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*Editorial:*

# **Integration Research for Natural Resource Management in Australia: An Introduction to New Challenges for Research Practice**

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## **1. The Research Practice of Integration**

This special issue of the *Journal of Research Practice* focuses on *integration research*, also known as integrated or integrative research. Integration between disciplines and between research and practice is increasingly recognised as essential to tackle complex

problems more effectively. But there is little to guide researchers about how to undertake integration research. This special issue provides a number of case studies of how integration has been approached and exemplifies the challenges facing researchers seeking to embed integration in both existing and new organisations and make it acceptable and respectable. Documenting these developments provides a unique illustration of how integration research is evolving as a type of practice.

The context is natural resource management in Australia. Researchers in this and other areas in the environmental sciences are at the forefront of developing integrative theory and methods, and Australian organisations are recognised leaders in implementing these developments. Other areas, such as public health, security studies, management studies, and studies focusing on geographical regions, such as South-East Asian research, are also building integrative expertise, but they are doing it independently, so that there is little overlap between different initiatives, let alone any coordinated development. Discipline-based researchers are also becoming more and more involved in thinking about how to synthesise their work with that of other disciplines, as well as how to make it more relevant to policy and other areas of application. Our hope is that this group of papers will form the nucleus of a wider discussion about integration research to guide the further development of this new research practice.

## **2. Papers in this Special Issue**

The papers were originally written for a symposium on Integration for Natural Resource Management held in Canberra, Australia in May 2004, but have been updated and revised following both discussion at the symposium and double-blind international peer review. The symposium also included policy and other practice perspectives, most of which are published in a supplementary issue of the *Australasian Journal of Environmental Management* (Bammer, Curtis, Mobbs, Lane, & Dovers, 2005), which is a companion to this special issue. The original symposium papers are available on CD free from <http://www.lwa.gov.au/products.asp> (enter Code: EC040735).

The symposium was hosted by Land & Water Australia, which has the following mission: *To invest in knowledge, partnerships, innovation and adoption to underpin sustainable natural resource management* (<http://www.lwa.gov.au>). There is a growing expectation that Land & Water Australia, as one of 14 rural research and development corporations in

Australia, will fund research that will directly contribute to changed practices for managing land and water resources, which in turn will lead to an improvement in the condition of those resources. Integrative research practice is essential for linking research to policy and management in this domain.

The symposium was designed to bring together representatives from the research, management, and policy communities to share understandings of how to *do* integration, and, at a deeper level, of what integration actually means, and when and why it should be pursued. **Stephen Dovers** highlights these matters in his paper in this special issue (“Clarifying the Imperative of Integration Research for Sustainable Environmental Management”). This review of how integration is approached in natural resource management was originally a background paper for the symposium. Further reflection on these issues during the symposium led to the development of “Guiding Principles for Integration in Natural Resource Management (NRM) as a Contribution to Sustainability” (Bammer & Land & Water Australia Integration Symposium Participants, 2005), which cover: (a) the value of integration, (b) ways of thinking about integration, (c) approaches to integration, (d) realistic expectations of integration, (e) new institutions and networks for enhancing integration, and (f) funding for integration, all in the context of natural resource management.

The symposium was an unprecedented step towards consolidation and communication of approaches to integrated natural resource management. Most of the key papers focusing directly on integration research are included in this special issue. The papers represent a broad range of *research styles*, namely case studies, critical analyses, personal histories, and state-of-knowledge reviews. **Alice Roughley and David Salt** took an oral history approach to provide a retrospective overview of the challenges facing those who were single-handedly charged with integrating the social sciences into five major Australian organisations, which until then had taken a biophysical view of natural resource management (“Introduction of Social Sciences in Australian Natural Resource Management Agencies”). Not only were they expected to represent all of the social sciences, but they were also expected to integrate the different biophysical disciplines. One of those pioneers, **Geoff Syme**, provides a more detailed personal account of how his organisation, CSIRO, which is the largest research agency in Australia, has continued to grapple with the integration imperative (“Integration Initiatives at CSIRO: Reflections of an Insider”). This has involved the development of “flagship” research programs, fostering

integrative “emerging science” areas, building informal teams in response to demand, and incorporating integration into the research management structure.

