

## Chapter 6

### **Breaking down the fences: Engaging stakeholders in integrated catchment management**

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**ABSTRACT:** Management for ecological sustainability cannot be achieved alone by fencing off protected areas within an overall managed landscape (eg. in parks, enclosures). It requires an approach that also addresses the issues associated with transaction costs and the uncertainty and interconnectedness of the behaviour of natural and human systems in a managed landscape. In response to these issues, all Australian governments have endorsed community-based integrated approaches to resource management. These approaches are based on a collaborative partnership between government and the community and as such involve multiple stakeholders with multiple and often conflicting objectives.

This paper examines an integrated approach to catchment management and the challenges of effectively engaging multiple stakeholders. It describes the issues experienced by an Integrated Catchment Management (ICM) organisation in Northern Queensland and the strategy adopted by that organisation to foster stakeholder involvement in ecological sustainable development (ESD). An examination of a number of activities undertaken by the organisation demonstrates how catchment resource use issues are being addressed and the means of engaging stakeholders in ecologically sustainable resource management. In conclusion, we consider, the distribution of outcomes of ICM and their implications for offering incentives for catchment stakeholders to engage in management and planning practices that will potentially impact on the ecological sustainability of the catchment system as a whole.

## INTRODUCTION

An emerging paradigm for natural resource management is based on the two core concepts of ecosystem management and an integrated and adaptive approach to planning and management (Holling 1995, Wallace *et al.* 1996, Gardner and Stern 1997, Bellamy *et al.* 1999). These concepts have significant implications for the practice of conservation and the management of natural resources for ecological sustainability. The new paradigm implies a move away from a single-species, single-unit or single-use management focus toward a systems approach designed to ensure the long-term health of ecosystems and the preservation of biodiversity that extends across traditional management boundaries. The implications are also that ecological sustainability cannot be achieved alone by fencing off protected areas (eg. in parks, enclosures) within an overall managed landscape. The conservation of biodiversity and sustainable use of natural resources needs to be an integral part of an overall strategy for natural resource management that encompasses all elements of the landscape or regional ecosystem and its interaction with human management and use.

Under the new paradigm, sustainable use and management of ecosystems and other elements of biological diversity requires cooperative processes in planning and on-ground implementation of management strategies. These cooperative processes are expected to be inclusive of all managers responsible for the management of the multitude of inter-linked units of the landscape. Managers include not only individual landholders or resource users within a catchment or a regional ecosystem, but also organisations in all spheres of government, industry and the community with some role and responsibility or interest in the use, management and conservation of the natural resource. In response to the needs of the emerging paradigm, all state governments in Australia have endorsed integrated approaches to the planning and management of natural resources based on collaborative partnerships between government, industry and the community (Syme *et al.* 1994, Bellamy and Johnson 1999). Although implementation contexts and policy mechanisms may vary greatly, all of these approaches involve multiple stakeholders and are inherently characterised by multiple and often conflicting objectives and values. As such they invariably require negotiation and bargaining processes as stakeholders attempt to address conflicts from a broader systems perspective extending across traditional decision-making boundaries.

This paper examines an integrated approach to catchment management and the challenges of effectively engaging multiple stakeholders. It describes the issues experienced by an Integrated Catchment Management (ICM) organisation in Northern Queensland and the strategies being

used by that organisation to foster stakeholder involvement in Ecological Sustainable Development (ESD). An examination of a number of activities undertaken by the organisation demonstrates the challenges of addressing resource use issues at a catchment scale and engaging stakeholders in the process.

## **ECOLOGICAL SUSTAINABLE DEVELOPMENT AND MANAGED SYSTEMS**

The three fundamental underlying assumptions of ESD are environmental sustainability, social well-being and economic development. In the first place, ESD places a burden of responsibility on all decision-makers including national, state and local governments, local communities, industry and individuals to take a long term perspective and commitment to achieving ecological sustainability. Secondly, it requires that social, economic and environmental issues are considered as essential components of natural resource management and planning. To this end, collaborative approaches based on systems thinking and systemic behaviour are increasingly being advocated to change the culture of decision-making of individuals, organisations and communities (Ison *et al.* 1997, Chambers 1997, Bellamy *et al.* 1999). The core principles of this systems approach are:

- (i) the long-term sustainable use and management of natural resources;
- (ii) the application of technically-sound environmental, economic and social assessment methods and understanding;
- (iii) the coordination of government, industry and community policies and decision-making processes; and
- (iv) the reconciliation of conflicting values, interests and expectations of stakeholders involved in the use and management of resources through more transparent structures of negotiation and bargaining.

