


# Beyond threat- and asset-based approaches to natural resource management in Australia

A.L. Curtis and E.C. Lefroy\*

Natural resource management (NRM) in Australia began as a series of campaigns against specific threats to agricultural and pastoral production, with war progressively declared on soil erosion, introduced pests and dryland salinity. Critiques of NRM programs in the 1990s coincided with a shift towards an asset-based approach. This approach emphasises the need for public investment to be focused on those parts of the landscape of high value, rather than defending large areas against broad-scale threats. The asset-based approach is more strategic, but runs the risk of sacrificing effectiveness for efficiency by overlooking the large-scale biophysical and social processes that underpin the viability of discrete assets. Further, the asset-based approach fails to sufficiently acknowledge the importance of engaging and building the human, social and cultural capital required to underpin long-term environmental management. A condition-based approach to NRM is proposed that builds on the best of the threat-based and asset-based approaches by setting targets based on environmental processes rather than perceptions of ideal states; borrowing systematic approaches to assessing value and condition from conservation planning; and investing in the social, economic, human and cultural capital required to support lasting change.

**Keywords:** natural resource management, Australia, asset-based approach

---



Publicly-funded natural resource management (NRM) programs in Australia have gone through two major phases over the last century. The first phase focused on threats to the productive capacity of agriculture and the strategies to manage those threats, with an initial emphasis on pest plants and animals, and soil erosion. Criticism of the ineffectiveness and inefficiency of NRM programs in the late 20th century saw a shift to more targeted management of discrete environmental assets, prioritised on the basis of their perceived value.

---

\* Allan Curtis is with the Institute for Land, Water and Society, Charles Sturt University, PO Box 789, Albury NSW 2640. Ted Lefroy is with the Centre for Environment, University of Tasmania, Private Bag 55, Hobart Tasmania 7001. Email: acurtis@csu.edu.au.

This article examines the origins, strengths and weaknesses of these threat-based and asset-based approaches. A third approach is then proposed that combines the best of both by focusing on the maintenance and measurement of environmental condition at the most appropriate scales from local to national. It is suggested that such a hybrid 'condition-based' approach would involve:

1. setting realistic and achievable resource condition targets by acknowledging current and potential resource use patterns as well as reference historic states
2. assessing environmental value and condition in a representative and comprehensive manner
3. using an adaptive learning framework to accommodate the uncertainty and complexity inevitable in landscape management
4. including the following factors when prioritising investment of public funds:
  - i. the relative value of environmental assets
  - ii. their vulnerability to threats
  - iii. the technical feasibility and adoptability of intervention
  - iv. the social, economic, human and cultural capital available and needed to support improved management
  - v. the ratio of public to private good per unit cost
5. a division of labour between national and state governments, regional organisations and community groups that supports local action and management; regionally appropriate targets and strategies; and national coordination of monitoring and data integration to produce State of the Environment reporting capable of assessing the effectiveness of interventions.

We acknowledge that more thinking will be needed to refine these ideas into an effective framework. Our intention is to begin that discourse.

## Threat-based approach to NRM

The first formal response to natural resource management by Australian governments was the formation of state-based soil conservation organisations. In 1936, the states

were requested by the Commonwealth Government to 'form soil conservation committees to promote and coordinate efforts to combat this wastage of soil resources' (ABS 1963, p. 1003). This request was a response to soil erosion in the early 1930s and mirrored the establishment of the Soil Conservation Service in the USA in 1933 following the dust bowl years in the Midwestern states. The New South Wales Soil Conservation Service was the first to form with the introduction of the *Soil Conservation Act 1938*, while the *Victorian Soil Conservation Act 1940* authorised establishment of the Soil Conservation Board in that state. Their focus was management of the highly visible threats to agricultural and pastoral production after a period of rural expansion, good seasons and high stocking rates in the late 19th and early 20th centuries, followed by drought (Stafford Smith et al. 2007).

Ratcliffe (1947) encapsulated two of the early threats to agriculture and pastoralism in his account of a Commonwealth Government commission to report on the causes and remedies of erosion in the pastoral areas of South Australia and pest damage to crops in Queensland. His report led to the establishment of CSIRO's Wildlife Survey Branch, which subsequently became the Division of Wildlife and Ecology, and later Sustainable Ecosystems. In 1964, Ratcliffe was instrumental in the formation of the Australian Conservation Foundation (ACF 2009).

