



Regional Scale Adaptive Management: Lessons from the North East Salinity Strategy (NESS)

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The regional scale has become increasingly important for natural resource management, with funding support focused on regional plans. It is also the scale at which adaptive management - an approach to managing natural resources that actively seeks to learn from the implementation of policies and strategies - could be expected to work best. This article explores passive and active adaptive management through review of a salinity management program in the north-east region of Victoria between 1997 and 2001. The North East Salinity Strategy (NESS) was a conventional, passively adaptive program, but active adaptive management could have been considered. We sought to understand the NESS program logic through document review, semi-structured interviews and a focus group, and in the process looked for signs of adaptive management.

The NESS program logic was sound, and it achieved progress towards many of its goals. A more actively adaptive approach may have achieved more, but it would have been constrained by some social and institutional factors. We suggest that a culture of reflection was absent from the NESS. Reflection was inhibited by institutional arrangements such as reporting requirements and funding processes, and by social norms that separated implementation from research, and equated rationality of action with certainty of outcome.

We present a hypothetical NESS to highlight the differences between the current conventional approach and one based on active adaptive management. We suggest that any attempt to adopt active adaptive management will need substantial commitment and flexible thinking to overcome the identified barriers.

Introduction

'Adaptive management' encompasses three related but separate approaches to managing natural resources, which have been described as evolutionary, passive and active (Walters and Holling 1990). Evolutionary and

passive adaptive management are common approaches to managing natural resources. *Evolutionary adaptive management* is eventual learning from experience, or trial and error. *Passive adaptive management* is more directed, using past experience to develop a single best policy to apply in practice. *Active adaptive management* is a change in the way management is undertaken. It is an approach to natural resource management that consciously uses policy and implementation as experiments, designed to enable people to learn about systems as they manage them (Lee 1993a; Walters and Green 1997; Johnson 1999). Active adaptive management arose from within the ecosystem management discipline as part of an attempt to address perceived issues of scale, uncertainty and some limitations of reductionist science (Holling 1978).

Active adaptive management has become a popular theoretical approach in North America and Europe because it promises solutions to a number of problems encountered by natural resource managers. Firstly, the focus of natural resource management is moving from harvesting and exploiting natural resources to their sustainable management, with the result that uncertainty and complexity have become real issues. Adaptive management appears to offer a way to manage resources sustainably in the face of this uncertainty and complexity through increased flexibility and openness to surprise (Holling 1995; Gunderson 1999). Secondly, learning from conventional management is a slow, often directionless process. The experimental focus of active adaptive management can lead to more efficient learning from implementation (Lee 1993b). Thirdly, extrapolation from small scale experiments may be inadequate to describe complex interactions at ecosystem scales. Active adaptive management fosters learning from whole systems to increase understanding of real world interactions (Walters and Holling 1990; Carpenter 1998). Finally, a resurgence of interest in participatory approaches to natural resource management has prompted searches for appropriate models for stakeholder involvement (e.g. Shindler *et al.* 1999; Swanson 2001). Active adaptive management may provide increased democratisation of management, via enhanced community involvement in informed decision-making (Lee 1993a; Roe 1996; Olsen and Folke 2001).

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Adaptive management is said to underpin most natural resource strategic planning in Australia (Alexandra *et al.* 1998). Some Australian examples of adaptive management do exist (e.g. Grayson *et al.* 1994; Mapstone *et al.* 1996; Ewing *et al.* 1998; Gilmour *et al.* 1999). However the uptake of active adaptive management in Australia has been slow. This is not because it would not be useful here; the issues that drove the development of adaptive management in North America and Europe are also present in the management of Australia's natural resources. Dryland salinity, for example, presents an ecosystem scale problem which is complex and poorly understood, and the management of which requires the participation of stakeholders from many different backgrounds and disciplines.

Dryland salinity management, along with other natural resource management issues, is supported through the Federal programs of the Natural Heritage Trust (NHT) and the new National Action Plan for Salinity and Water Resources (NAP). Funding from NHT has always had a regional focus, and both NHT and NAP will invest future funds through regional natural resource management plans (NHT 2002).

A recent workshop at Albury, NSW, explored the applicability and appropriateness of adaptive management in regional scale natural resource management programs. Important factors constraining active adaptive management were also identified, including scarcity of information about how to achieve adaptive management, adequate monitoring and evaluation regimes, ensuring genuine stakeholder involvement and social attitudes to risk and uncertainty (Allan and Curtis 2003).