The central challenges of a systems-based approach therefore include firstly addressing the issues associated with the heterogeneity, uncertainty, nested nature and interconnectedness of the behaviour of natural and human systems, and secondly ensuring that the distribution of the costs and benefits of resource management are appropriate.

### **Operationalising ESD**

In the past, natural resource management and planning has invariably relied on top-down centralised governance. This has been typically expert-driven, single-agency initiated and enforced, frequently regulatory-based, and technocratic in practice (Wallace *et al.* 1996, Bellamy and Johnson 1999, Dale and Bellamy 1998). The organisational structure of federal and state government agencies typically involves centralised decision-making in which legislation and regulatory arrangements are passed by the respective governments with the objective of regulating and managing the use of natural resources at the management unit level, such as a farm, reserve, local government area, catchment or region. Examples of these approaches include conservation within protected areas (eg. parks and reserves), emission permits, water entitlements, land clearing permits, and tax/subsidy measures designed to equate social and private costs and benefits of resource use.

Approaches to natural resource policy based on centralised governance however have not generally lead to changes in the behaviour of individuals and communities toward more sustainable resource use and development (Vanclay and Lawrence 1995, IC 1997, Dale and Bellamy 1998). A review of the literature identifies a number of failures of centralised governance responses including:

- (i) simplistic solutions and linear cause-and-effect assumptions that fail to deal with the uncertainty, complexity, and multi-dimensionality of the problems being addressed (Funtowicz and Ravetz 1990, RAC 1993, Dovers 1996);
- (ii) the failure to recognise ESD as a continuous evolving process rather than a particular system state for which to aim (Bellamy *et al.* 1999);
- (iii) the failure to address the distribution of costs and benefits of policy impacts (ANAO 1997, MDBC 1996);
- (iv) flawed policy responses that de-emphasise the consideration of affected interests in favour of “objective” analyses and suffer from a lack of popular acceptance (Renn *et al.* 1995);
- (v) an almost exclusive reliance on systematic observations and general theories that tends to ignore the local and anecdotal knowledge of the people most familiar with the problem and risk producing outcomes that are socially and economically unworkable (Renn *et al.* 1995);
- (vi) uncoordinated, compartmentalised or sectorally-based implementation of policy, programs and planning initiatives (Bellamy and Johnson 1999);
- (vii) the lack of appropriate institutional arrangements to facilitate participation that is inclusive of all interests in the community (Lang 1990);
- (viii) the weaknesses of the strategies adopted to resolve conflict (Dorcey 1991); and
- (ix) the failure to move beyond the development of management plans to on-ground implementation (Dale and Bellamy 1998).

In Australia “the incorporation of ecological sustainability into policy has been ad hoc, incomplete and tentative” with continuing land degradation the major barrier to sustainable resource use and development (IC 1997, p.48). Despite favourable attitudes and known solutions, appropriate practices in many cases are not being adopted at the farm or management unit level (Vanclay and Lawrence 1995, ANAO 1997, IC 1997). This apparent contradiction has been attributed to a wide variety of social, economic, cultural, perceptual and situational reasons. Curtis and Lockwood (1998) contend that “most natural resource degradation results from the activities of people and improvement will only happen when people alter their behaviour” and that this requires “understanding of the organisation, beliefs and aspirations of people” (p.2).

To-date the achievement of a balance between environmental sustainability and social and economic objectives have been one of the major challenges to operationalising ESD. In practice, the social objectives have been frequently sidelined. In response, stakeholder-based approaches are emerging as a new approach to decision-making based on an adaptive approach to ecosystem management, social learning processes and collaborative decision-making (Wallace *et al.* 1996, Chambers 1997, Ison *et al.* 1997, Bellamy *et al.* 1999). Local groups in the community that have an identifiable ‘stake’ in the future of the community are linking together to create a vision for the future which has a set of goals and measurable criteria or indicators. This approach has the potential to engage stakeholders in ESD and enable the community to move forward together so that decisions are based on a shared set of values.

