identify their hopes, fears and expectations of the project, the research team and the community representatives. These were developed into an informal agreement.

Inventory

Services	Land uses											
	1	2	3	4	5	6	7	8	9	10	11	12
a												
b												
c												
d												
e												
f												
g												
h												
i												
j												
k												
l												

Figure 5. Ecosystem services (rows) judged to be of high importance to various land uses (columns) in the Goulburn Broken Catchment. Key to column headings: 1 — Dairying, on farm; 2 — Fruit and grapes; 3 — vegetables; 4 — Grazing; 5 — crops; 6 — Intensive Animals; 7 — Forestry; 8 — Food processing; 9 — Housing; 10 — Water production; 11 — Recreation; 12 — Areas of cultural/future options. Key to row headings: a — Pollination; b — Life fulfilment; c — Regulation of climate; d — Pest control; e — Provision of genetic resources; f — Maintenance of habitat; g — Provision of shade & shelter; h — Maintenance of soil health; i — Maintenance of healthy waterways; j — Water filtration and erosion control; k — Regulation of rivers and groundwater; l — Waste absorption and breakdown.

One of the first messages from the community representatives was that they could not wait for 4 years until a detailed scientific analysis was performed. They asked for a rapid assessment within the first year. This request was met in the form of a qualitative inventory, based on expert judgement, of the state of ecosystem services, the perceived dependence and impacts of land uses on ecosystem services, and the expected future trends (Figure 5).

Scenarios (options)

Developing a set of plausible scenarios for the future management of the Goulburn Broken Catchment, and assessing how ecosystem services change under these different future scenarios, were central components of this project. The scenarios approach has been adopted for several reasons:

- to focus discussions of value (economic and otherwise) on specific circumstances that are relevant to decision makers
- to allow for a rigorous and systematic assessment of interactions between different ecosystem services under different land-use assumptions
- to use as an input to prioritising and valuing ecosystem services within a specific context
- through the use of an 'impact matrix', provide a useful and transparent aid in the decision-making process for any future land-use change.

From the inventory development process described above we were able to develop a set of key issues of concern facing the people of the Goulburn Broken Catchment. From these key issues we were able, with the input of stakeholders, to develop a set of scenarios for future land use in the Catchment. In 2001, we convened the first of a series of workshops of stakeholders with the purpose of the meeting being to develop the scenarios. The stakeholder group was selected in close consultation with the Goulburn Broken Catchment Management Authority. A broad cross-section of representatives covering a wide range of occupations and interests was chosen informally. The representatives had, in most cases, a strong association with the management of the catchment and were also chosen with the purpose of bringing knowledge, experience and skills to the project's development. A more formal or structured process of selecting members from a sample of the population of the catchment was not undertaken because of the technical nature of the work and the short time frame available for familiarising members with the complex biophysical and other analyses.

As a result of the concerns of the stakeholders, land use change was acknowledged as an overriding scenario. Land use change can be identified as the catchment wide scenario and can be used to guide the development of more focused issues/scenarios associated with dairying (at the enterprise scale) and floodplains, vegetation, culture and tourism (at the sub-catchment scale, Figure 6).

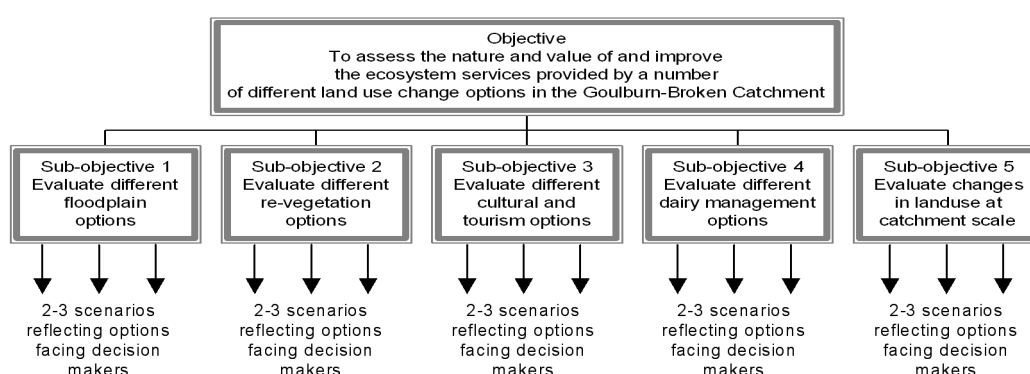


Figure 6. Relationships among objectives, sub-objectives and scenarios for the Goulburn Broken Catchment

Ecological modeling

Within the five future options, key questions for biophysical science were identified and were addressed largely through modelling (Abel et al. 2003). These analyses involved researchers from CSIRO, universities, consultants, and the Victorian state land management agencies as well as technical experts from the Goulburn Broken Catchment Management Authority. We will not present detailed results here, although comments will be made later about the implications of these analyses.