In 1946, the Australian Agricultural Council recommended the formation of the Commonwealth Standing Committee on Soil Conservation, consisting of heads of each state soil conservation organisation plus representatives from the Commonwealth Departments of Primary Industry and Interior and the CSIRO (ABS 1963). However, it was 40 years until the formation of the National Soil Conservation Program (1983-1992). The merger of that program with the Federal Water Resources Assistance program (1978-1992) became the original portfolio of The Land and Water Resources Research and Development Corporation (later Land and Water Australia, 1990-2009) when the Rural Research and Development Corporations were established under the federal *Primary Industries and Energy Research and Development Act 1989*.

National-scale initiatives that followed those first two included the National Landcare Program (1992-2008), the National Dryland Salinity Program (NDSP) (1993-2005), the Natural Heritage Trust (1996-2008), the National Action Plan for Salinity and Water Quality (NAP) (1999-2008) and Caring for Our Country (2008-).

The NDSP and NAP represented the peak of the threat-based approach in Australia. Both were large-budget NRM programs focused on specific threats or problems. The first generation of regional-scale NRM plans, developed first in Victoria in the 1990s, were also threat- or problem-focused (Park & Alexander 2005).

At the same time, a consensus was emerging amongst governments, farmer groups and conservation leaders about the need to develop the knowledge and skills within rural communities to support adoption of conservation practices and their maintenance for the long term (Campbell 1994; Cary & Webb 2000). The National Landcare Program, established in 1989, was an example of commitment to engage and build the human and social capital necessary to underpin long-term improvement in the condition of natural resources (Curtis & De Lacy 1995). The subsequent formation of 56 NRM regional bodies across the country was partly a response to the success of the Landcare movement with 2500 groups across the country looking for support and guidance to deliver public benefits on private property (Curtis & Lockwood 2000). The regional model was intended to improve the efficiency of engagement between these local groups and governments at all levels, to strengthen cooperation between the Australian and state governments (Crowley 2001), and to provide an ecologically sound, bioregional context for devolved decision-making.

It can be argued that the threat-based approach was ecologically sound in that it conformed to the pressure-state-response concept that emerged in Europe in the 1980s (Woodhead et al. 2002), and focused on questions of scale and effectiveness. However the large scale and extensive nature of Australian primary industries has meant that the approach has very rarely been applied at appropriate scales (Hajkovicz 2009). In the case of water quality, in particular, the small scale of intervention and lack of appropriate monitoring has meant that there are very few well-documented cases of successful intervention. Two of these provide an interesting contrast to the community-based approach typical of Landcare and Integrated Catchment Management as they both involved one owner, major land-use change over more than half the catchment, and rehabilitation primarily funded by the state (Bari & Schofield 1992; Van Dijk et al. 2007).

Limited understanding of ecological processes, plus the challenges of governance faced by small local groups and new regional organisations operating within a federal framework (Stratford et al. 2007), commonly resulted in

untargeted investment, poor accountability and a focus on symptoms rather than cause. The expectation that learning and action at a local scale would eventually lead to landscape-scale change has not been realised. Four national audits of NRM programs concluded that there had been focus on outputs rather than environmental outcomes, which were often poorly specified, based on untested assumptions, and either not measured or unmeasurable (ANAO 1997, 1998, 2001, 2008).

Underlying this ineffectiveness has been a limited understanding of the fundamental causes of degradation and a lack of evidence to support interventions. For example, the National Land and Water Resources Audit predictions of the extent of land under threat from salinisation turned out to be exaggerated, being based on flawed modelling that drew on very limited bore data and assumed that ground-water flows were similar across large catchment areas (NLWRA 2001). However, as improved understanding emerged through the 1990s, the concept of integrated catchment management became more widely adopted, intervention and research were carried out at larger scales in focus catchments (Robins 2004), and by the end of the 1990s, approaches were emerging to critically assess technical feasibility, cost effectiveness, and public versus private benefit (Pannell 2001; Ridley & Pannell 2005).

### **Asset-based approach to NRM**

Despite the successes of Landcare and regional NRM in raising awareness, developing networks and building capacity for change (Paton et al. 2004; Curtis 2007), Phillips and Lowe (2005) argued that the threat-based approach was a missed opportunity for integration and action on a landscape scale. Accusations of poor accountability of public funds expended on NRM, and recommendations that programs adopt more strategic approaches (ANAO 1997, 1998, 2001, 2008), led to more centralised priority setting with a focus on specific high-value environmental assets (Commonwealth of Australia 2008).