### **Issues in Engaging Stakeholders in ESD**

As Renn *et al.* (1995) point out, “There is no such thing as a single ‘public interest’. Rather, society consists of individuals with unique sets of interests, some of which are identical to those of others, and collectivities of people which form shared interests” (p.2). A stakeholder is “anyone who has an interest in or is affected by an issue, activity or transaction and therefore has a natural right to participate in decisions relating to it” (FAO and UNEP 1997, p.25). Stakeholders include not only those people having or needing access to, or use, or control of a

resource, but importantly also those who are affected by the use of a resource by others, and those who wish to influence the decisions of others with regard to the use of a resource for scientific, ethical or other reasons. Stakeholders include both present as well as future generations.

Approaches that are inclusive of all stakeholders however are proving challenging to put into practice both in Australia (Syme *et al.* 1994, Bellamy *et al.* 1999) and internationally (Dorcey 1991, Gunderson *et al.* 1995, Gardner and Stern 1996). In this section of the paper we discuss four key issues that constitute fundamental challenges to the implementation of stakeholder-based approaches:

- *participation*, that is dealing with the vast heterogeneity of interests and social values of the multiple stakeholders concerned.
- *coordination*, that is coping with the fragmentation of roles and responsibilities for natural resource management across multiple organisations within and between all three spheres of government (federal, state and local), industry and the community.
- *reducing uncertainty*, that is dealing with the uncertainty and ignorance which is an inherent characteristic of the interaction of human and natural systems (Funtowicz and Ravetz 1990).
- *cost-sharing*, that is addressing the distribution of public and private costs and benefits and their social impact.

#### *Participation*

The shift in focus of theories of social organisations from the individual to the community and the increasing emphasis on partnerships between the government and community in natural resource management and planning imply increased empowerment of local communities (Orstom 1990, Gardner and Stern 1997, Chambers 1997). Participatory approaches that foster purposeful and meaningful stakeholder involvement are perceived as potential or partial solutions to empowering communities to engage in ESD (Hollick 1993, Renn *et al.* 1995). As Gardner and Stern (1997) observe:

*The needs to understand the actor's perspective, attract people's attention and gain their commitment, monitor and adjust programs, and design interventions that are within people's limits of tolerance all point to participatory processes as a solution (p.169).*

Participation is concerned with interaction among individuals, interest groups and institutions. Central to the philosophy of participation is a focus on both shared values and interests and learning processes:

*By participating with others in democratic decision-making, people learn they have things in common. By bonding together, they can achieve goals and meet their needs. They also discover that other groups and individuals have interests and values in direct contradiction to their own. Resolving the conflict is not always the main purpose of participation, but acknowledging it is important. (Renn *et al.* 1995, p. 8).*

Participatory processes designed to engage a broad spectrum of stakeholders with often conflicting objectives are perceived to have a number of significant benefits (Syme and Sadler 1994, Hanna *et al.* 1995, Moote and McClaren 1997, Gardner and Stern 1997, Chambers 1997) including:

- prevention or amelioration of conflict;
- promotion of perceptions of fairness that lead to the design of policy or programs that lead to a more appropriate distribution of the costs and benefits of resource management in practice;
- attracting stakeholder attention to issues and setting more realistic expectations of the outcomes of a policy initiative or planning process;
- gaining commitment of multiple actors and the development of trust in the planning process or policy initiative;

- enhancing understanding of a policy initiative or planning process and a broader view of the key issues;
- enhancement of stakeholder information exchange and learning;
- improving stakeholder acceptance or ownership of the results or outcomes;
- generating feelings of personal satisfaction and control;
- designing interventions that are within people's limits of tolerance;
- supporting continuous stakeholder involvement and providing effective feedback mechanisms; and
- reducing the costs of information gathering, coordination, monitoring and achieving compliance.