The next two papers examine how two organisations tackled the challenge of integration as part of their original mandate. **Robert J. Wasson and Stephen Dovers** chart the 30-year history of a pivotal *case* in Australia, the Centre for Resource and Environmental Studies at the Australian National University (“Integrative Research in the University Context: Centre for Resource and Environmental Studies, The Australian National University”). They demonstrate the impossibility of including all necessary relevant disciplines under one roof and the tensions between disciplinary respectability and interdisciplinary relevance. The merits and disadvantages of large centre-wide projects and smaller efforts bringing together sub-groups of staff and students are also canvassed. The next paper (“Strategic Integration: The Practical Politics of Integrated Research in Context”), by **Lorrae van Kerkhoff**, explores a more recent key development: the Australian Cooperative Research Centre Program, which began in 1990. Cooperative Research Centres are natural science and engineering research organisations which bring researchers from different universities, government agencies, and the private sector together with research “users,” such as government, industry and community. They are mandated to be integrative, but given great latitude in how to achieve this. In her critical analysis, van Kerkhoff contrasts the processes used by two Centres and identifies three strategies for connecting research and application: (a) matching research program categories to partners’ implementation program categories, (b) reproducing existing integrative partnership models, and (c) filling gaps in understanding with new technical approaches. Which of these is chosen is, at least in part, influenced by political practicalities, namely the extent of stakeholder decision-making, sources of scientific credibility, and the political risks facing the partners. Van Kerkhoff argues that the “practical politics” of how research is organised offers a new lens for understanding both the practice and theory of integration research.

The two final papers emphasise methodological aspects of integration. **Steven J. Cork and Wendy Proctor** take us back to the work of CSIRO, examining a major project where CSIRO partnered with four other organisations (“Implementing a Process for Integration Research: Ecosystem Services Project, Australia”). This descriptive paper demonstrates how integration was enhanced by the concept of *ecosystem services*, in other words, benefits such as food, purification of air, stabilisation of soils, and spiritual inspiration,

produced by an ecosystem. An important study outcome was the development and testing of a new integrative tool for participative research, which combined deliberative decision making with multi-criteria evaluation. This enables decision-makers to consider the best available information and to balance multiple, sometimes competing, values in a transparent and structured process. Finally **David J. Brunckhorst** makes an argument that a bio-cultural region or landscape is the main arena of human interaction with the environment, as it links multiple spatial and temporal scales of biodiversity with human uses and socio-economic imperatives (“Integration Research for Shaping Sustainable Regional Landscapes”). He highlights the importance and challenges of working at that scale and provides three brief case studies.

While each paper stands on its own, some readers will find a deeper understanding of the context useful; therefore we provide a brief overview of Australian environmental issues, government responses, and the natural resource management *knowledge system*.

### **3. Background on Natural Resource Management in Australia**

#### **3.1. The Australian Environment**

Australia’s unique environment provides singular challenges for the management of its natural resources. A verse from Dorothea Mackellar’s poem “My Country” (1911) epitomises some of the greatest challenges:

I love a sunburnt country,  
A land of sweeping plains,  
Of ragged mountain ranges,  
Of droughts and flooding rains.  
I love her far horizons,  
I love her jewel-sea,  
Her beauty and her terror--  
The wide brown land for me!

Note. Excerpt reprinted from the Dorothea Mackellar Web site <http://www.dorotheamackellar.com.au/> with permission of the Dorothea Mackellar Estate.

Australia is one of the largest and most ancient continents in the world. There has been little uplift or volcanic activity to rejuvenate the land surface in the last 125 million years, and this means that the land is generally very flat with comparatively few mountain ranges. The long duration of processes such as weathering and leaching have led to high

concentrations of minerals (and hence mineral wealth) in rocks, but soils which are shallow, stony and high in salt. They are generally unproductive and fragile.