Economic and social assessments

The socio-economic analyses largely utilised the results and data from existing studies done in the catchment. At the catchment wide scale an input-output analysis was undertaken to assess the connections between economic, social and biophysical inputs and production outcomes coming from the region.

Integrating across analyses and people: Deliberative Multi-criteria Evaluation

In the Ecosystem Services Project, a trial of a new integration tool, Deliberative Multi-criteria Evaluation was conducted. This trial involved the combination of two widely used decision aiding techniques—Multi-criteria Evaluation and the Citizens' Jury.

Multi-criteria Evaluation is a means of simplifying complex decision-making tasks which may involve many stakeholders, a diversity of possible outcomes and many and sometimes intangible criteria by which to assess the outcomes. MCE is an effective technique in which to identify trade-offs in the decision-making process with the ultimate goal of achieving compromise. It is also an important means by which structure and transparency can be imposed upon the decision-making process. A Multi-criteria Evaluation seeks to identify the alternatives or options that are to be investigated in coming to a decision, a set of criteria by which to rank these alternatives, the preferences or weights the stakeholders assign to the various criteria and an aggregation procedure to combine the above data and produce an optimal outcome. In this way, it provided a suitable approach to integrating outputs from different disciplinary analyses as well as values and preference from different people.

Multi-criteria Evaluation has the advantage of being able to provide a framework for complex decision-making problems that allows the problem to be broken down into workable units and to be structured in such a way that enables the complexities of the problem to be unravelled. This is done essentially through the process of identifying options, criteria and preferences.

A Citizens' Jury resembles the procedure of a normal criminal jury where a group of citizens are asked to deliberate over a given charge with the ultimate aim of coming to a consensus decision on the charge. Expert witnesses are asked to provide information where the jury requires it and the process is facilitated by a 'judge'. The jury is given time to discuss and deliberate over the decision.

With multiple decision-makers, MCE does not provide clear guidelines on how to analyse or aggregate multiple weights. Citizens' Juries, on the other hand, do allow for an effective approach of interaction between multiple decision-makers and for conducting an iterative process chiefly through the deliberative aspects of the jury approach. In effect, the Citizens' Jury approach aggregates multiple preference weights through deliberation to achieve consensus. In general however, Citizens' Juries have not addressed the problem of structuring the decision-making task. A logical progression to overcome the problems and to enhance the advantages of both methods is to combine the two approaches as Deliberative Multi-criteria Evaluation (DMCE).

Steps in the DMCE

1. Choose the jury: the jurors can be selected based on a demographic overview of the population that will be affected by the decision. The choice of jurors can be made using a random sample or a stratified random sample of this relevant population. In our study, the jurors were natural resource managers—the decision-makers in charge of strategies for recreation and tourism in the region.
2. Choose the options and the objectives: the jury should choose the objectives and options, input from other sources, such as expert advice, can occur.
3. Select the criteria: the jury should be given the task of selecting the criteria which are designed to compare and assess each of the options and therefore must relate to the overall objective of the decision-making task. Decisions concerning the environment and natural resource management can often be broken down into the broad criteria groupings of 'ecological', 'economic' and 'social and cultural', with sub-criteria defined under these categories.
4. Weight the criteria: the preferences of the decision-maker are accounted for by the weighting placed on each of the criteria and sub-criteria and may be qualitatively expressed, quantitatively expressed or a mixture of both. In analyses which involve many different decision-makers, this can be the most important and informative part of conducting the whole process. It allows stakeholders to express differing views explicitly and it helps identify those areas which are of most importance to them and which warrant careful investigation. The weightings make explicit those areas which may ultimately require possible trade-off solutions and thus they provide a greater focus for a complex decision problem. The jury process can be used to great advantage in determining the weights of the criteria. The jurors discuss the relative merits of each of the criteria and call expert witnesses if necessary to help them reach a consensus on the weights. If consensus is not reached initially, then those criteria of greatest contention in priorities would be the subject of greater scrutiny in the process.
5. Assess the options: the assessment of the n options with respect to each individual j criteria or sub-criteria is done via the production of an Impact Matrix; an n by j table where each element represent the evaluation or impact of an option according to a particular criterion. In this study, ecosystem services were considered important criteria and contributed to a large proportion of the total number of decision criteria. The matrix represents a powerful tool for organising complex information, aiding the decision-making process and defining the scope of the overall decision problem.
6. Aggregate the criteria: the aggregation procedure used in the DMCE was based on the PROMETHEE (Preference Ranking Organisation Method for Enrichment