Although a philosophy of participation has become widely accepted, there are considerable challenges in its implementation. Martin and Sherington (1997) caution that there is a significant gap between the rhetoric and reality in participatory approaches:

*Participation has become institutionalised into a requirement in project design, rather than an indication of the more radical reversal of approach and attitude advocated in the participatory research. .... Implementation of the empowerment agenda has been limited.* (Martin and Sherington 1997, p. 197).

Despite these challenges, we contend that participatory decision-making has the potential to provide a viable alternative to centralised, top down approaches to natural resource management. The principal intent of participatory decision-making in natural resource management through partnerships between government and community is to help organise an effective interaction program or process to achieve ESD goals. Perceived influence in decision-making is a fundamental element affecting such partnerships (Syme *et al.* 1997). Moreover, meaningful influence over the direction of a planning process or policy is a core principle of participatory approaches (Gardner and Stern 1997).

#### *Coordination*

Closely linked to the concept of participation in natural resource management and planning processes is a philosophy of coordinated government processes conducted in partnership with the community (Lang 1990, RAC 1993, Holling 1995, Gardner and Stern 1997, Dale and Bellamy 1998). Hall *et al.* (1977) define coordination as “the extent to which organisations attempt to ensure that their activities take into account those of other organisations” (p.457).

The degree to which there is communication and coordination between government and other relevant organisations is one of the fundamental factors underlying the effectiveness of partnerships in planning (Syme *et al.* 1997). Coordination in this sense is a way of trying to avoid overlaps in responsibility and conflicting messages from different organisations. Moreover, coordination may lead to significant reductions in transaction costs relating to data collection, analysis, design and implementation of regulations, communication, and conflict resolution (Hanna *et al.* 1995). In particular, Marshall *et al.* (1997) regard the reduction in transaction costs associated with negotiation over the use or management of resources over which there are no clear property rights as a major economic benefit from the process. Transaction cost savings are identified as being associated not only with bargaining for property rights over resources but with the flow of information and with the enforcement of solutions to resource degradation problems.

In light of the integrative nature of the new paradigm of natural resource management, coordination of policy and planning processes is therefore a fundamental challenge of stakeholder-based approaches to ESD.

#### *Managing Uncertainty*

Most resource management and planning contexts are faced with incomplete knowledge that leads to uncertainty or ignorance (Funtowicz and Ravetz 1990, Dovers 1996). Dealing with uncertainty and ignorance is a central challenge of ESD. As Funtowicz and Ravetz (1990) state, the challenge is that facts are uncertain, values in dispute, stakes high and decisions urgently needed. Also, there is considerable uncertainty about others' actions or behaviours.

There are many different forms of 'ignorance', which have different implications for resource management policy and planning (Dovers 1996). Dovers (1996) observes that neither type nor level of ignorance will be uniform across individuals, stakeholder groups, communities or organisations, "either in the sense of differing levels of access to, or possession of knowledge, or in the sense of varying perspectives, values or preferences" (p.17). Ignorance may be realised, unrealised, socially constructed or technically based. Effective management of ignorance and uncertainty across and within stakeholder groups in terms of type, level, equity of access and use, and their variation over time are fundamental challenges of the meaningful and equitable engagement of stakeholders in natural resource management and planning processes.

#### *Cost-sharing*

There is growing expectation in government and the community that stakeholders with common interests will share responsibility for sustainable natural resource management and planning for the long-term health of our natural resource base (ANAO 1997, IC 1996, 1997, MDBC 1996). Communities and governments are making long term investments in natural resource management infrastructure and other on-ground works. There is considerable social conflict however relating to the fairness of cost-sharing arrangements, that is, whether paying for sustainable natural resource management is a private, public or shared responsibility among resource users, the community and the three spheres of government.

