



A systems approach to the evaluation of natural resource management initiatives

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Adopting a new paradigm for natural resource and environmental policy that emphasises continuous change, adaptation and learning demands a new approach to evaluation to enable improvements in the way these initiatives contribute to sustainable resource use. Evaluation is fundamental to identifying change, supporting an adaptive approach that is flexible enough to meet the challenge of change, and enabling learning at individual, community, institutional and policy levels. Based on a consideration of changing approaches to natural resource management (NRM) policy and observations and experiences in the practical assessment of on-the-ground initiatives, the authors develop a set of principles for evaluation in NRM that: (a) addresses evaluation from a systems perspective, (b) links objective to consequence, (c) considers the fundamental assumptions and hypotheses that underpin core policy or program objectives, (d) is grounded in the natural resource, policy/institutional, economic, socio-cultural and technological contexts of implementation in practice, (e) establishes practical and valid evaluation criteria by which change can be monitored and assessed, (f) involves methodological pluralism including both quantitative and qualitative methods to ensure rigour and comprehensiveness in assessment, and (g) integrates different disciplinary perspectives (i.e. social, economic, environmental, policy and technological). The paper develops a systems-based evaluation framework that incorporates these principles and also recognises the multiple levels and nested nature of NRM policy, namely: problem characterisation, policy formulation and intent, program logic, and on-ground implementation. Finally, we demonstrate its utility through application to three contrasting Australian case studies: a community-based Integrated Catchment Management policy implementation; a resource information delivery system; and the development of a Decision Support System.

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Introduction

In practice, the implementation of natural resource management (NRM) policy initiatives is proving a difficult challenge for the individuals, institutions and communities concerned (Dorcey, 1991; Gunderson *et al.*, 1995; Bellamy *et al.*, 1999a) and as a consequence, actual impact is often perceived to fall short of expectation. Chambers (1997:100) remarks that 'myths have led to massive misallocation of funds and human resources, to misguided

programmes, to missed opportunities and among professionals to deception, cynicism and loss of commitment'. Such difficulties can be attributed in part to inadequate evaluation of the efficacy of policy initiatives that can contribute to on-going policy improvement. Most importantly, the adoption of new policy models demands a new approach to evaluation.

Evaluation in natural resource management

Program evaluation and policy analysis are critical elements of successful policy development and

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implementation. The challenge to create policy processes, institutional arrangements and natural resource management practices that contribute towards achieving sustainable and equitable resource use outcomes requires rigorous evaluation as part of the change process. Evaluation is fundamental to identifying change, supporting an adaptive approach that is flexible enough to meet the challenge of change, and enabling progressive learning at individual, community, institutional and policy levels. However, evaluation in natural resource management policy has been neglected and a substantial gap is emerging between theory and practice (Wallace *et al.*, 1995; Curtis *et al.*, 1998; Bellamy *et al.*, 1999a).

The practice

Existing models of evaluation of natural resource management and planning are fragmented in terms of reconciling the different domain perspectives in evaluation, do not provide an integrated evaluation, and are not sensitive to the socio-economic, policy/institutional, and environmental context within which performance is assessed (Syme and Sadler, 1994; Bellamy *et al.*, 1999a). Significantly, no clear evaluative frameworks have emerged to guide continuous program development in the way natural resource management initiatives contribute to on-going improvements in resource use sustainability and social well-being of the communities concerned. An over-arching systemic framework to guide the evaluation of natural resource management policy initiatives is lacking.

Bridging the gap

It is critical that policy makers, project managers and catchment, watershed and regional coordinators or practitioners can evaluate their programs and activities effectively. An effective framework for evaluating the success of natural resource management policy initiatives needs to be both practical and to draw on evaluation principles and methods from a broad spectrum of disciplines (e.g. social psychology, ecology, economics, organisational science and management science) to characterise, monitor and evaluate the process and its outcomes (Bellamy *et al.*, 1999a). Ison *et al.* (1997:261) argue that the emerging systems perspectives of complexity science, 'chaos' and self-organising theories and complex adaptive systems can 'bridge the natural, socio-economic and

management sciences by serving either as explanations of phenomena or as metaphors which can guide thinking and action'. Systems theory provides us with powerful concepts for evaluation. A system for NRM program evaluation will be like all systems 'a construction of reality' of the components and processes conceived as best to define the problem at hand. For program development, in the 1950s Simon (1955) pioneered the rational approach that identified the components of planning systems and the links between them. The 'rational planning model', with its systems view of scientific decision making, subsequently found its way into most branches of resources management and planning with its emphasis on objectives, options development, explicit evaluation, implementation, monitoring and review. The system included feedback processes from evaluation and monitoring to other planning components. Rigorous evaluation techniques notably cost-benefit analysis and its derivatives such as cost-effectiveness analysis, were natural partners in this scientific conception of planning.

While theoreticians and practitioners alike found this model naïve in behavioural and political terms and inadequate as a normative model for policy making processes, interest in applying systems in planning and policy analysis has not disappeared. The concepts of systems persist, recast and refined to address these weaknesses by new constructions of reality (see Ison *et al.* 1997). Most importantly, we argue here that natural resource management initiatives need to be evaluated as a system that links the objectives and instrumental rationale of the policy or program to actual performance on the ground. Developing an improved framework and methodologies for analysing situations, incorporating institutional concerns and, in turn, informing the process of improvement, therefore, requires a systemic and integrated approach that has the ability to:

- (a) Assess public and private investment in integrated approaches to natural resource management.
- (b) Identify the most critical social, economic, institutional, environmental and technological factors that influence natural resource management initiatives.
- (c) Develop appropriate performance criteria for assessing the potential impacts and influences of an approach on the management of resources, on institutional arrangements and society as a whole.

- (d) Identify what the outcomes and expectations of an integrated resource management initiative might be.
- (e) Establish guidelines and techniques for identifying progress towards agreed objectives and outcomes.

In this paper we consider, on the basis of our broad case study experience, some of the operational challenges that these objectives pose. These experiences in turn provide a basis for presenting an integrative systems-based framework to guide and structure the evaluation of natural resource management policy initiatives. Finally we demonstrate the application of the systems-based framework through three contrasting case studies: a community-based Integrated Catchment Management policy implementation; resource information delivery system; and the development of a Decision Support System.