One issue discussed at the workshop was that, when challenged, some natural resource managers say they have always taken an adaptive approach, and that adaptive management is merely a new label. Here we describe our attempt to understand the degree to which passive or active adaptive management operated within a regional scale implementation program, the North East Salinity Strategy (NESS). We also used this case study to explore what an active adaptive management approach to a regional scale problem would involve, and what factors might constrain the application of active adaptive management.

The North East Salinity Strategy

Background

North East Victoria encompasses the Upper Murray, Kiewa and Ovens River Basins, and provides 38 per cent

of the water of the Murray-Darling river system (North East Catchment and Land Protection Board 1997, p15). Picturesque alpine areas and productive foothills supporting horticulture and vineyards ensure that tourism is an important regional industry (North East Catchment Management Authority 2001). Over half the region is forested, but agriculture is a dominant land use in the 500-1200mm rainfall zone. Much of the highly modified agricultural landscape supports sheep and cattle grazing in the eastern uplands, with some cereal cropping in the west. An unintended consequence of the landscape modification is dryland salinity, which is an emerging problem for the region (Lumsden and Reid 1996).

Dryland salinity was of little importance in the north east until the 1990s (Department of Conservation Forests and Lands 1988), and funding from the Victorian State Salinity Initiative was not available to the region (Reid and Cheng 2001). However, salinity emerged and spread, and in 1994 the North East Salinity Working Group (NESWG) formed to develop a strategy to address the problem. The NESWG included Landcare group representatives, individual farmers, and staff from various State government agencies. While acknowledging the dearth of local hydrogeological and salinity related information, the NESWG published the NESS in draft form in 1997. The NESS was approved, unchanged, by the Victorian government two years later (Clifton and others 2000). The objective of the NESS was "to control salinity in the North East Region for the benefit of the environment, local communities and downstream users for future generations" (North East Salinity Working Group 1997, p28).

The NESS made no explicit claims to use adaptive management, but a passive adaptive approach was implied by the program logic. The NESS document acknowledged that dryland salinity was a complex problem, and that the implications of management options were uncertain. Regional stakeholders needed to learn about dryland salinity as efficiently as possible, both to address the issue effectively and to gain government funding. At the same time, there was a long history of widespread and effective involvement of community members, particularly through Landcare, in natural resource management in the region (Curtis and Van Nouhuys 1999). Passive adaptive management suited this type of natural resource management, but a more active adaptive management approach may have been more appropriate and efficient.

The NESS review

The authors were commissioned to evaluate the NESS implementation between the strategy release in 1997 until

December 2001. Our review focussed on assessing the NESS program effectiveness, and we attempted to make judgments about the extent to which the NESS implementation accomplished program goals and addressed stakeholder needs. We also used the opportunity to look for signs of adaptive management in the implementation of the NESS.

The original NESS document contained 56 recommended actions, incorporating many proposed activities, from which we articulated seven goals (see Box 1). We used a qualitative approach to evaluate progress towards these goals with reference to a number of topics. These topics were developed deductively from the State guidelines for the review of salinity plans (Catchment and Water Division, DNRE 2000), and inductively as new topics arose during data creation (See Box 2).

Data creation and categorical content analysis followed Patton (1990), Dey (1993) and Silverman (2001). Initial review of regional, Victorian and Murray-Darling Basin salinity management documents was followed by semi-structured interviews with 20 stakeholders, and a focus group with landcare facilitators. The interviews and focus group were audio taped and transcribed, and phrases in the notes coded by evaluation topic. Similarly coded phrases were collated to identify themes in the data.

What we learned about the NESS implementation

The total budget for the five years of NESS implementation, including community contributions, was \$1,545,340. The average full time equivalent staff available to implement the NESS program was 1.8. Much of the implementation of the NESS was directed towards developing a better understanding of regional and local salinity processes, raising community awareness of dryland salinity, achieving on ground works such as establishing trees and perennial pastures, and sourcing resources for the program. Some resources were directed at the other goals, including seeking better understanding of management options, building skills and capacity for change, and working within an integrated framework. Limited resources hampered progress towards all goals, but particularly these latter ones. Our review concluded that the NESS was underpinned by sound program logic, and was at least partially successful in working towards its goals (Allan and Curtis 2002). But what of adaptive management?

Understanding adaptive management in the NESS

The NESS implementation program developed over time, and was responsive to new technical information and community concerns. Stakeholders recognised that the

Box 1. NESS Goals

1. Develop a better understanding of salinity processes

Proposed activities included ground and surface water monitoring, discharge and recharge mapping, and hydrogeological interpretations and predictions.