An acceptable cost-sharing mechanism may improve the basis for negotiation for resource use planning and management by providing a principled and objective approach to determining the public and private benefits of on-ground works, such as revegetation, the fencing off of sensitive areas and water supply (MDBC 1996). To this end, cost shares represent the true split of benefits between individual landholders and the public (MDBC 1996, p.13). Benefits may relate to increased production, social and environmental benefits, and other goods and services produced by the works, while costs may relate to implementing and maintaining the works, production foregone, and monitoring the results of the works (MDBC 1996, p.5). Types and levels of benefits and costs, particularly environmental and social, will vary spatially across the landscape and over time, which introduces significant challenges to the achievement of the social justice aspects of ESD.

It is argued that communities and resource users will only accept cost-sharing arrangements and on-ground works after trusting partnerships have been developed, and after satisfactory levels of education and demonstration have been achieved (MDBC 1996, p.14). Stakeholder perceptions of levels of public and private benefits derived from policy implementation (eg. involving on-ground works) and the fairness of necessary cost-sharing arrangements will have an important influence on negotiation in natural resource management and planning.

#### *A way forward?*

Stakeholder-based approaches to sustainable resource use and management are still experimental, and much is to be learned from systematic study of such programs and their interactions with people, groups and organisations. The significant challenges posed by participation, coordination, uncertainty and transaction costs associated with the management of natural resource problems have influenced the effectiveness of these approaches. The next section of this paper examines

these issues in the context of a community-led stakeholder-based approach to integrated catchment management.

## **BREAKING DOWN THE FENCES: A COMMUNITY-BASED APPROACH**

### **Integrated Catchment Management in Queensland**

As one of the key platforms for operationalising the concepts of ESD, the Queensland Government established a stakeholder-based approach to natural resource planning and management through an Integrated Catchment Management (ICM) policy initiative. The overall purpose of ICM in Queensland is “to integrate the management of land, water and related biological resources to achieve their sustainable and balanced use” (DPI 1991). The ICM program is intended to promote and facilitate community involvement in the development and implementation of a coordinated approach between resource users, community groups and government agencies to the planning and management of natural resources.

The implementation of ICM in Queensland is based on the establishment of Catchment Coordinating Committees (CCCs) which provide a forum for discussion between various stakeholder interests in the catchment. CCCs work with and through existing organisations and agencies and as such do not have specific legislative support. The principal intent of the ICM approach as implemented by the Queensland Government may be summarised as (DPI 1991, Rowland and Begbie 1997):

- *Voluntary*: participation in ICM is voluntary for both community and government.
- *Community-based*: all structures have a majority of community members with formation of catchment coordinating committees (CCCs) being dependent on interest from the community and other sectors.
- *Partnership*: ICM is based on a partnership between the levels of government, industry and the community with all sectors and key stakeholders involved. As the CCCs do not have any legislative framework or statutory base, implementation of ICM strategies relies on negotiated and voluntary action by responsible agencies and individuals.
- *Participative*: all processes used in coordinating and integrating management of the catchment should be participative and consultative.
- *Strategic*: ICM is intended to be a strategic and long-term planned approach to achieving action in addressing priority natural resource management issues in the catchment that cross organisational boundaries.

To-date ICM programs have been implemented in 34 rural catchments in Queensland covering nearly 80% of the area of the state. The impact of land use on water quality, soil erosion and sedimentation of watercourses, salinity induced through clearing of vegetation, loss of habitat on land in rivers and streams, the impact of land and water use on freshwater and marine ecosystems, the spread of weeds by water and competition for land and water resources have been identified as important issues requiring a new catchment approach. These issues involve not only interaction between many components of a river catchment, but also many individuals and organisations, including landholders and other resource users, government agencies, local authorities, conservation groups and rural industry groups, each with a responsibility for different parts of a catchment or specific activities within it. Importantly, they require decision-making that extends across traditional property and other administrative unit management boundaries.

In the following sections, we draw on findings from a 5-year longitudinal study undertaken to monitor and evaluate the implementation of the ICM process in the Herbert River catchment of wet tropical north Queensland (Bellamy and Johnson 1999, Bellamy *et al.* 1999) to shed some light on some of the issues relating to stakeholder engagement in this community-based approach

to ESD. A brief overview of the Herbert River catchment and initial progress in the ICM process are provided in a companion paper in this volume by Johnson and Bellamy (1999).