Requirements for NRM evaluation

Implementation issues in evaluation

Our broad experience in the evaluations of a range of different NRM initiatives covers for example:

- (a) Policy issues relating to water resources planning and community-based catchment management (Syme *et al.*, 1994, Syme and Sadler, 1994; Bellamy and Johnson, 1999; Bellamy *et al.*, 1999a,b; Hooper *et al.*, 1999).
- (b) Methods and tools for resource use management and planning including decision support for sustainable grazing management and a community resource information centre (Bellamy *et al.*, 1996; Walker and Johnson, 1996; Johnson and Walker, 1997; Bellamy and MacLeod, 1999).
- (c) Natural resource management research and development including the evaluation of decision support for sustainable resource use and the use of corporate knowledge bases in agricultural research (Bellamy and MacLeod, 1998; Walker *et al.*, 1997).
- (d) Assessment of community-based projects submitted for funding by the Natural Heritage Trust (McDonald, 2000).

This experience reveals a number of common factors that make the evaluation of natural resource management initiatives with broad societal purposes implementationally demanding and

potentially costly. The key challenges are identified below.

Breadth of evaluation

Evaluation of impact against a single criterion or overly limited set of criteria may miss important benefits and lead to significant costs remaining unrecognised.

Multi-dimensionality of impacts

The impact of an initiative is likely to be multi-dimensional, encompassing, for example:

- (a) Individual and organisational learning effects (e.g. new collaborations, partnerships or strategic alliances, networking).
- (b) Behavioural changes (e.g. new skills, new planning processes, sharing of information).
- (c) Impacts on norms/standards (e.g. new ways of technical assessment, accessibility of information).
- (d) Social effects (e.g. changed social networks).
- (e) Contributions to knowledge bases or scientific progress.
- (f) Resolution or amelioration of resource use problems (e.g. improved water quality, rehabilitation of riparian vegetation).

Intangible objectives and outcomes

Many policy programs and planning processes have vague and even unrealistic aims and objectives. They often arise from political compromise and may even be internally inconsistent. In addition, many of the important measures of progress or success are intangible, making the identification of appropriate criteria for evaluation difficult.

Causality

Understanding of causality is essential for designing effective programs based on policy instruments that can produce the required change. There is often considerable ambiguity associated with cause-and-effect relationships in natural resource management problems, which involve dynamic, complex, multi-dimensional processes that are invariably affected by a number of diverse factors.

Consequently, it is not generally possible to provide definitive answers on causality and to identify the difference that particular policies or programs can make to what would have happened without them.

Short term needs versus long-term impacts

Impacts or outcomes of natural resource management policy initiatives almost always take a considerably long time to be realised and may only become visible beyond the lifetime of any evaluation.

Evolution or drift in objectives

There are difficulties related to the dynamic context of implementation of natural resource management initiatives and the potential for changing 'fit' of objectives with instrumental assumptions and context. These changes may relate to different political priorities or different economic conditions. For example, an initiative may, at inception, have clear relationships between issue, intent, assumptions, criteria and context. At a later date, the issue and intent may have evolved markedly either in conjunction with or independently of changes in context. However, instrumental assumptions and evaluative criteria may not have co-evolved, leading to a complex distortion that needs to be dealt with in the evaluation process.

Multiple perspectives on criteria for success

In the case of policies promoting sustainability by multiple stakeholder participation, the 'views' of the purposes of the program and the criteria of success of the different stakeholders may be quite diverse. Establishment of an evaluation framework which includes the perception of stakeholders according to their functions within the overall system can be problematic. Depending on one's role, there may be subtle or distinctly different priorities for outcomes and even on criteria for measuring whether the outcomes have been achieved. These differences may be necessary for the healthy functioning of the system as a whole but they make evaluation as pluralistic as the policy-making process itself.

Principles for evaluation of NRM policy initiatives

On the basis of this set of challenges and our collective experience, we argue that evaluation in natural resource management needs to be addressed as a system that:

- (a) Links objective to consequence.
- (b) Considers the fundamental implementation assumptions and instrumental hypotheses that underpin core policy or program objectives.
- (c) Is grounded in the natural resource, policy/institutional, economic, socio-cultural and technological contexts of implementation in practice.
- (d) Establishes practical, valid and equitable evaluation criteria by which change can be monitored and assessed.
- (e) Involves methodological pluralism (including both quantitative and qualitative methods) to ensure rigour and comprehensiveness in assessment.
- (f) Integrates different disciplinary perspectives (i.e. social, economic, environmental, policy and technological).

Furthermore, evaluation must allow for the assessment of *impact* (i.e. environmental, economic, social, institutional, and technological) and be implemented as a *process tool* that (Bellamy and MacLeod, 1999):

- (a) Supports purposeful and informative stakeholder participation.
- (b) Creates improved opportunities for the incorporation of on-going learning processes at individual, organisational and policy levels.
- (c) Facilitates negotiation and mediation processes.
- (d) Supports the move towards better outcome including the amelioration, or improvement in the manageability, of problems.

Finally, evaluation of natural resource management policy initiatives should be interactive, iterative, and meaningful and be directed towards influencing what emerges in an on-going positive and constructive way (Bellamy *et al.*, 1999a).

Development of a systems-based framework

Figure 1 presents a systems-based evaluation framework that addresses these principles. As