Evaluations) multi-criteria decision aid which uses an outranking procedure as the basis of its evaluation (Brans and Mareschal 1990).

7. Conduct sensitivity analysis and deliberation: sensitivity analysis is a well-known and widely used tool for the investigation of the impact of uncertainty and variability on the outcome of a particular analysis. Knowledge of these sensitivities allows us to assess- how critical a consensus on the criteria weights is; in which criteria is a dissent on the weights most responsible for the variability in the rank order, pointing to those criteria where deliberation and the effort of finding consensus should be targeted; and at which point in the decision process sufficient consensus on the criteria weights has been reached in order to come to a fairly unique rank order of options.
8. Allow for interaction between jurors and analysts and conduct several iterations: the use of sensitivity analysis in the way described allows for continuous iterations and interactions between the analyst and the decision makers to solve the decision problem. This includes the continuous update of the decisive parameters (particularly, the criteria weights) and iterated analyses as the deliberation goes on.

Communication

Due to the high priority of communication in this project, we developed a communication strategy in partnership with a professional communications company, Cox Inall Communications. It had the following components:

- encouraging two-way communication on ecosystem services between the research team and stakeholders through a variety of vehicles, including internet, email networks, newsletters, workshops, public forums and media interviews and features;
- ensuring ecosystem services become central to national policy debates on natural resource management through developing networks with policy makers;
- creating understanding amongst landholders of the importance of ecosystem services — through regional communications plans and extension staff;
- progressing the creation of markets for critical ecosystem services, through developing networks with the investment community;
- creating national awareness of the ecosystem services project, through the media, partner networks and an education strategy.

We identified our key stakeholders as regional policy makers and influencers (including local government, State and Commonwealth policy and research agencies, industry and other community leaders and representatives of land management non- government organisations like Landcare and conservation groups).

We wanted to avoid doing the research first and then looking for an application. Instead, we wanted to take our ideas to stakeholders at the beginning and learn with them how to modify the approach to best meet their needs. To do this, we had to create a community of stakeholders and researchers who understood one another, were aware of the issues and could engage in dialogue. Therefore, we embarked on a program of not only awareness raising but also engagement with stakeholders to increase mutual understanding of the issues and possible solutions.

Key stakeholders were not only engaged in regular workshops and focus groups, but many were also engaged in steering and management committees. In this way, key stakeholders became partners with a strong influence on how the project was done. This provided us with opportunities for enriching our research, as well as challenging us to integrate our scientific culture with other cultures.

APPLICATION AND IMPLICATIONS

What's in a name? Integrating across society

The concept of ecosystem services was a useful integration tool in that it helped us bring together information and people with very different backgrounds in ways that addressed many of the needs of policy-developers, land managers and other decision-makers. It provided a way of thinking about the benefits of different options in a way that had meaning for a range of different people.

The use of the words “ecosystem services” in policies and background papers (e.g. the National Action Plan <http://www.napswq.gov.au/>, the Wentworth Group's report *Blueprint for a Living Continent* <http://www.clw.csiro.au/new/WWF0703-02%20A4%20Horiz.pdf>) has increased dramatically since 1999, both in Australia and internationally. Feedback from policy developers in Commonwealth and State agencies suggests that the term helps them express sustainability more clearly and to a broad audience. “Ecosystem services” implies balancing of environmental and social values. It sits comfortably within economic rationalist frameworks but also challenges those frameworks to account for ecosystem values better. It is a lot simpler to understand and conveys a more positive message than previously used economic jargon, although that jargon contained subtleties of meaning that are not conveyed by most people using ecosystem services language.