## **Herbert River ICM Process**

### *Background*

ICM in the Herbert River catchment is a community-led and voluntary process in a formative stage initiated by key interests in the catchment. The impetus for the establishment of the Herbert River Catchment Coordinating Committee (HRCCC) in 1993 related to two key factors. Firstly, broad community-based concern over the ineffectiveness of fragmented government decision-making on river management issues, and the failure of past studies to move beyond the development of plans and lead to action on the ground to resolve these issues. Secondly, the perceived need within the catchment for more active and meaningful community involvement in decision-making on these issues, that is beyond a basic consultative approach.

The objectives of the ICM process in the Herbert Catchment have evolved since its inception to encompass a broader and more 'holistic' set of objectives as identified by the HRCCC in its draft Catchment Management Strategy (HRCCC 1996, p.i):

- Co-ordinate government agencies and the community to pursue common goals
- Seek community involvement in catchment management
- Reflect the requirements of the wider community within the Catchment
- Identify and rectify natural resource degradation
- Promote ways to prevent and reduce natural resource degradation
- Promote the wise use of all natural resources within the Catchment
- Identify key indicators of biodiversity and monitor as a measure of catchment health
- Encourage the retention of significant natural habitats within the Catchment.

Although these broad objectives are couched in terms that suggest an overall policy framework for the catchment, ICM has no legislative jurisdiction in Queensland. Success therefore will depend to a considerable extent on the degree to which the Herbert ICM process can engage public and private interests in a substantive way to voluntarily effect required action.

### *Engaging stakeholders in ICM in the Herbert River Catchment*

The approach to the implementation of ICM in the Herbert River catchment in its early stages has been pragmatic and opportunistic motivated initially by a perceived need to raise the awareness of the organisation and natural resource management issues in the catchment and to "get runs on the board" (Bellamy and Johnson 1999). As such the Herbert River ICM process provides an opportunity to examine some of the broader issues relating to the engagement of stakeholders in ESD identified earlier in this paper.

### *The Herbert River Catchment Coordinating Committee*

As previously noted the principal intent of a stakeholder-based approach to natural resource management like ICM in the Herbert Catchment is to help organise an effective stakeholder interaction program or process to achieve ESD goals. This requires broad stakeholder recognition of the legitimacy of the HRCCC as a community-based organisation concerned with facilitating a move toward ESD in the Herbert River catchment. To this end, the HRCCC involves representatives of a broad range of rural industry, community and local government and other statutory organisations that have an interest and/or role in natural resource management in the catchment (Table 1). As such, the membership reflects the influential groups, power structures, and prominent community interests in the catchment. In 1998, the HRCCC had a local Chairman and 16 other members representing community, industry and local government and statutory bodies in the catchment. A full-time Catchment Coordinator facilitates the process.

Nine of the current members (50%) have been involved with the HRCCC since its inception in March 1993. Most of the members are active community members with multiple sectoral interests or 'hats'. Eleven of the seventeen HRCCC members are either sugarcane farmers or employed within the sugar industry reflecting the economic, social and cultural importance of the sugar industry in the lower Herbert catchment community.

**Table 1: HRCCC Sector Group Representation.**

<b>Industry:</b>	<b>Community:</b>	<b>Government/Statutory Authority:</b>
CANEGROWERS (1)	Recreational/Sporting Fishing (1)	Hinchinbrook Shire Council (3)
CSR Herbert River Mills (1)	Landcare (1)	Herberton Shire Council (1)
Cattlemans Union (1)	Wildlife Preservation Society of	Herbert River Improvement
Horticulture/Rare Fruits (1)	Queensland (1)	Trust/Drainage Boards (1)
Queensland Commercial Fishing		Hinchinbrook Development Bureau (1)
Organisation (1)		Herbert Pest and Productivity Board (1)

Significantly, in 1998 the HRCCC has no formal State government agency representatives although officers from the Department of Natural Resources may participate in meetings. The Catchment Coordinator is funded from the federal government's National Landcare Program with additional support provided by the Department of Natural Resources, the lead government agency for ICM in Queensland. In addition, local stakeholder groups including Local Government and sugar industry bodies have provided in-kind support in terms of office accommodation, administrative support and their HRCCC member's time. State and federal government grants that are awarded through a competitive bidding process also provide financial support for many on-ground HRCCC activities. Through involvement in HRCCC meetings and activities, ICM in the Herbert Catchment is attempting to engage a range of key stakeholders in ESD.