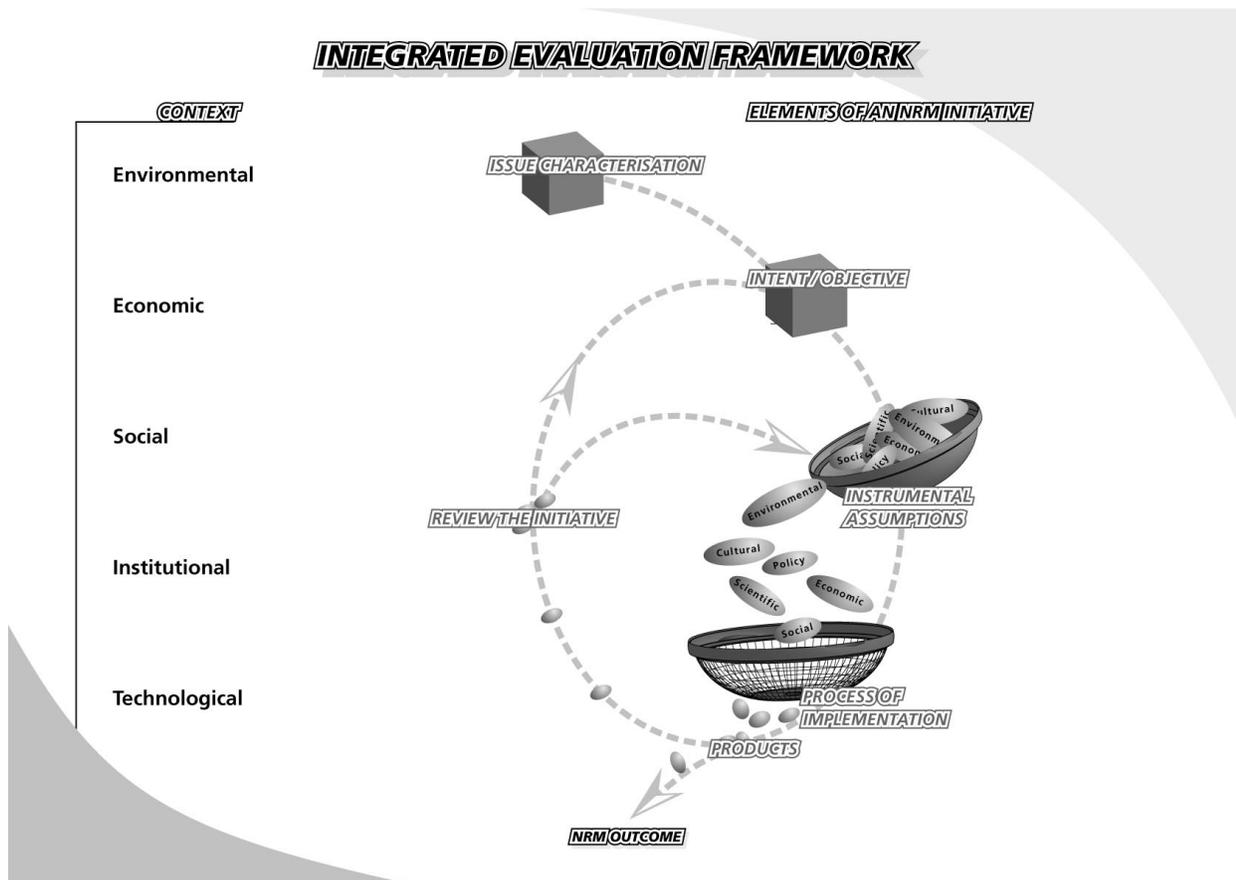


Figure 1. Integrated systems-based framework for the evaluation of natural resource management policy initiatives.

previously noted, the authors relied on their collective experience in NRM evaluation as the primary data source for this framework and most importantly the results of an intensive long-term project evaluating an Integrated Catchment Management (ICM) program (Bellamy *et al.*, 1999b).

The approach here had several major antecedents:

- The Mazmanian-Sabatier (MS) model, which the authors used initially because of its valuable structuring capabilities, but found it to be deficient in addressing instrumental assumptions ('causal theory' in MS terms) and implementation processes (see Bellamy *et al.*, 1999a).
- The PRIME model (Syme *et al.*, 1994) which focused on management processes but needed better grounding in program context and structures.
- The authors, collective experience with complex resource management programs, many of which were experimental, making conventional economic methodologies largely ineffective, limiting them to a minor supporting role only.

Context

A range of social, economic, environmental, institutional and technological factors influence the framing or characterisation of the problem, the rationality underlying the policy response, the implementation process and on-ground performance. Importantly, within a particular community established social networks and interactions, societal values, legal policy frameworks and historical influences shape human association with their natural resources and will continue to influence that association and the pattern of behaviour in the future. As a consequence the impact of a particular initiative on the community concerned, and ultimately the sustainability of the natural resources, may vary considerably for different situational contexts.

The system-based evaluation framework recognises the multiple levels and nested nature of natural resource management policy, namely: issue characterisation, policy formulation and intent, program logic, and on-ground implementation and the fundamental importance of context (social,

economic, environmental, institutional and technological) on all of these aspects. The framework links both the intent and rationale of a natural resource management policy initiative to its implementation and performance 'on the ground'. It also provides the basis for synthesising the multiple perspectives on the evaluation of the phenomenon of interest.

The fundamental elements of this framework are discussed below.

Issue characterisation

A poorly defined problem leads to a poorly formulated policy or program. The nature of the issue or problem underlying the natural resource management policy initiative being evaluated (e.g. policy, program, activity, method/tool), and the context in which the issue or problem developed need to be explicitly characterised.

Objective/intent

Similarly, the objectives or intent of (a) the initiative being evaluated, its expected outcomes and key stakeholders, and (b) the evaluation itself need to be clearly articulated. These objectives will invariably be multiple. Although not necessarily mutually exclusive, five broad purposes for natural resource management evaluation and a range of potential outcomes are identified in Table 1. These include: improving program management, improving transparency and accountability, reducing risk and uncertainty, fostering learning, and improving process.

Instrumental assumptions

Whether explicitly identified or, more often, implicit, a policy initiative will have some basis in theory. Each theory base brings with it different methodologies, assumptions and value systems. In evaluation, identifying the theory underpinning the implementation of the initiative therefore will highlight the underlying assumptions and instrumental hypotheses, clarify what evaluation measures are needed, and contribute to an understanding of causal linkages (Bellamy *et al.*, 1999a). Significantly, it is necessary to make explicit and transparent the rationale of the initiative, that is the hidden or implicitly held assumptions, behaviours and motivations reflected

Table 1. Purposes of a natural resource management evaluation and possible outcomes

Evaluation purpose
<p><i>Improving program management</i></p> <ul style="list-style-type: none"> • Develop a common understanding of objectives and expected outcomes • Provide a basis for informed decision-making on program/research direction, resource allocation and attainable levels of performance. • Identify and focus attention on factors influencing the initiative's outputs and outcomes • Identify gaps in performance and insights on how they might be addressed • Facilitate a robust and integrated approach to program planning and implementation.
<p><i>Improving transparency and accountability</i></p> <ul style="list-style-type: none"> • Evaluate costs and benefits of an investment of public or private resources • Improving efficiency and effectiveness of a program or process • Early identification of unanticipated outcomes
<p><i>Reducing risk and uncertainty</i></p> <ul style="list-style-type: none"> • Identify impacts of a project, program or process • Identify information pathways and processes and their role • Develop understanding of causal relationships • Identify equity and social justice issues
<p><i>Fostering learning</i></p> <ul style="list-style-type: none"> • Influence decision-making and policy development • Support on going information exchange, feedback and learning • Improve awareness of equity and social justice problems as they arise
<p><i>Improving process</i></p> <ul style="list-style-type: none"> • Facilitate continuous participation • Support the public consultation process • Build stakeholder capacity • Develop ownership of project outcomes • Provide information and a structural framework to underpin negotiations • Provide a platform for cultural change.

in identified goals of that initiative and which influence decision-making and policy implementation processes and ultimately the outcomes. Such underlying assumptions or instrumental hypotheses may relate for example to the program or policy logic, stakeholder involvement, the implementation process, policy and institutional arrangements, technical information and support mechanisms, communication and interaction processes, or expectations of policy impacts and program products or outcomes.