2. Develop a better understanding of management options

Proposed activities included trials and demonstrations of vegetative options such as alley farming and lucerne establishment, and investigations into engineering options such as sub-surface drainage and groundwater pumping.

3. Raise awareness of salinity and promote sustainable land use

This included awareness raising activities and general promotion of current recommended practices. Proposed activities usually included 'encourage' and 'promote' in relation to recommended practices.

4. Build skills and capacity for change

This goal encompassed proposed training activities that increased individual land manager and community group skills. It also included activities which sought to reduce financial and time constraints on changing to more sustainable land management.

5. Implement on-ground works

This included proposed works such as tree planting, remnant vegetation protection, perennial pasture establishment and management, and improved management of discharge areas.

6. Work within an integrated framework

All activities which would increase linkages and compatibility with other organisations and programs were included.

7. Source Resources

NESS could change as a more complete understanding of dryland salinity in their region developed, e.g.

"We were really only operating under like best bet solutions I suppose....we just hoped we were doing the right thing.... and we'll certainly be open to modifying the projects further on down if... the research does shows us different ways to go."

However, such flexibility does not constitute active adaptive management. The NESS was a conventional,

passively managed program. Decisions about research directions were unsystematic, there were missed opportunities for using implementation to enhance learning, and program evaluation was unstructured and undervalued. The three examples below illustrate these points.

No research framework

The development of a Research and Investigation strategy was recommended but not implemented, so decisions about research activities were made in an unstructured manner through the NESWG. While most of the investigations undertaken were useful, the absence of a research framework contributed to inefficiencies in the use of the information generated. For example, Electromagnetic Mapping (EM 31) was undertaken early in program implementation in response to pressure from Landcare groups. The EM 31 raised community interest in salinity, but there was limited follow-up as other activities vied for scarce NESS resources. Without a research framework it was unclear what the EM 31 investigations were trying to achieve, how the information could be used, and how it related to other information gathered through the NESS and elsewhere. This lack of clarity also led to some unfulfilled expectations within the farming community, and a subsequent disillusionment with investigations within the NESS program.

"We did all the work with the electromagnetic surveying, and we really didn't get it interpreted properly, because I don't think they knew...I expected we would get more positive results than we got. They gave us maps...but it still didn't solve..."

Missed opportunities to learn

There was scant locally specific information about the efficacy of different salinity management options. Despite this, no local experimental field trials were established to assess recommended actions such as alley farming (incorporating trees within pastures) and groundwater interception plantings. One reason trials were not established was the higher priority given to the implementation of on-ground works, including tree planting in various configurations on over 50 properties. Within an active adaptive management paradigm these tree plantings could have been viewed as experimental treatments. However, only three of the areas treated as part of implementation had extensive formal monitoring, and only one provided an example of learning from implementation. On that property alley farming was established on a sub-catchment scale, groundwater monitoring was established, bird inventories undertaken and landholder interviews conducted to provide historical

Box 2. Evaluation Topics

Goals/activities	Information
Compatibly with social values and norms	Technical information
Complexity	Practical information
Target setting	Local information
Encouragement	Communication
Promotion	Storage
Adoption theory	Capacity building-understanding
Compatibility with state/MDBC	Awareness of issues
Learning	Resources
Preparedness to learn	Public funding/public costs
Alternative views	Capacity building- cost share
Scientific method	Commercial money
Local knowledge	Trade-offs
Expert knowledge	Implementation
Tolerance of failure	Plans/ strategies
Adult education theory	On ground activities
Adaptive management	Whole farm planning
Reporting	Risk
Evaluation activities	Risk management
Rewards/punishments	Social
Monitoring	Social impacts
Mapping	Interest in issues
Modelling	Equity
People	
Leadership	
Citizen participation	
Networks	
Statutory and regulatory environment	
Decision-making	
Power	
Agency support	
Partnerships	

and agricultural context. The impetus for much of this monitoring was to improve the demonstration value of the site, rather than to test the efficacy of the treatment. A second property also had groundwater monitoring established, but so many demonstration treatments were applied above the monitoring that it would be problematic to attribute discernible groundwater changes to any particular treatment. The third area was part of the Victorian discharge mapping program, and had

groundwater monitoring established, as well as an EM base map. The local landcare group had established trees and shrubs above the discharge site. They were also planning a number of new vegetation management activities around the discharge site, primarily for tree and shrub related demonstration purposes. Unfortunately, planning for this later revegetation was carried out in isolation from planning for discharge monitoring.