The asset-based approach is characterised by the application of terms and concepts to the natural environment adopted from the private sector, such as asset, investment, services and market-based instruments. Their use by governments across the OECD during the 1980s and 1990s reflected an attempt to achieve greater effectiveness and efficiency in the use of public funds, referred to by Kearney and Hays (1998) as New Public Management.

As Park and Alexander (2005, p. 49) explained, ‘...the asset-based framework, as required for state and Commonwealth accreditation, has imposed a new discipline on the regions’. The focus became to enhance the value of discrete environmental assets through the efficient allocation of public funds to purchase specified environmental outcomes, often through market-based instruments (MBIs), a recent addition to the NRM toolkit. The asset-based approach has notable strengths, including the common-sense aim of making strategic investments with scarce public resources; focusing on those parts of the environment in better condition than the most degraded; and engaging landholders through the aim of enhancing environmental assets rather than addressing problems.

At the catchment scale, the asset-based approach is increasingly associated with INFFER (Investment Framework for Environmental Resources) (Pannell et al. 2009). INFFER was developed to assist regional NRM bodies improve the quality of their investment decisions within the asset-based approach. INFFER requires regional decision-makers to be explicit about the outcomes they seek to achieve and to assess the potential contributions of alternative delivery mechanisms. INFFER therefore represents an important attempt to institutionalise sound investment decision-making processes in regional NRM. Our critique is of the asset-based approach, rather than of INFFER, which is equally applicable to the condition-based approach suggested here.

The asset-based approach appeals to governments as it implies that we can manage the environment by focusing on small areas while ignoring the rest. However, governments have been misled if they believe that it is technically or socially possible to protect assets – such as the icon sites in the Living Murray program (e.g. MDBC 2006) – in isolation of their social and biophysical context. Economic efficiency and accountability are now firmly on the agenda for good reason, but at the risk of ecological effectiveness.

The fundamental weaknesses of the asset-based approach are rigidity of scale and relativity of value. In most applications, the asset-based approach ignores the principle that the boundaries of consideration must be isomorphic with the boundaries of causation (Jackson 2002). In other words, when deciding to intervene in the interests of a particular asset or location, assessment must be carried out at the scales relevant to the processes on which it depends and by which it is threatened. Reliance on the relative value of natural assets has meant that the

process has been strongly influenced by specialists, whose knowledge of and interests in species and communities is frequently taken as the basis of value. As a result, compositional and structural aspects of biodiversity (i.e. what's there and how it's arranged, *sensu* Noss 1990) tend to take precedence over functional aspects (i.e. what it does) because they are easier to define. Furthermore, the rarity and representativeness of 'connoisseur' species and communities (Pannell 2003) has tended to dominate questions of ecological value while the functional role has been commodified into ecosystem services (Daily 1997).

The asset-based approach has increasingly involved the direct purchase of environmental outcomes from landholders or the direct investment by NRM agencies in on-ground work on private land. These strategies are seen as more efficient and more effective than the often untargeted investments in human and social capital that were the principal strategies of most NRM programs in the threat-based era. It should be possible to 'mix-and-match' from a range of policy instruments but the language and application of the asset-based approach suggests that this is not happening. In mid-2009, the longest-running of the national NRM programs, the National Landcare Program, ceased, bringing to an end a national network of Landcare facilitators. This was despite evidence that expenditure on human and social capital can raise landholders' awareness; improve their knowledge and management skills; is strongly correlated with implementation of improved management practices; and that voluntary approaches can deliver landscape-scale change where they operate as partnerships with government and non-government organisations (Cullen et al. 2003; Curtis 2007; Curtis et al. 2008a). Given the predicted rate of rural property turnover and the arrival of a new cohort of land managers who are not farmers by occupation (Barr 2009; Mendham & Curtis 2010), plus the challenges of climate change including changing fire regimes, there is little basis to assertions that we have 'done Landcare and it's time to move on'.