Our experience with over 40 community members in the Goulburn Broken Catchment revealed the power and importance of the words being used. There was overwhelming comfort with the concept from the first workshop. Many farmers understood immediately that their business is managing ecosystem services on behalf of society, and that these new buzz words potentially gave greater recognition to the role of land managers in society.

We explored alternative words. “Environmental services” is used almost as frequently around the world, but many of our partners preferred “ecosystem” because it brought a stronger focus on living systems. Some of our partners preferred “nature's benefits”, although they agreed that “benefits” has subtle but important differences in meaning from “services”. While some reacted negatively to “services”, because to them it has connotations of subservience, others felt it underlines the importance of the relationship between humans and nature. We found the word “nature” to be problematic as we frequently encountered people who wanted to debate what is “natural”.

Potentially, the concept of ecosystem services can engage a broad spectrum of society in dialogue about why society should consider the environment and how the costs and benefits might be most equitably shared. We certainly found that we were able to generate debate about these issues using the concept. The dialogue inevitably leads to the recognition that institutions need to change, including not only formal legal and regulatory institutions but informal institutions like societal attitudes and behaviours. In this way, people with little formal training in economics, social science or ecology were brought to a point where they could understand and integrate a lot of the key messages from these disciplines.

The most tangible evidence of the use of the concept of ecosystem services was its incorporation as a framework in the recently revised Goulburn Broken Catchment Management Plan.

Integration across scientific disciplines

The concept of ecosystem services was in some ways useful and in other ways problematic when integrating across scientific disciplines.

It was clear from early in the project that perceptions of ecosystem services differ between scientific disciplines and between scientists and non-scientists. For example, most non-scientists see the provision of clean water as a service from ecosystems. But biophysical scientists identify and specialise in an array of processes that contribute to the production of clean water, including: filtration of sediment, above and below ground water flows, breakdown of toxins, interactions among species and ecological communities that regulate potential pathogens, and the roles of plants, fungi, and a range of animals in maintaining soil structure and function.

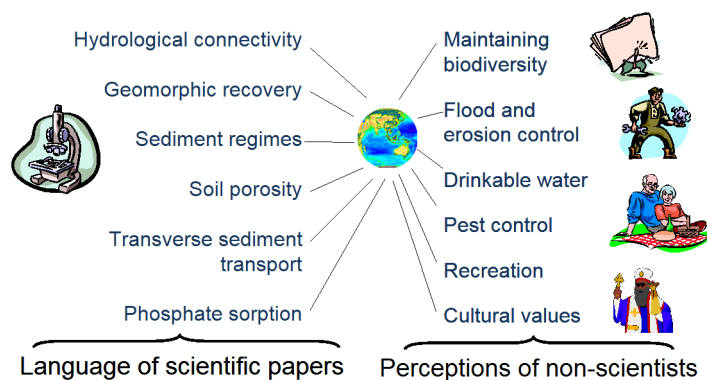


Figure 7. Examples of differences in language used by scientists and non-scientists in different sessions at a conference on river management (S. Cork, personal observation)

Similarly, economists like to think in terms of production functions—the relationship between a set of inputs and a set of outputs. Estimating the marginal value of an output requires thinking about how the production of that output might change if a set of inputs changed marginally and all other parts of the system stayed constant. In ecosystems, any

set of inputs is likely to affect several ecosystem services simultaneously and possibly in different directions, making marginal valuation of individual services almost impossible.

On the other hand, being forced to think about ecosystem services encouraged scientists to think about how their analytical frameworks could be made compatible with the thinking of non-scientists. Educational psychologists alerted us to concepts like the “zone of proximal development” or “scaffolding” (Newman, Griffin, & Cole, 1989), which postulates that people are only able to accept concepts and information that fall within or close to their current understanding of the world. Communicating new concepts requires building links from their current worldview in much the same way as scaffolds are used to support workers while they construct buildings where none stood before. We suggest that scientists often fail to recognise that their concepts are foreign to scientists or non-scientists with different backgrounds. Similar ideas are now taught in centres for science communication (e.g. <http://info.anu.edu.au/CPAS/index.asp>).

The dialogue created around ecosystem services helped achieve better understanding between ecologists and economists in the course of the project. In many studies involving ecologists and economists working together, there has been a tendency to allow the economists to deal with the valuation side and the ecologists with the ecology. Because we struggled so much with defining what “service” or “value”, and because we had many long discussions about how ecosystem processes should be mapped to ecosystem services, the ecologists learned a lot more about the underpinning assumptions of economics than they would normally have done and the economists understood the constraints of ecological analyses.