Evaluation criteria

The fundamental basis for evaluation is the establishment of practical criteria by which change

can be monitored and assessed in order to evaluate progress and impact of the policy initiative on the problem or issue it was set up to tackle. Importantly, evaluative criteria should reflect the achievement of key objectives of the initiative. Criteria, however, also provide the basis for testing assumptions and instrumental hypotheses underlying the implementation of the natural resource management policy initiative.

In fostering a multi-perspective approach, potentially there is scope for a whole suite of evaluative measures that reflect the influences and impacts of the NRM policy initiative. However, for practical and efficiency reasons, each evaluation needs to focus on a selected number of critical evaluation criteria and indicators that are relatively readily measurable over time, yet rigorous and effective in reflecting change in an evaluative criteria. A significant challenge is how to deal with the potentially unbounded scope of possible evaluation criteria in light of the practical realities of available resources and the need for 'sensitive' evaluation that moves the process forward rather than undermines it. The identification of evaluation criteria for a particular natural resource management initiative therefore necessarily requires an iterative process of development to continually refine the criteria to a critical but manageable set. This process needs to take into account:

- (a) The objectives or intent of the natural resource management initiative.
- (b) The instrumental assumptions underpinning the implementation of the initiative.
- (c) The objectives or intent of the evaluation itself.
- (d) The feasibility and practicality of methods given the resources available.
- (e) The constraints of the context of implementation.

This iterative refinement process forces a 'bounding' of the problem or issue of interest and, in turn, its evaluative criteria.

Evaluation methods

The selection of the evaluation team, the formulation of the problem, the analytical models used, the methodological approach adopted, the information selected as relevant, the data collection techniques, the scope and construction of questions addressed, and so on reflect the world views (e.g. the values, priorities, experience and organisational culture) of those who participate in the design, development, implementation and interpretation of the

evaluation. In the context of natural resource management initiatives, therefore there is a strong case for methodological pluralism. Multiple methods and triangulation of observation can contribute to methodological rigour in evaluation (Patton, 1987). Values and instrumental assumptions need to be made explicit in theoretical frameworks, principles of inquiry and evaluative methods adopted.

The choice of the quantitative and qualitative performance assessment methods for (a) the evaluation of performance measures/criteria and (b) the interpretation or analysis of findings will be influenced by these considerations and the timing of evaluation. There are three well-recognised stages of evaluation: *ex-ante* evaluation undertaken before implementation; *progress* evaluation during implementation; and *ex-post* evaluation after completion of a project or program. In all of these stages, there are four fundamental criteria that can guide the design of an evaluation: usefulness and relevance to the evaluation purpose, feasibility and cost-effectiveness, equity and social justice, and technical validity (Department of Finance 1994). As there is no recognised best evaluation methodology, a balance is required amongst these various considerations when designing an evaluation. Importantly, the framework for evaluation presented here is designed to be independent of the methods applied for evaluation.

Process of implementation

The process of implementation encompasses the activities, strategies or operations by which the initiative is implemented or delivered and which produce the outputs and, in turn, outcomes of the initiative. The evolution of this process may vary from one situational context to another for a host of local community (i.e. catchment, region) contextual factors. In addition, activities associated with a policy initiative (such as planning, research, implementation, monitoring and evaluation) usually occur simultaneously rather than sequentially (Syme *et al.*, 1994). Evaluation therefore needs to consider all activities simultaneously.

Products and outcomes

The products of a natural resource management initiative are the tangible outputs of that initiative over which it has some degree of control, such as the establishment of a multi-stakeholder coordinating committee or the development of a

catchment management plan. In contrast, the outcomes of an initiative relate to the anticipated and unanticipated impacts of those products and the implementation process for the initiative, such as improved adoption on-farm of sustainable practices, improved water quality or more accountable land development and planning processes.

Implementing an evaluation

Figure 2 shows the logical structure and a set of steps for the evaluation. It is this way that the framework is systems based and different from the conventional methodologies. Evaluation is a central component of resource management rather than a dispassionate activity external to the program process. The systems view encourages critical reflection on program implementation and a 'learning organisation' involved in continual and iterative program improvement (see Senge, 1992).

Evaluation needs to be directed toward influencing what emerges in a positive and constructive way, rather than focussing only on *post hoc* evaluation related to mere achievement of initially proposed means of reaching objectives. Importantly,

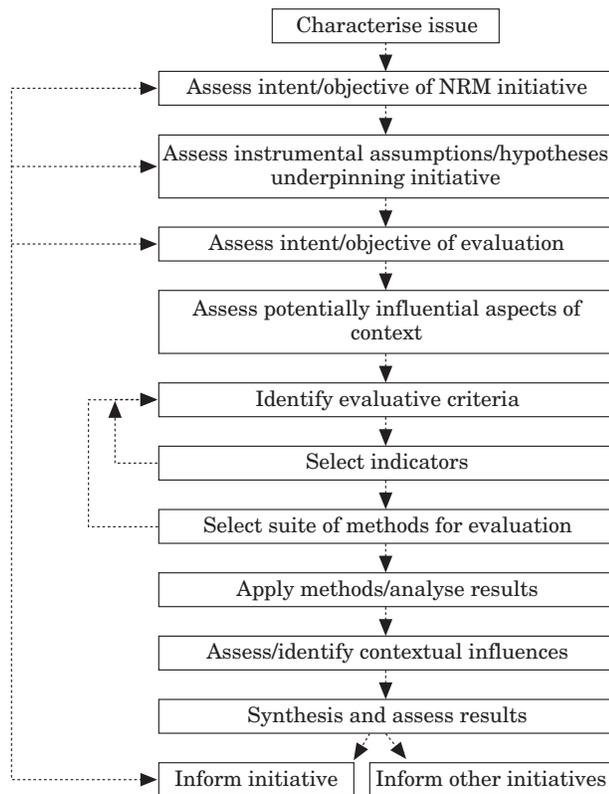


Figure 2. Steps in the evaluation of natural resource management policy initiatives.