One of the more important manifestations of the asset-based approach has been the increasing use of market-based instruments (MBIs) to purchase environmental services from landholders. The typical approach is for a state agency or regional body to identify an asset class, and conduct an auction where landholders are invited to submit a bid for relevant funding and to indicate in their response their plans and expected payments. Proposals are assessed on the basis of the benefits that they are likely to achieve, and program funds are allocated to landholders on the basis of which bids achieve the best

outcomes per dollar requested. Proponents assume that MBIs will achieve more efficient environmental outcomes than approaches that engage or build human and social capital (Eigenraam et al. 2005; Whitten et al. 2007). There are several MBIs currently used to enhance the management of native vegetation on private land to achieve biodiversity outcomes, such as Land Management Tenders in New South Wales; BushTender and its successor EcoTender in Victoria; and the Vegetation Incentive Program in Queensland (Cutbush 2006).

The claimed success of these pilot MBI projects has led to calls by their proponents that MBIs should become the predominant instruments for delivering NRM outcomes. As Morrison et al. (2008) explained, it is therefore timely to critically examine the claims made by these proponents.

In the first instance, we know that investing in human and social capital contributes to active, ongoing management by landholders; we don't have that evidence for MBIs. The focus on individual property owners and of competition between landholders for funding is also likely to undermine efforts to integrate the actions of individual property owners that are needed to achieve catchment-wide or landscape-scale responses (Campbell 1994). In turn, a key benefit of platforms such as Landcare is that they provide a space where landholders can learn and develop more sustainable practices for their local conditions. State agency staff cannot simply mandate 'best-practices' that will work for many assets as part of a MBI.

Assertions about the greater cost-effectiveness of MBIs have not been substantiated by independent evaluations. In a typical fixed-grant scheme administered by a Landcare group, there is time and opportunity for participants to learn about their environmental asset and how it should be managed. If landholders are to develop an informed bid for a MBI, they need to have acquired that knowledge and skill before they submit their bid. Invariably, this will require a huge up-front investment in engaging landholders if the MBI is to succeed. Otherwise, it is likely that landholders with insufficient knowledge will either not participate or will underestimate the real costs of the services that they are providing, with subsequent disappointment, loss of commitment to ongoing management, and reduced benefit.

Given these issues, it is not surprising that MBIs tend to 'cherry-pick' the more informed landholders, including those who have been involved in Landcare. Again, the

proponents need to demonstrate that there is a pool of willing participants beyond those who are attracted to pilot MBI projects.

A final critique of MBIs is that we simply do not have functioning markets for environmental services in that there is typically only one purchaser: the government. Our view is that MBIs may prove to be a useful addition to the NRM toolkit, but should not be seen as a replacement for approaches that invest in engaging or building human and social capital.

## The 'capitals' and NRM

The 'capitals' concept is a framework (Black & Hughes 2001; ABS 2002) that can be used to understand the complex web of factors that affect landholder capacity to implement practices expected to lead to improved environmental management (Webb & Curtis 2002; Pannell et al. 2006). Webb and Curtis (2002) suggested that, 'the concept of capital recognises that there is a stock of resources ... that can be used to achieve some endpoint (improved NRM)', and that NRM capacity is the product of human, social, human-created and natural capital. As these authors explained, economic resources and physical infrastructure are types of human-created capital. The skills, abilities and wellbeing of the population form our human capital (Castle 2002), while social capital refers to the social relations, networks, trust and norms that arise between people when they interact and which can then lead to further benefits (Sobels et al. 2001). Natural capital refers to the non-human parts of the world upon which human existence depends.

Social researchers working in NRM often focus on exploring the assumed relationships between investments that engage or build human and social capital and landholder-practice change. In this article, we use the terms 'engage' and 'build' advisedly. It is our view that researchers, and to a lesser extent NRM practitioners, often underestimate the existing capacity of landholders.

## Towards a condition-based approach

Incorporating the best of both threat-based and asset-based approaches would require broad-scale condition assessment and targeted investment. This would mean developing diagnostic techniques to assess the condition of environmental processes that support and threaten particular assets. It would also mean setting realistic environmental states or end points that recognise landscapes as human constructs, and therefore acknowledge the limited relevance of historical or pristine states as the basis for targets in production

landscapes. It would also involve acknowledgment of the importance of engaging existing – and building new – human, social and cultural capital to bring about and maintain lasting improvement in environmental condition.