Table 2 identifies some of the activities undertaken by the HRCCC and the types of stakeholders that have been engaged by them. It is important to note, however, that the HRCCC does not work in isolation from government agencies, community groups or industry support organisations. The HRCCC works to co-ordinate the activities of all interested organisations and influence catchment decision-making on natural resource issues. As a result the possible outcomes from many of the activities undertaken by the HRCCC cannot be attributed solely to the endeavours of the HRCCC but to a cooperative effort from a number of organisations. We briefly discuss in the remainder of this section of the paper some of these activities in more detail.

#### *Catchment Management Planning*

The HRCCC's approach to ICM focussed in the first instance on establishing a legitimate role and building a credible and influential organisation dealing with natural resource management. To this end, the HRCCC prepared a Catchment Management Strategy that provides a vision for the future management of the Herbert River catchment's natural resources (HRCCC 1996). It was prepared by HRCCC members through a series of working groups and internal workshopping and released for public comment in June 1997. The strategy suggests a "community-based approach to solving problems – an approach that integrates the needs of individuals, community groups and industry" (HRCCC 1996, p.1).

**Table 2. Examples of the range of stakeholders engaged in HRCCC Activities and the level of community influence**

<b>HRCCC ACTIVITY</b>	<b>Catchment Community</b>	<b>Individual Land Managers</b>	<b>Rural Industry Organisations</b>	<b>Local Government, Statutory Bodies</b>	<b>State Government Agencies</b>	<b>Research/Industry Support Organisation</b>
Catchment Planning: <ul style="list-style-type: none"> <li>• Management Strategy</li> <li>• Catchment Atlas</li> </ul>	✓ ✓	✓	✓	✓	✓	✓ ✓
Riparian/wetland Management: <ul style="list-style-type: none"> <li>• Community forum</li> <li>• Riparian Mapping</li> <li>• On-farm advice</li> <li>• Artificial wetland development</li> </ul>	✓	✓ ✓ ✓	✓ ✓	✓ ✓ ✓	✓ ✓ ✓	✓ ✓
Land Use Change/Caneland expansion: <ul style="list-style-type: none"> <li>• Wharps area rural drainage</li> <li>• Shire Planning Scheme</li> </ul>	✓	✓	✓	✓ ✓	✓ ✓	
Water Quality: <ul style="list-style-type: none"> <li>• Tin mining dam inventory</li> <li>• Acid Sulfate Soils Awareness</li> </ul>	✓ ✓	✓ ✓		✓	✓ ✓	
River Management: <ul style="list-style-type: none"> <li>• Bank stabilisation (Long Pocket)</li> </ul>		✓		✓		
Pest/Weed Management <ul style="list-style-type: none"> <li>• Owl Boxes</li> </ul>	✓	✓		✓		✓

The strategy itself is issues-based and it identifies a broad range of priority management and planning issues, which are summarised in Table 3. Specifically, the strategy discusses key management and planning issues, identifies what needs to be done, who should take responsibility for undertaking the work and how the issue is to be addressed. An example of a strategy and the stakeholders to be involved is provided in Table 4. The strategy's issue focus is consistent with Laut and Taplin's (1989) view that an emerging trend for catchment management would be to concentrate on *issues* rather than on establishing a holistic strategic management approach in the catchment. Importantly, it clearly identifies the need for a coordinated effort amongst stakeholders in order to address these issues and move the community towards achieving ESD.