the evaluation should influence the objectives themselves and incorporate an effective process of continuing feedback and improvement to the natural resource management implementation process as a whole (that is, the conceptualisation of the natural resource management issue, the objectives of the policy response and the assumptions underlying its implementation). In this context and in recognition of the dynamic nature of the implementational context of natural resource management policy initiatives, evaluation objectives and related criteria also need to be reviewed and refined regularly to ensure continuing relevance.

Application of the framework

Case studies

The use of the systems-based framework is demonstrated through its application to three Australian case studies concerned with natural resource management policy initiatives:

- (1) Implementation of a community-based Integrated Catchment Management (ICM) process in Queensland (McDonald *et al.*, 1999; Bellamy *et al.*, 1999b; <http://irum.tag.csiro.au/icm/>). Recently, there has been considerable public and private investment in integrated approaches at a catchment scale involving partnerships between government, industry and community. However the translation of the concept of such approaches into practice has proven difficult with on-ground implementation being largely experimental and often falling far short of community expectations. This case study focuses on assessing the social, economic and institutional factors influencing the success of an ICM policy initiative, evaluating its impact, and capturing lessons learnt to support on-going improvements in the way such initiatives contribute to change and improve resource use outcomes.
- (2) Development of a community-based resource information centre, the Herbert Resources Information Centre (Walker *et al.*, 2001). Traditionally, most decision-making in planning natural resource use options has been vested with regulatory authorities. In recent years significant changes have occurred to involve the community in the decision-making process. This case study focuses on assessing the impact of a research initiative to provide the

community with access to information to underpin resource use decision-making and also to develop the capacity of stakeholders to use that information.

- (3) Development of a decision support system for sustainable grazing management called Landassess DSS (Bellamy *et al.*, 1996; Bellamy and MacLeod, 1999). With continuing degradation of our pastoral lands over a long time frame of use, there was a perceived need for government agencies and industry to identify the current state of grazing lands, monitor change and foster a 'voluntary' approach to sustainable land use. This case study focuses on the role and effectiveness of a computer based decision support systems to support this policy approach through early identification of potential sustainability problems and the assessment of likely land resource and economic impacts of management options at a scale relevant to management decision-making.

These case studies were selected to illustrate a range of:

- (a) *Scales of application* (national/state policy, catchment/local community, individual/farm enterprise).
- (b) *Types of product* (improved process, a tool or method).
- (c) *Levels of intervention* (research, information and extension, planning, implementation).
- (d) *Stages of evaluation* (progress, ex-poste).

The three case studies are compared in terms of these factors in Figures 3. Using the evaluation framework as a reporting structure, the evaluation of the three natural resource management initiatives are presented in summary form in Appendices 1 to 3. These studies illustrate the use of the

integrated evaluation framework for two different situations:

- (1) Establishment of comprehensive evaluation criteria and methods for on-going evaluations of natural resource management policy initiatives (i.e. Appendices 1 and 2).
- (2) Clarification, structuring and comprehensive presentation of previous evaluations of tools or methods for natural resource management (i.e. Appendix 3).

Based on the experience of applying the framework in these case studies, a number of strengths can be identified relating to its operational use including:

- (a) *Multiple perspectives*: the logic of the framework is not confined to traditional accounting-based or linear program evaluation methods. Rather, it forces a broad perspective by facilitating the consideration of a wide range of underlying assumptions and, in turn, evaluation criteria (e.g. environmental, social, economic, institutional and technological).
- (b) *Integration of different perspectives on the evaluation*: the framework provides an effective basis for integration of multiple perspectives on the evaluation of each initiative, particularly when used in a formative evaluation context.
- (c) *Problem bounding*: the framework forces a 'bounding' of the problem or issue of interest through forcing a focus on the specific elements of relevance to the assumptions underlying an initiative and importantly the purpose of the evaluation.
- (d) *Structuring logic*: the framework provides a logical structure and set of steps for undertaking an evaluation.

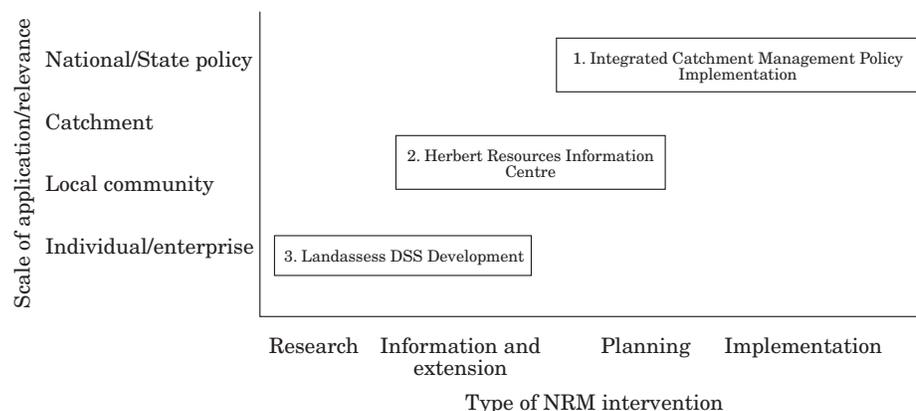


Figure 3. Comparison of case studies.

- (e) *Reporting structure*: the framework provides an effective and logical structure for reporting on an evaluation.

It needs to be stressed, however, that this is a framework only. Key measures and criteria developed within this framework need to be developed to meet the specific needs of particular application contexts, as well as being negotiated with those actors involved in the policy and planning process.

Conclusion

While natural resource management and environmental planning are increasingly being promoted globally as mechanisms to resolve intractable resource use problems and conflicts, there still remains no common theoretical base upon which such approaches are developed and implemented. Significantly, a clear evaluative framework has failed to emerge to guide improvements in the way that such initiatives actually contribute toward achieving sustainable and equitable resource use and management. This paper has sought to overcome some of the significant challenges to evaluation in complex natural resource and human systems. In particular, it has sought to place NRM evaluation in a clear context as a first step to establishing an integrated framework for evaluating initiatives.