The elements of a condition-based approach might therefore be as follows:

1. *Recognising condition as a social construct.* In human-occupied landscapes, desirable and achievable environmental condition or end points are social constructs. They are likely to vary from the pristine state for many, if not most, environmental indicators and may have crossed thresholds which would be difficult, expensive or impossible to reverse. The concept of multiple stable states is useful here to illustrate the type of state in which a particular landscape, catchment or sub-catchment resides and the state or states within which it can be maintained. Science alone cannot define these questions of value, but is invaluable in helping to determine what states are possible and achievable.

2. *Assessing environmental condition in a representative and comprehensive manner that incorporates major landforms, processes and resource use patterns.* NRM stands to learn from the CAR (comprehensive, adequate and representative) principles applied to the selection of nature conservation reserves (ANZECC & MCFFA 1997). In the case of NRM, diagnostic techniques are required that can simultaneously assess areas of high natural value and the condition of their supporting and threatening processes. There is potential to learn a great deal from the rapid assessment techniques developed within conservation science over the last 20 years (e.g. Margules & Pressey 2000).

3. *Using adaptive learning as an organising principle to acknowledge the uncertainty and complexity inevitable in landscape management.* The principle of adaptive management has been frequently invoked but rarely employed in NRM (Allan & Curtis 2005). In most cases, it is misinterpreted to mean investment as an unplanned experiment. However, adaptive management differs from trial and error. It requires clearly stated hypotheses, a conceptual or actual model of how the system functions, adequate design, and carefully collected data to enable attribution of cause and effect. The non-linear interdependencies across multiple scales, and the unknown thresholds of system change typical of NRM, lead to an inevitable level of irreducible uncertainty (Walker & Salt 2006). In this complex domain, the idea of management is presumptive. Instead, we are in the business of adaptive learning, characterised by Snowden and Boone's

(2007) sequence of 'probe-sense-respond'; 'probe' meaning intervention; 'sense' meaning collecting data capable of distinguishing between the intervention and other influences; and 'respond' meaning learning from the intervention, and revising conceptual models and hypotheses.

4. *Including consideration of the available social, economic, human and cultural capital required for sustained commitment to improved management when prioritising investment of public funds.* Any lasting improvement in or maintenance of environmental condition in human-occupied (as opposed to pristine) landscapes is a function of the five capitals: social, human, environmental, economic and cultural. It is not possible to simply step in and purchase the desired environmental condition outcomes. This is because landscape-scale action requires the support of land managers and other stakeholders who typically have limited resources and are attempting to address 'wicked problems', where causality is uncertain, there are long lead times between interventions and outcomes, and no one group has the capacity to effect change on their own (Allan et al. 2008).

Where NRM investments are undertaken to engage or build human, social or cultural capital, then assumed outcomes need to be articulated, monitored and evaluated. For example, if improved understanding of processes that lead to nutrient pollution of surface- and ground-water is assumed to be an essential step in landholders implementing appropriate practices, then that objective of improved understanding needs to be included in monitoring and evaluation frameworks at the regional scale. This is in addition to four criteria currently used to prioritise investment in most asset-based assessments, namely the relative value of environmental assets; their vulnerability to threats; the technical feasibility and adoptability of intervention; and the ratio of public and private good per unit cost).

5. *Acknowledging the complementary roles and responsibilities of national, state, regional and local entities.* Recent history has seen local and regional autonomy progressively abandoned in favour of a higher degree of national control and coordination. Rather than operating at these different levels in series, progressively abandoning local and regional levels in the face of criticism of limited effectiveness, there is a strong case to combine their complementary strengths into a truly national NRM framework. The local level is where the human, social and cultural capacity resides that is required to implement change, influence environmental

condition, and is also where the economic and technical feasibility of practice change is best assessed. The regional scale is the most appropriate scale at which to use surrogate measures to map environmental value and condition as a basis for decision-making, to examine the balance of public and private good, and to apply monitoring frameworks capable of detecting change and attributing it to human intervention. The national level is the most appropriate at which to set broad priorities, to coordinate funding and knowledge exchange, and to aggregate regional monitoring to produce State of the Environment reporting as the ultimate measure of effectiveness.

## Conclusions

Environmental management is characterised by large spatial scales, high levels of natural variability, multiple interacting drivers of change, long time-lags between intervention and response, non-linear processes involving undefined thresholds of change, and multiple owners and managers often with competing interests. These features make 'success' a very elusive prospect. Over the short history of Australia's attempt at a national approach to NRM, we have seen a strategic retreat from campaigns against threats to the defence of high-value assets. In the process, the impetus has shifted from high-level national coordination to state-based authorities, then local-level community groups, 'cooperative environmental federalism' focused on bioregions, and most recently a return to top-down national coordination.