Australia is the driest inhabited continent, with a climate characterised by low and variable rainfall and high variable temperatures. The unpredictability from year to year is more extreme than in other continents--Australia is indeed a land of droughts and flooding rains. The drainage is in general very sluggish. In large parts of Australia the drainage never reaches the sea, but ends in inland lakes and evaporates leaving large salt pans. The country covers latitudes from 9 degrees South to 44 degrees South and has a very long coastline, providing a huge diversity in climatic drivers and therefore in terrestrial and coastal ecosystems. The continent has been isolated for a very long time, allowing the evolution of unique flora and fauna.

It is estimated that Aboriginal people arrived in Australia 60,000 years ago. The harshness of the land and the variable climate ensured that populations stayed small. There is strong evidence that Aborigines deliberately managed the land through the use of fire--and changed some of the characteristics of the land and ecosystems.

European settlers and convicts arrived in Australia in the late 1700s, and began to clear the land for agriculture, harness some major rivers for transport and irrigation, fish the seas and estuaries, build large coastal cities, and exploit the mineral wealth. The European settlers did not understand the nature of the Australian environment and there was a broad consensus of societal forces including government policy, incentive structures, and regulatory directives on farmers, which led to severe impacts on the land. These include salination of soil and water (becoming too salty to be economically viable for agriculture and pasture), erosion, and loss of native plants and animals through:

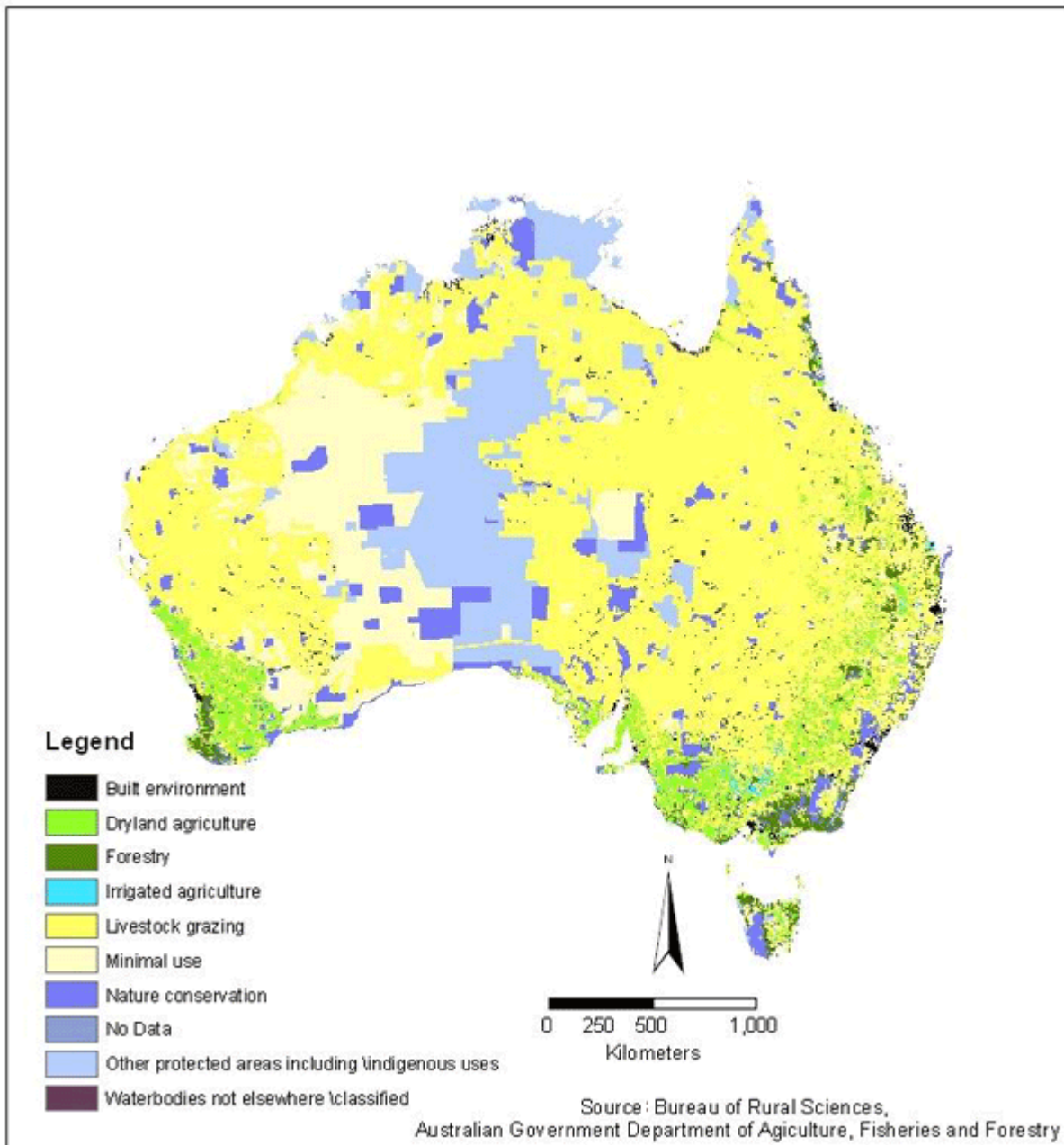
- extensive clearing of land for agriculture;
- modifying stream courses and flow regimes, extracting water for irrigation and stock;
- planting crops in unsuitable areas, and sheep and cattle overgrazing; and
- introducing rabbits, foxes, cats and exotic plants, which ran wild (Cocks, 1992).