NRM policy and planning initiatives need to be evaluated as a system that links the latter's objectives and rationale to performance 'on the ground'. Importantly, evaluation is not only a means of assessing impact but also a critical process tool for improving program management, providing a basis for assessing accountability, fostering learning, improving the body of knowledge, and improving the implementation of policy objectives. The systems-based evaluation framework developed here provides:

- (a) A basis for an integrated evaluation of the different perspectives (i.e. social, economic, environmental, institutional and technological) on the performance of the natural resource management initiative.
- (b) A framework for guiding its implementation.
- (c) A rigorous basis for synthesising findings.

Unless there are structured and coordinated attempts to adopt improved evaluative frameworks appropriate to the theoretical context within which natural resource management and planning

occurs, we do not believe that there can be significant on-going improvements in the way policy initiatives can contribute to sustainable and equitable resource use outcomes at the local, regional, national and global levels. As a consequence, integrated and adaptive approaches to NRM may be discarded before a fair and comprehensive assessment of their potential role and impact is determined. This would be counter to the general theoretical developments in systems theory, ecology and the participative and adaptive management philosophies that currently drive policy reform. Importantly, the challenge to create policy processes, institutional arrangements and NRM practices, which enable the choice of methods, tools and mechanisms most suited to moving communities towards achieving sustainable and equitable outcomes of resource use and management, needs rigorous evaluation incorporated as part of the change process.

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Appendix 1

Case study: Integrated Catchment Management (ICM) in Queensland

ELEMENT	DESCRIPTION
Issue characterisation	<ul style="list-style-type: none"> ● Resource degradation of waterways, pastoral and agricultural lands, concern for biological diversity. ● Fragmented centralised governance approaches need to be replaced by more adaptive and integrated approaches at a catchment scale involving partnerships between government, industry and communities. ● There is considerable public and private investment in integrated approaches with high community expectations but the translation of the concept into practice is experimental and evolutionary. ● Evaluation is necessary to determine whether strategies are achieving desired resource management outcomes. ● Evaluation is fundamental to identifying impact, supporting an adaptive integrated approach that is flexible to meet the challenges of change, and informing on-going learning at individual, community, institutional and policy levels.
Intent/objective	<p>The stated intent of the Integrated Catchment Management (ICM) policy initiative in Queensland is a coordinated approach to integrate the management of land, water and related biological resources in order to achieve their sustainable and balanced use by:</p> <ul style="list-style-type: none"> (a) Generating a better understanding of ecosystem interactions at a catchment scale by the community and Government and moving towards common or agreed goals through development of a catchment management strategy; (b) Facilitating coordination and cooperation within and between Government agencies and the community to enable the prioritisation of actions, and joint or independent action to seek solutions to problems. <p>Evaluation of ICM in practice is needed to guide continuous improvements in the way the policy initiative contributes to on-going change.</p>
Instrumental assumptions	<ul style="list-style-type: none"> ● Land and water resources are basic and interactive components of natural ecosystems and therefore management of land and water resources should be based on geographic units which account for the interactions between these resources. ● Management of land and water resources must be coordinated. ● Land and water resource management decisions must be based on the best available information. ● Sound land and water management is best achieved through the informed action of all the individual users and managers of these resources. ● For change in resource use to be acceptable and beneficial it must be socially, economically, institutionally and environmentally sustainable. Therefore, a balance between economic development and conservation of land and water resources must be maintained.
Context of implementation	<p><i>Policy/institutional</i></p> <ul style="list-style-type: none"> ● ICM is a community-based policy initiative with no statutory base but is implemented through administrative and financial arrangements of State Government. ● Evolving political and legislative context. <p><i>Environmental</i></p> <ul style="list-style-type: none"> ● Competing and conflicting resource use issues with increasing demands and values being placed on resources for a range of uses. <p><i>Economic</i></p> <ul style="list-style-type: none"> ● ICM program poorly resourced, relying heavily on federal funding with short term financing arrangements and work plans. ● Focus of policy on technical solutions with a failure to clearly address the public and private costs and benefits and their social/ cultural implications. <p><i>Social/cultural</i></p> <ul style="list-style-type: none"> ● Requires voluntary coordinated local community-based support and action in the context of no previous experience in these issues at community level. ● Costs largely borne by individual resource users in the short term, while many benefits accrue to society as a whole.

EVALUATION CRITERIA	EVALUATION MEASURE/INDICATORS	METHODS FOR ASSESSMENT
1. Resource use context	<ul style="list-style-type: none"> • Tractability of resource use issues and tensions in the catchment: <ol style="list-style-type: none"> (a) External environment vigilance in community (b) Extent of catchment resource use and land use practices (c) Community attitudes and behaviour 	<p>Longitudinal study involving:</p> <ul style="list-style-type: none"> • Participant observation at State level policy and program meetings. • Questionnaire surveys of Chairs and Coordinators of all Catchment Committees. • Literature survey including minutes of all State level ICM coordinators meetings, policy releases, reviews. • Analysis of financial and other reports. • Media monitoring and content analysis.
2. Institutional structure	<ul style="list-style-type: none"> • Adequacy of policy frameworks and institutional arrangements to address issues at a catchment scale. • Community capacity to plan and implement catchment management strategy. 	
3. Community process	<ul style="list-style-type: none"> • Adequacy and equity of community processes: <ol style="list-style-type: none"> (a) Mechanisms for communication and interaction on catchment issues (b) Equity of opportunity for involvement (c) Level of strategic alliances/partnerships developed to exploit future synergy 	
4. Technology context	<ul style="list-style-type: none"> • Adequacy of available technology: <ol style="list-style-type: none"> (a) Capability to identify and address catchment resource use issues (b) Technical support for effective implementation of on-ground activities. 	
Key findings	<ul style="list-style-type: none"> • There are clear enough technical solutions to many of the natural resources management problems in Queensland. The biggest obstacle to ICM is the process within the community and within government to redress and prevent resource management problems – political and social processes to apply known technological solutions. • The difficulty of promoting a program with relatively few immediate benefits but often with immediate cost implications for landholders. Those catchments with more apparent and visible resource problems have a better chance of focussing community attention, especially when locals are affected. • While considerable progress has been achieved in some catchments and in some regions, the depth, coverage, and effectiveness of the Queensland integrated resource management system is very patchy. • Catchment Coordinating Committees (CCCs) conduct a wide range of activities reflecting largely the age and maturity of the CCCs. A progression of activities can be recognised through time from organisational activities – public awareness and involvement – issues generation – catchment planning – technical studies. Most respondents believed that support from the general public was low due largely to the public’s low level of awareness about catchment issues. • Dept. of Natural resources (DNR) is the lead agency for ICM which was perceived to be a successful partnership between DNR and the rural land owner interests and not much more than that. There was a widely held view that local governments, both politically and at officer level have not been involved effectively in the ICM process although this is evolving. • There was a disturbing low level of satisfaction amongst the respondents at the state level (especially the Coordinators). CCCs have to contend with low awareness in the general public about resources management issues and a general resistance to external intervention. A surprising, consistent and very significant result from the study was respondents universal view that there is too much government regulation. • There is a clear absence of a ‘whole of government’ approach, commitment or involvement in ICM. State politicians seemed to ignore ICM and there was ineffective, even counter productive involvement of some state agencies. • Financial resources for a program with such ambitious goals has been erratic and low. A key source of funds has been the National Landcare Program, without which ICM would struggle to survive. CCCs are required to find funding on their own initiative rather than use established revenue sources as do most public programs. At present they have no revenue raising capacities and there is a lack of confidence in government funding for implementation, which is of particular concern given that once CCCs have been established and created strategies, their requirement for funds for on-ground works will increase their financial requirements. Planning is inexpensive relative to action. • Providing technical information on natural resources was an effective strategy, but the lack of integration of information providers makes this more difficult. 	