As a result of this dialogue, we realised that our original objective of measuring the economic value of ecosystem services was naïve for several reasons. “Value” has a specific meaning in economics, relating to the difference between what people have to pay for something versus what they are prepared to pay. What people are *willing* to pay for ecosystem services depends on their understanding of those services. What they *have* to pay depends on how well ecosystem services are recognised in institutional arrangements. Our focus therefore changed to improving the understanding of decision makers about benefits from ecosystem services, understanding the financial implications of alternative land management policies, and investigating different institutional arrangements that could lead to greater recognition of ecosystem services and greater human welfare outcomes.

We also realised that the types of biophysical information required to estimate marginal changes in ecosystem services was generally not available. This caused us to incorporate expert judgement in our modelling where quantitative information was not available and to present the information in ways that allowed marginal changes to be explored visually by decision makers (Abel et al. 2003).

Deliberative Multi-Criteria Evaluation

The above issues of how to integrate across different people’s values as well as across scientific disciplines led to the development and application of Deliberative Multi-Criteria Evaluation. The Deliberative Multi-Criteria Evaluation tool was trialed on one

of the five major scenarios for the future of the catchment: future recreation and tourism strategies in the upper catchment. As a result of workshops with stakeholders, five options were considered within this scenario, including a business as usual option, a maximise environmental concerns options, a maximise social/employment concerns option, a maximise economic concerns options and a sustainable mix strategy developed by a team of natural resource managers in the Catchment. The outcomes of the Deliberative Multi-Criteria Evaluation on the recreation and tourism case scenario are now provided.

The Deliberative Multi-Criteria Evaluation highlighted the fact that carrying on with the current regime of recreation and tourism strategies (the business as usual strategy) was not an appropriate option. The process did support a change to the Mix strategy but emphasised the need for greater research on public access issues, the effects of education on tourists and environmental damage, methods for the recovery of management costs and the role of market and other incentives in limiting environmental damage of recreation and tourism activities. The Mix option is to be implemented and no doubt would have been anyway regardless of the outcome of the DMCE, but the process pointed out some issues that need greater investigation in order for this option to reach its objectives.

The process identified to the decision-makers the importance of breaking down the decision problem and consequently being able to investigate the correct information to try and solve the problem. This involves asking the right questions at the start of the process and for researchers to know the priorities of the decision-making criteria and which of those criteria are important to measure.

The process also allowed for an effective and structured means by which to integrate many different outcomes from the different scientific analyses and models that were conducted as well as integration of different values or priorities of the various jurors.

It also served as a learning process for both decision-makers and analysts by highlighting the impacts of various scientific indicators under different management options as well as the trade-offs required due to different decision-makers priorities. (More information on this case study can be found in Proctor and Drechsler, in press)

CONCLUSIONS AND FUTURE DIRECTIONS

The concept of ecosystem services was found useful as a way to bring a range of people from different backgrounds together to discuss issues of broad public importance. Most stakeholders involved in these discussions said that they gained a clearer understanding of the issues. The concept was a communication device that addressed issues previously addressed within the discipline of economics. Some economists argue that these issues still are more rigorously addressed within economics and they question some of the vaguaries of ecosystem services, including the sometimes inconsistent definitions and uses of terminology.

It is important to realise that an ecosystem services framework is not intended to replace economics or ecology as disciplines. Indeed, this is a major challenge for any integrative framework if it provokes negative reactions from established disciplines. In our view, one of the values of applying the ecosystem services framework was that it exposed some of the differences in thinking and approach not just between ecologists and economists but also between these sciences and thinking outside science. We suggest that addressing these differences remains a major challenge for science, especially at a time when the role of science in society's decision making is increasingly under question.

We encountered similar frictions with the deliberative multi-criteria evaluation approach. Some economists question the assumptions of this approach, again illustrating that integrative approaches often provoke negative reactions from the disciplines they seek to bring together. We acknowledge the importance of these debates, which help to encourage development of the theoretical bases for new approaches but stress that the achievements of a truly integrative process across disciplines and people requires us to think beyond our own disciplinary teachings and interests in order to obtain more holistic and acceptable solutions.

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