The intensity of land and water use has accelerated in the last 3-4 decades, with the long-term consequences only becoming starkly evident quite recently.

Of the current population of just over 20 million people, 80% live within 50 kilometres of the coast (Pittock, 2003), and approximately 65% live in metropolitan areas (Australian Institute of Health and Welfare, 2004). The current pattern of land use, which reflects the major uses of natural resources, is shown in Figure 1. Around 60% of the Australian continent is managed for agricultural and pastoral production, however only 9% has a growing season of more than nine months, the period necessary for long season annual crops and perennial crops. Around 14% of the continent is managed by indigenous communities and a similar proportion is desert country with minimal use. Around 5% of the continent is in conservation reserves and a similar percentage is managed for forestry. Defence and mining lands, urban areas, roads, and water bodies comprise the remaining 2-3% of the continent (National Land and Water Resources Audit, 2002).

The use of natural resources plays an important major role in the Australian economy. The Australian Gross Domestic Product is AUD 813.6 billion (2003-2004), which is ranked 16th by volume and 13th on a per capita basis in the world. The agricultural industry comprises 4.3%, and mining 5.1% of Gross Domestic Product (Wikipedia, 2005). These figures underestimate the real contributions and costs however, and there is currently a move towards “triple bottom line” accounting, which considers financial, social and environmental aspects. For example, Foran, Lenzen, and Dey (2005) have developed a framework which uses generalized input-output analysis of ten indicators (three financial, three social and four environmental) through the whole-of-lifecycles of 135 sectors of the Australian economy. This analysis shows, for example, that for each dollar of final demand, primary production (and its value-added food and fibre products) have greenhouse emission, and water and land disturbance intensities that are considerably above the average across all sectors. By contrast, the mining sector shows good financial and environmental outcomes, but poor employment and income levels for each dollar of final demand. This approach enables an integrated benchmarking comparison across the sectors, providing a different picture to standard economic assessment.

Overall, the uniqueness of Australia’s landscapes, climates, soils, plants, and animals means that, in the main, knowledge about management of natural resources cannot be imported. Australians have to develop their own solutions for their own problems. For agricultural production, in particular, other countries enjoy younger, richer, more forgiving soils with more reliable climate (Campbell, 2005).



*Figure 1.* Land Use in Australia (National Land and Water Resources Audit, 2002)

### **3.2. Institutional and Governance Arrangements for Natural Resource Management**

Government incentives originally favoured land clearance and other environmentally destructive practices and these were exacerbated by farmers' attitudes about their right to use their land as they wished, a view that productive (commodity-producing) land use was



better than non-productive use, and that the resources were not a limit to growth (Cocks, 1992).