Appendix 2

Case study: Herbert Resource Information Centre

ELEMENT	DESCRIPTION
Issue characterisation	<p><i>Building Stakeholder Capacity</i> Traditionally, most decision-making in planning natural resource use options has been vested with regulatory authorities. In recent years significant changes have occurred to involve the community in the decision-making process. Initiatives are needed to ensure that communities have access to the information needed to underpin this decision-making and to develop the capacity of stakeholders to use that information.</p>
Intent/objective	<p><i>Evaluation</i> Such initiatives will impact on the decision making process. What impacts occur?</p> <p><i>Herbert Resource Information Centre (HRIC)</i> To build capacity for stakeholder participation in resource use planning by providing four fundamental requirements for effective participation:</p> <ul style="list-style-type: none"> ● Effective access to information pertinent to resource use planning; ● Access to the analytical tools required to make effective use of that information; ● The capacity to make appropriate use of those analytical tools and data sets; and ● An organisational structure that fosters effective collaboration.
Instrumental assumptions	<p><i>Evaluation</i> To assess the impact of one such initiative</p> <p>The HRIC structure and functions can deliver the following:</p> <ul style="list-style-type: none"> ● Improved quality of data available for the Herbert catchment; ● Improved access to data; ● Better informed decisions in planning & implementing data collection & use projects; ● Better informed decisions in natural resource management; and, ● Improved collaboration.
Context of implementation	<p><i>Technological</i></p> <ul style="list-style-type: none"> ● Use of spatial data in decision-making is map-based. ● Limited existing GIS capacity used solely for map production. ● No network facilities for data-sharing. ● Existing data dispersed within and between agencies. ● No rigorous data/meta data management. ● High quality base data available from Herbert Mapping Project. <p><i>Institutional</i></p> <ul style="list-style-type: none"> ● Limited use of spatial data within stakeholder groups. ● Very limited sharing of spatial data across groups. ● Limited computing ability in stakeholder agencies. ● Almost no GIS skills. ● Staff willing and able to take on new skills.

EVALUATION CRITERIA	EVALUATION MEASURE/INDICATORS	METHODS FOR ASSESSMENT
1. Operational impacts	<ul style="list-style-type: none"> • Intentions in using new data sets that became available, implications for existing data, constraints to use. • Impacts of involvement in the HRIC on data availability, data collection, data storage, data access, complexity of decision-making, efficiency of decision-making, quality of decisions made, presentation of decisions. • Impact of the HRIC on the resolution of resource management issues within the catchment. • Impacts of participation in the HRIC on the types of activities agency involved in. 	<p>Qualitative research techniques.</p> <p>Individual, face-to-face interviews using a semi-structured interview schedule with key participants in the HRIC each year over three years: 19 in February 1996 (6 months before completion of the joint venture agreement and employment of HRIC staff), 19 in February 1997; 17 in March 1998 (17 interviewees). With some change in key participants a total of 41 individuals were interviewed over the three years with a core group of 7 individuals being interviewed at each of the three times.</p>
2. Evaluation of process	<ul style="list-style-type: none"> • Importance of Herbert Mapping Project in triggering HRIC. • Constraints to use of HRIC. • Impact on other agencies. • Use of the HRIC by non-partners & impacts on those users. • Interaction with other organisations: changes to general levels frequency of interaction; understanding of the objectives of each agency; understanding of the constraints under which each agency operates; understanding of the data needs of each agency, willingness to work with the other agencies, nature and process of interactions, confidence in other groups. • Evaluation of the dynamics of the process (key participants; positives, negatives). 	
3. Changes in understanding	<ul style="list-style-type: none"> • Awareness of the quality and availability of data. • Credibility of data resources. • Understanding of the limitations associated with spatial data. • Understanding of data resources used by other groups in the project. • Understanding of the data needs of other groups. • Most important things learnt from involvement in HRIC. • Understanding of the tractability of resource management issues. • Understanding of the quality and limitations of data; awareness of the availability of data. 	
Key findings	<p><i>Improved quality of data available for the Herbert catchment and improved access to that data:</i> Data access improved dramatically with participants becoming more aware of the range of data available and having access to all but that which was 'commercial-in-confidence'.</p> <p><i>Better informed decisions in planning and implementing data collection and use:</i> While processes for data collection were only moderately impacted for most parties, compatibility with other data had become a significant criteria such that data storage and management collectively and individually had been significantly impacted.</p> <p><i>Better informed decisions in resource management:</i> Formal spatial analyses were being used in planning decisions, often with a substantial cost saving and resulted in decisions perceived to be as good as, and frequently better than, would have been achieved with previous processes.</p> <p><i>Improved collaboration:</i> Willingness to work together increased amongst the partners to the Centre and external use of the HRIC by businesses and the broader community began to occur.</p> <p><i>Contributions to success:</i> The key contributions to the success of the Centre were identified as: skilled professional staff, common goals, lack of pre-existing (and therefore potentially competitive) infrastructure, neutrality of location, credibility, and an evolutionary history.</p> <p><i>Threats:</i> Issues of intellectual property, 'head office' pressures within partners to the initiative, and over-commitment.</p>	