An analysis of this short history and the truly formidable challenges of evaluating impact suggests that it is premature to dismiss the contribution of any one level of intervention: national, state, regional or local. Rather, it is suggested that their strengths could be brought together into a framework that is: more realistic, by setting achievable goals and acknowledging our current limited understanding; more systematic, in terms of the use of available information to assess value and condition; and more integrated, to give us the ability to report on the State of the Environment and the critical capitals that underpin efforts to improve environmental condition.

## References

- ABS (Australian Bureau of Statistics) 1963, *Year book Australia*, no. 49, Australian Bureau of Statistics, Canberra.
- ABS (Australian Bureau of Statistics) 2002, *Measures of Australia's progress 2002*, Catalogue no. 1370.0, Australian Bureau of Statistics, Canberra.
- ACF (Australian Conservation Foundation) 2009, *The Australian Conservation Foundation: a remarkable history*,

- ACF, Carlton, Victoria, viewed 9 November 2009, <[http://www.acfonline.org.au/articles/news.asp?news\\_id=335](http://www.acfonline.org.au/articles/news.asp?news_id=335)>.
- Allan, C & Curtis, A 2005, 'Nipped in the bud: why regional-scale adaptive management is not blooming', *Environmental Management*, vol. 36, no. 3, pp. 414-425.
- Allan, C, Curtis, A, Stankey, G & Shindler, B 2008, 'Adaptive management and watersheds: a social science perspective', *Journal of the American Water Resources Association*, vol. 44, no. 1, pp. 166-174.
- ANAO (Australian National Audit Office) 1997, *Commonwealth natural resource management and environment programs*, Audit Report no. 36 1996-97, ANAO, Canberra.
- ANAO (Australian National Audit Office) 1998, *Preliminary inquiries into the National Heritage Trust*, Audit Report no. 42 1997-98, ANAO, Canberra.
- ANAO (Australian National Audit Office) 2001, *Performance information on Commonwealth financial assistance under the National Heritage Trust*, Audit Report no.43 2000-01, ANAO, Canberra.
- ANAO (Australian National Audit Office) 2008, *Regional delivery model for the National Heritage Trust and the National Plan for Salinity and Water Quality*, Audit Report no. 21 2007-08, ANAO, Canberra.
- ANZECC & MCFFA (Australian and New Zealand Environment and Conservation Council & Ministerial Council on Forestry, Fisheries and Aquaculture) 1997, *Nationally agreed criteria for the establishment of a comprehensive, adequate and representative reserve system for forests in Australia*, report by the Joint ANZECC / MCFFA National Forest Policy Statement Implementation Sub-committee, ANZECC, Canberra & MCFFA, Canberra.
- Bari, M & Schofield, N 1992, 'Lowering of a shallow, saline water table by extensive eucalypt reforestation', *Journal of Hydrology*, vol. 133, no. 3-4, pp. 273-291.
- Barr, N 2009, *The house on the hill: the transformation of Australia's farming communities*, Land & Water Australia, Canberra, in association with Halstead Press, Canberra.
- Black, A & Hughes, P 2001, *The identification and analysis of indicators of community strength and outcomes*, Occasional Paper no. 3, Department of Family and Community Services, Canberra, viewed 18 March 2009, <[http://www.facs.gov.au/internet/facsinternet.nsf/vIA/occasional\\_papers/\\$file/No.3.pdf](http://www.facs.gov.au/internet/facsinternet.nsf/vIA/occasional_papers/$file/No.3.pdf)>.
- Campbell, A 1994, *Landcare: communities shaping the land and the future*, Allen & Unwin, Sydney.