Interviewer: ...that's a CLPR monitoring site, so how have you linked with them?

Landcare member: We haven't, well I suppose I'm hoping that [agency staff] is doing that link...

Interviewer: So there wasn't any thought when you were doing that, that this is all being monitored, so this would be a chance to monitor?

Landcare member: To monitor the works? No, as far the hydrogeological thing goes...

Together with the many unmonitored works, these last two examples represented a lost opportunity to learn more systematically from the implementation that was occurring.

Unsystematic evaluation

The original NESS document was not written to facilitate evaluation. There was no statement of program objectives, and many of the 56 recommended actions were unconnected, loosely defined and therefore difficult to evaluate. Targets were set, but only for on-ground works. Prior to our review, formal evaluation of the program relied on reports from NESS staff to the various funding bodies and focussed on reporting the completion of proposed activities. These reports were closer to audits than evaluations, and did little to encourage reflection and learning from experience.

"...the only things we really report on are... whether our dollars have been spent... and then on the hectares of revegetation, and hectares of perennial pastures, and discharge treatment, so that's the only formal information that sort of filters through up to the program."

This type of reporting was encouraged by the NHT, which had a focus on project monitoring at the expense of evaluation (Howard Partners 1999).

The review conducted by the authors was welcomed by interview participants as a way of evaluating progress in the program. This review had been flagged in the NESS document, but the evaluation had not been envisaged as a way of refining and improving the program. In the absence of an active adaptive management framework we could only look back at what had been undertaken in an attempt to identify what were largely unintended lessons.

Discussion

Context

Although adaptive management appears full of promise for natural resource managers, experience with active adaptive management over the last two decades has been disappointing (McLain and Lee 1996; Dovers and Mobbs 1997; Lee 1999). Many of the suggested reasons for the constraint of active adaptive management are social, rather than technical in nature. Adaptive management needs patient accumulation of data and systematic assessment, two things that are hard to achieve when stakeholder values or priorities conflict (Miller 1999). Many management agencies lack sufficient flexibility or the commitment required by adaptive management (Nagendra 1999; Moir and Block 2001). Some agencies also fail to recognise that human society and behaviours are part of, rather than outside, the ecosystem and they are therefore reluctant to embrace the holistic responses required by active adaptive management (Holling and Meffe 1996). Adaptive approaches highlight the limitations of the technical/scientific knowledge base, challenging the traditional scientific-rational paradigm held by many natural resource managers, and exposing communities to previously unrealised uncertainty (Stankey and Shindler 1997).

Societal and institutional issues combine to inhibit a culture of reflection, an ingredient vital for successful active adaptive management. The institutional arrangements and societal norms that appear to have inhibited the development of a culture of reflection in the NESS were the separation of implementation from learning, and funding arrangements which favoured auditing over evaluation. These are considered below.

Social norms and institutional arrangements

Over the past century Western societies have encouraged the separation of learning and implementation. Learning is achieved predominantly through research, an activity assigned to specialists in distinct organisations or divisions (Fischer 1990). Attempts to broaden stakeholder participation in research can appear to delegitimise the findings (Kormacher 2001).

In keeping with societal expectations research was separated from extension and on-ground works in the NESS strategy document, and this distinction carried through into program implementation. Technical research was conducted by experts from the Centre for Land Protection Research (CLPR), and Goulburn Murray Water (GMW), while communication and implementation were the responsibility of the extension

officers, Landcare people and farmers. The separation legitimised scientific research and maintained the technocratic hierarchy at the expense of actively learning from the implementation which occurred.

Another social issue that constrains an active adaptive management approach is risk-averse behaviour (McLain and Lee 1996). Many factors contribute to individual and community perception of, and response to, risk. One of these factors is confidence in institutions and the perceived credibility of the information they promulgate (Wildavsky and Dake 1990). Incomplete or conflicting information can create mistrust, because experts appear not to be expert (Finucane 2000). The NESS took a landscape scale approach to managing dryland salinity. Because the landscape in question was predominantly private land, implementation relied on persuading landholders to undertake recommended works. Persuasion was best achieved by showing confidence in the technical information provided.

"The single most important thing is to be able to assure the public, I think, that we're not guessing, in the causes of salinity, and therefore have the skill to target more specifically the areas that are causing salinity."

"We need to get smarter, from a scientific perspective, and try to fully understand or better understand what the processes are and where are the areas... I think there needs to be more science."

"The important thing is that you need to understand the processes involved so that you can identify what activity's required, and where it should occur to get the best outcome."