Appendix 3

Case study: development of Landassess DSS for sustainable grazing management

ELEMENT	DESCRIPTION
Issue characterisation	<ul style="list-style-type: none"> • Increasing public concern for resource conservation and environmental quality of our pastoral lands. • Land degradation occurred over a long timeframe of use but a lack of methods for (a) identification of early warning of sustainability problems, or (b) the assessment of potential effects of management options and implications for future use. • Perceived need for government agencies and industry to determine the current state of lands, monitor change and foster a 'voluntary' approach to sustainable land use. • The role and effectiveness of computer-based agricultural IT innovations are being strongly questioned by R&D and industry organisations.
Intent/objective	<ul style="list-style-type: none"> • Develop methods for a computer based decision support system to assess the current state of a grazing management unit (e.g. paddock) and to assist pastoral resource managers to formulate and evaluate alternative strategies for the sustainable use of the management unit. • Better define the role of IT innovations in sustainable resource management. • Develop methods to evaluate the effectiveness of science-based IT innovations for achieving a move toward sustainable resource use outcomes.
Instrumental assumptions	<ul style="list-style-type: none"> • Considerable public and private investment is being made in multiple objective IT innovations to address complex decision-making on natural resource use and management. The expectation being that the technology will increase the effectiveness of decisions and the efficiency of the decision process for individuals and organisations involved with its use. Research supporting such outcomes is generally lacking. • The perceived need for integration of the multiple levels and concerns regarding natural system functionality and grazing impact requires an interdisciplinary approach at scales relevant to grazing management decision-making (i.e. paddock, property). • Evaluations of IT effectiveness generally approached as an applied problem (e.g. user acceptance, level of usage of product, task efficiency, user/ organisational relevance, system functionality and ease of use) and has not recognised IT innovations as social constructs. In particular, the relationship between the collaborative processes involved with most IT development and complex evolving natural and human systems has generally been ignored. • Need to deal with the dynamic and varied situational context of key stakeholders and to manage end user expectations of R&D over a relatively long development timeframes.
Context of implementation	<p><i>Policy/institutional</i></p> <ul style="list-style-type: none"> • New legislation required land managers to demonstrate sustainable use of pastoral lands. • Fragmentation of land management responsibilities for across three agencies with very different 'cultures'. <p><i>Environmental</i></p> <ul style="list-style-type: none"> • Land degradation continuing to occur through impact of grazing of beef cattle. • Large heterogeneous grazing management units. • New management practices changing spatial and temporal distribution of grazing impact. <p><i>Economic</i></p> <ul style="list-style-type: none"> • Industry export-oriented, with fluctuating prices, low input and low return operations. <p><i>Social/cultural</i></p> <ul style="list-style-type: none"> • Divergence of views on what sustainable use means within and between government, industry and the community. • Past focus of industry and government on development (i.e. improving animal production, infrastructure) rather than land resource management. <p><i>Technological</i></p> <ul style="list-style-type: none"> • No system of appraisal of sustainability of pastoral activities exists. • Poor integration, access to, and sharing of existing data and knowledge.

EVALUATION CRITERIA	EVALUATION MEASURE/INDICATORS	METHODS FOR ASSESSMENT
1. Progress toward sustainable grazing resource use:	<ul style="list-style-type: none"> • Contribution to improved interaction and communication on sustainable use of pastoral lands between government agencies. • Contribution to improved understanding of sustainable use in grazing systems to support advisory and extension activities. 	<ul style="list-style-type: none"> • The evaluation involved a collaborative between a scientific research agency and three government agencies responsible for pastoral land management, and grazing industry representatives. The evaluation methods included the assessment of needs, the evaluation of process, and stakeholder reflections on potential impact through: <ul style="list-style-type: none"> (a) process evaluation through documentation of the dynamics of the IT development process and its organisational context; (b) formative evaluation in order to improve the DSS system development process.
2. Stakeholder capacity building	<ul style="list-style-type: none"> • Improved access, sharing and meaningful use of data/knowledge on sustainable grazing practices. • Improvement in analytical capacity to assess current state of the land resource and to formulate and evaluate management options. • Endurance of collaborative R&D alliance. 	<ul style="list-style-type: none"> • An ex poste strategic constituency assessment of key stakeholder group expectations of the effectiveness of the DSS innovation as a product based on stakeholder workshops.
3. Effectiveness of IT development process	<ul style="list-style-type: none"> • Stakeholder satisfaction with level of involvement and influence in IT development process. • Stakeholder views of costs/benefits of collaboration. • Stakeholder satisfaction with relevance, functionality and ease of use of IT product. 	<ul style="list-style-type: none"> • An ex poste strategic constituency assessment of the overall effectiveness of the participative system development process based on face to face interviews using a scenario approach.
Key findings	<p><i>R&D on Sustainability</i></p> <ul style="list-style-type: none"> • IT innovations are characterised by: <ul style="list-style-type: none"> (a) Multiple stakeholders and multiple and evolving objectives. (b) Focus on broad societal purposes, (c) A broad outcomes and impacts (e.g. learning processes and stakeholder behaviour modifications). • Learning processes occur through participatory process of IT development, and the interactive use of an IT tool. • DSS have the potential to foster an adaptive and flexible approach to resource management decision-making at policy, advisory and enterprise levels. <p><i>IT Evaluation</i></p> <ul style="list-style-type: none"> • An iterative, participative and pluralistic approach is needed to evaluate IT development in terms of both a process tool and product success, i.e. one that encompasses: <ul style="list-style-type: none"> (a) Intangible outcomes (e.g. stakeholder learning processes and behavioural change, improved stakeholder relationships and interaction processes, broader societal benefits), and (b) Tangible outputs (e.g. technical quality, institutional efficiency, usage). • Impacts will accrue over a long time frame and are often not visible to beyond the life of the IT development process. 	