Direct evidence of negative impacts, especially resource depletion, and growing environmental consciousness has led to policies aimed at a more integrated system of managing agricultural land, rivers and estuaries. This is exemplified by the rise of the Landcare movement, which started as a grassroots initiative in the 1980s, and was strongly shaped and funded by government via the Decade of Landcare in the 1990s. In addition, there has also been widespread adoption of an Integrated Catchment Management framework by government, to build on the catchment approach to land management (e.g., Bellamy, Ross, Ewing, & Meppem, 2002).

The institutional and governance arrangements for natural resource management have become increasingly complex and dynamic because of the different levels of government involved, the level of public participation (through movements such as Landcare), and the range of legislative instruments and other structures.

Australia has a three-tiered system of government: the federal or national government, the governments of six states and two territories, and 722 local governments. Responsibilities for natural resource management are split between different agencies at these different levels. More recently, a regional tier of responsibility has also been introduced, where regions have boundaries which match natural biophysical boundaries, such as catchments (e.g., Bellamy et al., 2002; Reeve, Marshall, & Musgrave, 2002).

### **3.3. The Natural Resource Management Knowledge System**

The Australian natural resource management knowledge system is complex. Starting at the formal research and development end of the system, there are around 40 organisations established and funded by the Australian (national) government charged with purchasing, managing or delivering various aspects of natural resource management science. This number is greatly increased when state- and territory- based universities and other organisations are included and expanded even further when non-government organisations and intergovernmental coordination mechanisms are added. In total, there are several hundred organisations managing formal, scientific natural resource management knowledge. The main funder is the Australian government (Campbell, 2005).

We also note that formal scientific knowledge is just one form of knowledge required for more sustainable management of Australia's landscapes and natural resources. The skills, experience, rules of thumb and natural talents of land and water managers including farmers, indigenous people and water authorities are also significant (Campbell, 2005).

This background illustrates some of the integrative complexity faced in natural resource management research. While the papers in this special issue only scratch the surface of the organisations involved in natural resource management research, they do cover a number of the key players and initiatives in integration research. They also reflect the development and direction of integrated research on environmental issues in Australia. The Centre for Resource and Environmental Studies at the Australian National University pioneered the development of multidisciplinary research and the notion that holistic solutions are required if environmental management is to be effective. The CSIRO has gradually evolved its two major environmental management orientated Divisions, representing about 800 staff, to include systems approaches and comprehensive input to research by socio-economic disciplines. Finally, 18 current Cooperative Research Centres are classified as being dedicated to the environment. Of these, half can claim to be promoting integrated approaches to their issue area. In all, these organisations provide the major impetus towards integration research in Australia.

Nevertheless, the large number of players provides some insight into why effective integration is still more the exception than the rule. On the whole the disciplines have largely kept apart and there is still a considerable gulf between biophysical scientists and social scientists. Even interactions between related disciplines can be limited. This is especially true in the social sciences, where there seem to be relatively few organised interactions between different disciplines, such as between economists and other social scientists. New groupings, as in Social Assessment or Environmental Economics, are forming, but with little interaction, even though they have common interests in many issues, such as scaling and the notions of values and trust-building.

#### **4. Conclusions**

The patterns of use of natural resources in Australia developed during a time when people saw them as unlimited. This provided strong economic growth to many sectors. Many of these resources are, however, now reaching their limits of use--and in many cases their

value is being degraded by continued use. Australia is at crossroads--the past rates of increasingly intensive use cannot continue, and the negative environmental impacts are becoming socially and economically unacceptable (Dunlop, Turner, Foran, & Poldy, 2002).

The questions now being asked by Australians are increasingly sophisticated, and will require integrated science, policy, and practice to underpin their responses. The papers in this special issue address how researchers and research institutions can position themselves to more adequately meet these new and considerable challenges.

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