As the quotes suggest, NESS stakeholders believed they needed to offer a degree of certainty based on rational science about the nature of the salinity problem and the efficacy of proposed ameliorative actions. This perception inhibited questioning of the knowledge base underpinning recommendations and the appropriateness of those recommendations. It also devalued local and experiential knowledge. The emphasis on technical rationality and certainty constrained the emergence of a culture of reflection that would have supported fledgling attempts towards active adaptive management.

Resource management institutions are also constrained by risk averse behaviour, with narrow definitions of program success, and punishment of managers who fail to achieve set goals (Halbert 1993). Current resource management policies in Australia discourage experimentation and learning (Iles 1996). What is encouraged is efficiency, measured by performance auditing. As suggested, performance auditing and program evaluation are different. Performance audits evolved from financial

audits, and are largely concerned with establishing efficiency (Davis 1990). Program evaluation should be a more reflective process, with a focus on obtaining information that can help stakeholders improve the outcomes of their programs (Patton 1990; Curtis *et al.* 1998). As we have seen, the reports required by the fund providers of the NESS implementation were basically audits, with the format of reporting determined by institutional requirements rather than the needs of program stakeholders.

The nature, as well as the source, of the funding available to the NESS discouraged a culture of reflection. Funding was mostly short term (usually three years, but guaranteed for only one year at a time), tied to specific projects or expected outcomes, and often aimed at innovative or pilot programs.

"...we need some continuing funding rather than this piecemeal every year put your hand out and they slap it a couple of times and then they, they give you some money. ... , I think we need some sort of guarantee that we can continue."

"They don't understand the time scale involved in this, if you expect any results in less than a decade you're just whistling Dixie. And that's been our problem, short term funding, limited ... I won't say limited contracts, but limited times for programs and all this kind of stuff. Always got to have something new, not doing the same thing."

"...the uncertainty of budgets and the uncertainty with, makes it very hard to build up a long term on going program when ... we don't know what happens after the NHT after the ...first of October, that's when all our, basically the salinity program cranks, grinds to a halt then... the multitude of agencies and programs and projects and reporting arrangements and structures and just such a complex maze to to work through, we just make it really difficult for ourselves."

What would an adaptive NESS look like?

We have suggested that the NESS did not apply active adaptive management. So, what would active adaptive management of the NESS have involved? A hypothetical NESS management team would:

- Consciously design management actions to test hypotheses about the processes leading to dryland salinity in the region, and the efficacy of different management options. Either implementation would be designed to test these hypotheses, or opportunities for testing and learning would be sought during the inevitable patchy uptake of recommended actions.
- Develop an evaluation framework before implementation commenced. This would allow program

reviewers to have a clearer understanding of issues most directly valued by the program stakeholders, rather than sifting through program evidence for possible lessons.

- Foster a culture of reflection throughout NESS, including an acknowledgment of the importance of evaluation in improving ongoing program delivery. Priority would be given to the formulation of stakeholder goals and there would be adequate resources for evaluation. Information management (collection, storage, interpretation and sharing) would be an important NESS activity.
- Accept uncertainty about the outcome of actions. Program 'failures' would not be punished, as the information generated would recompense the resources invested in the attempt.
- Embrace all stakeholders in the culture of reflection. Distinctions between research and implementation would be reduced as lessons learned from doing were legitimised.

Conclusion

Despite its promise, active adaptive management of natural resources is not common in Australia. We suggest that many of the institutional and social barriers identified in the wider literature also impede more active adaptive management approaches to natural resource management in this country. We have proposed that an actively adaptive management approach in the NESS would have included:

- hypothesis testing through planned or opportunistic implementation 'experiments';
- an evaluation framework which promoted reflection on and learning about the catchment as it was being managed;
- adequate resources for monitoring and evaluation;
- acknowledgment of uncertainty and risk; and
- reduction of demarcation between research and implementation.

To support active adaptive management at the regional scale information is needed to:

- distinguish active adaptive management from other natural resource management approaches;
- underpin decisions about when adaptive management is an appropriate approach to pursue; and

- develop programs that address the important social and institutional barriers in order to become genuinely adaptive.

One outcome of the Albury workshop was the establishment of an adaptive management network. This network should become an important source of information about all aspects of adaptive management. Discussion at a national scale is needed, as any attempt to move to adaptive management will need substantial commitment and flexible thinking to overcome some very real constraints. Active adaptive approaches will not be achieved by a reliance on the comforting but misleading assertion that managers have always been adaptive.

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