- Cary, J & Webb, T 2000, *Community landcare, the national Landcare program, and the Landcare movement: the social dimensions of landcare*, Bureau of Rural Sciences, Canberra.
- Castle, EN 2002, 'Social capital: an interdisciplinary concept', *Rural Sociology*, vol. 67, no. 3, pp. 331-349.
- Commonwealth of Australia 2008, *Caring for our Country business plan 2009-2010*, Department of the Environment, Water, Heritage and the Arts, Canberra & the Department of Agriculture, Fisheries and Forestry, Canberra, viewed 3 November 2009, <<http://www.nrm.gov.au/publications/books/pubs/business-plan.pdf>>.
- Crowley, K 2001, 'Effective environmental federalism? Australia's Natural Heritage Trust', *Journal of Environmental Policy and Planning*, vol. 3, no. 4, pp. 255-272.
- Cullen, P, Williams, J & Curtis, A 2003, *Landcare farming: securing the future for Australian agriculture*, Landcare Australia, Chatswood, NSW.
- Curtis, A 2007, 'Monitoring and evaluation of watershed initiatives: lessons from Landcare in Australia', in J de Graaff, J Cameron, S Sombatpanit, C Pieri & J Woodhill (eds), *Monitoring and evaluation of soil conservation and watershed development projects*, Science Publishers, Enfield, New Hampshire, USA, pp. 377-397.
- Curtis, A & De Lacy, T 1995, 'Evaluating Landcare groups in Australia: how they facilitate partnerships between agencies, community groups, and researchers', *Journal of Soil and Water Conservation*, vol. 50, no. 1, pp. 15-20.
- Curtis, A & Lockwood, M 2000, 'Landcare and catchment management in Australia: lessons for state-sponsored community participation', *Society and Natural Resources*, vol. 13, no. 1, pp. 61-73.
- Curtis, A, Lucas, D, Nurse, M & Skeen, M 2008a, *Achieving NRM outcomes through voluntary action: lessons from Landcare*, Department of Sustainability and Environment, Melbourne.
- Curtis, A, Sample, R & McDonald, S 2008b, *Comparison of River Tender and Landholder Agreement program participants. A report to the North East Catchment Management Authority as the social research component of the 'Designer Carrots' evaluation of River Tender*, Institute for Land, Water and Society, Charles Sturt University, Albury, NSW.
- Cutbush, G 2006, *Incentives for natural and cultural heritage conservation*, paper prepared for the 2006 Australian State of the Environment Committee, Department of the Environment and Heritage, Canberra, viewed 10 December 2009, <<http://www.environment.gov.au/soe/2006/publications/emerging/incentives/index.html>>.
- Daily, GC 1997, *Nature's services: societal dependence on natural ecosystems*, Island Press, Washington DC.
- Eigenraam, M, Beverly, C, Stoneham, G & Todd, J 2005, 'Auctions for environmental outcomes, from desk to field in Victoria, Australia', paper presented to the 80<sup>th</sup> Annual Western Economic Association International Conference, 4-8 July 2005, San Francisco, California, USA, viewed 9 September 2010, <[http://www.land.vic.gov.au/CA256F310024B628/0/1611027A084EF113CA25725200036158/\\$File/WEA+conference+paper.pdf](http://www.land.vic.gov.au/CA256F310024B628/0/1611027A084EF113CA25725200036158/$File/WEA+conference+paper.pdf)>.
- Hajkowicz, S 2009, 'The evolution of Australia's natural resource management programs: towards improved targeting and evaluation of investments', *Land Use Policy*, vol. 26, no. 2, pp. 471-478.
- Jackson, W 2002, 'Poverty and agricultural policies: we ain't winnin' because the old dominant idea has a way of reasserting itself', *Population and Environment*, vol. 24, no. 1, pp. 55-67.
- Kearney, RC & Hays, SW 1998, 'Reinventing government, the new public management and civil service systems in

- international perspective: the danger of throwing the baby out with the bathwater', *Review of Public Personnel Administration*, vol. 18, no. 4, pp. 38–54.
- Margules, CR & Pressey, RL 2000, 'Systematic conservation planning', *Nature*, vol. 405, no. 6783, pp. 243-253.
- MDBC (Murray-Darling Basin Commission) 2006, *The Barmah-Millewa Forest Icon Site Environmental Management Plan 2006–2007*, MDBC, Canberra.
- Mendham, E & Curtis, A 2010, 'Taking over the reins: trends and impacts of changes in rural property ownership', *Society and Natural Resources*, vol. 23, no. 7, pp. 653-668.
- Morrison, M, Durante, J, Greig, J & Ward, J 2008, *Encouraging participation in market based instruments and incentive programs*, final report prepared for Land & Water Australia, Canberra.
- NLWRA (National Land and Water Resources Audit) 2001, *Australian dryland salinity assessment 2000*, NLWRA, Canberra.
- Noss, RF 1990, 'Indicators for monitoring biodiversity: a hierarchical approach', *Conservation Biology*, vol. 4, no. 4, pp. 355-364.
- Pannell, DJ 2001, *Economic tools to tackle dryland salinity in Western Australia*, Economic Research Paper, Department of Treasury and Finance, Perth.
- Pannell, DJ 2003, 'Heathens in the chapel? Application of economics to biodiversity', *Pacific Conservation Biology*, vol. 10, no. 2/3, pp. 88-105.
- Pannell, DJ, Marshall, GR, Barr, N, Curtis, A, Vanclay, F & Wilkinson, R 2006, 'Understanding and promoting adoption of conservation technologies by rural landholders', *Australian Journal of Experimental Agriculture*, vol. 46, no. 11, pp. 1407-1424.
- Pannell, DJ, Roberts, A.M, Park, G, Curatolo, Marsh, S, & Alexander, J 2009 *INFFER: Investment Framework For Environmental Resources*, INFFER Working Paper 0901, University of Western Australia, Perth.
- Park, G & Alexander, J 2005, 'Integrate or perish: lessons in integrated NRM from north central Victoria', *Australasian Journal of Environmental Management*, vol. 12, supplementary issue, pp. 47-56.
- Paton, S, Curtis, A, McDonald, G & Woods, M 2004, 'Regional natural resource management: is it sustainable?', *Australasian Journal of Environmental Management*, vol. 11, no. 4, pp. 259-267.
- Phillips, A & Lowe, KW 2005, 'Prioritising integrated landscape change through Rural Land Stewardship for ecosystem services', *Australasian Journal of Environmental Management*, vol. 12, supplementary issue, pp. 39-46.
- Ratcliffe, F 1947, *Flying fox and drifting sand: the adventures of a biologist in Australia*, Angus and Robertson, Sydney.
- Ridley, A & Pannell, DJ 2005, 'An investment framework for managing dryland salinity in Australia', *Farm Policy Journal*, vol. 2, no. 4, pp. 39-49.
- Robins, L 2004, *Dryland salinity and catchment management: a resource directory and action manual for catchment managers*, National Dryland Salinity Program, Land & Water Australia, Canberra.
- Snowden, DJ & Boone, ME 2007, 'A leader's framework for decision making', *Harvard Business Review*, vol. 85, no. 11, pp. 68-76.
- Sobels, J, Curtis, A & Lockie, S 2001, 'The role of Landcare group networks in rural Australia: exploring the contribution of social capital', *Journal of Rural Studies*, vol. 17, no. 3, pp. 265-276.
- Stafford Smith, DM, McKeon, GM, Watson, IW, Henry, BK, Stone, GS, Hall, WB & Howden, SM 2007, 'Learning from episodes of degradation and recovery in variable Australian rangelands', *Proceedings of the National Academy of Sciences of the United States of America*, vol. 104, no. 52, pp. 20690-20695.
- Stratford, E, Davidson, J, Griffith, R, Lockwood, M & Curtis, A 2007, *Sustainable development and good governance: the 'big ideas' influencing Australian NRM*, Report no. 3, Pathways to good practice in regional NRM governance, University of Tasmania, Hobart.
- Van Dijk, AIJM, Hairsine, PB, Peña Arancibia, J & Dowling, TI 2007, 'Reforestation, water availability and stream salinity: a multi-scale analysis in the Murray-Darling Basin, Australia', *Forest Ecology and Management*, vol. 251, issue 1-2, pp. 94-109.
- Walker, BH & Salt, D 2006, *Resilience thinking: sustaining ecosystems and people in a changing world*, Island Press, Washington DC.
- Webb, TJ & Curtis, A 2002, *Mapping regional capacity*, Bureau of Rural Sciences, Canberra.
- Whitten, SM, Coggan, A, Reeson, A & Gorrard, R 2007, *Putting theory into practice: market failure and market based instruments (MBIs)*, Socio-Economics and the Environment in Discussion CSIRO Working Paper Series 2007-02, CSIRO, Canberra.
- Woodhead, A, Jenkins, A & Packham, R (eds) 2002, *An interdisciplinary dialogue: agricultural production and integrated ecosystem management of soil and water*, Proceedings of OECD Co-operative Research Program Workshop, NSW Agriculture, Ballina, NSW, 12-15 November 2002, available as CD-ROM *Agriculture and ecosystems management: an interdisciplinary dialogue*, Department of Primary Industries, Orange, NSW.