In a survey of HRCCC members conducted in 1997, Bellamy *et al.* (1998) found that the strategy was considered to provide an overall direction to the group and a guide for future actions. For example, it identifies issues, prioritises needs, identifies stakeholders and their roles, and in general provides an initial reference point for the HRCCC. In addition, the strategy helped to get resources and support for ICM in the Herbert River catchment, such as continued funding for a Catchment Coordinator and natural resource management projects. Once State Government endorsement is obtained, members expected it would provide the basis for gaining commitment of responsible State Government agencies to undertake projects in the Herbert catchment to address these issues. Importantly, the development of the Catchment Management Strategy is perceived by members to have been of value because of a number of qualities and outcomes of the development process that include:

1. *inclusive and transparent* to all members involved; bringing all viewpoints across organisations on issues together and out into the open.
2. *establishing a clear direction* for the HRCCC; helping to focus the HRCCC as an organisation and providing an overall vision for the catchment.
3. *raising awareness* of catchment issues; especially improving Committee member's awareness of issues as well as other stakeholder's viewpoints on those issues.
4. *highlighting areas of common ground*; by identifying areas of agreement across diverse sector groups on some catchment issues, it provided a basis for the Committee to move ahead and develop better natural resource management and planning projects.

The final endorsement of the strategy is currently being negotiated with the relevant State government agencies. Planned improvements to the strategy will address their concerns relating to better recognition of indigenous land issues and an apparent over emphasis on state government activities and responsibilities in addressing some catchment issues, that is the need better recognition of local community responsibilities and action

**Table 3. Issues and key strategies identified in the Herbert River Catchment strategy (HRCCC 1996).**

Key Issues	Recommended Strategies	
<p><b>Land Management (LM)</b></p> <ul style="list-style-type: none"> <li>• Inappropriate land use allocation and its impact on resources and natural systems</li> <li>• Impacts of land management on productivity</li> <li>• Impacts on other values of land and adjacent land and water resources</li> </ul>	<p>LM1 LM2 LM3 LM4</p>	<p>Coordinate land use planning to achieve balanced use of land, water and related natural resources Encourage best management practices in all rural industries Implement arrangements to reduce adverse impacts of agricultural drainage on natural systems and existing developments Reduce adverse impacts of non-agricultural land uses.</p>
<p><b>Water Management (WM)</b></p> <ul style="list-style-type: none"> <li>• Full and over-allocation of existing resources</li> <li>• Increasing demands on finite surface and groundwater supplies</li> <li>• Limited monitoring of water quantity and quality</li> <li>• Threats to quality of surface and groundwater supplies</li> </ul>	<p>WM1 WM2 WM3 WM4 WM5</p>	<p>Assess available resources and develop appropriate allocation policies in consultation with stakeholders Promote efficient use of water resources within the Catchment Promote the coordinated planning and implementation of water management schemes in the catchment Reduce contaminant inputs to surface and groundwater systems from point and diffuse sources Establish and promote water monitoring priorities and standards for the catchment.</p>
<p><b>Stream Management (SM)</b></p> <ul style="list-style-type: none"> <li>• Lack of awareness of stream values shown in development actions</li> <li>• Stream bank erosion and stream migration</li> <li>• Sedimentation</li> <li>• Impact of uncoordinated levee banks and flood mitigation schemes</li> <li>• Impacts of degradation of riparian zones</li> <li>• Instream habitat degradation such as weed invasion and loss of water holes</li> </ul>	<p>SM1 SM2 SM3 SM4 SM5 SM6</p>	<p>Continue implementation of a strategic approach to stream management Facilitate appropriate protection and management of riparian zones throughout the catchment Ensure development and engineering works associated with streams take account of all stream functions and issues Identify and protect sensitive areas, to retain the function and health of our stream systems Develop fisheries and habitat management plan for the stream systems of the catchment, involving stakeholder groups and the broad community Provide community awareness, support and involvement in stream management</p>
<p><b>Habitat Management (HM)</b></p> <ul style="list-style-type: none"> <li>• Threats to significant terrestrial and aquatic habitats and species</li> <li>• Loss of wetland and instream habitat quality and subsequent impacts on fish stocks</li> <li>• Fragmentation of remaining habitats through loss of connectivity (ie. corridors)</li> </ul>	<p>HM1 HM2 HM3 HM4 HM5</p>	<p>Promote the values of habitat retention and restoration to the broader community through awareness, technical support and incentives Maximise the habitat values of existing protected areas Ensure the retention of significant habitat values outside protected area reserves Protect and rehabilitate wetland habitats on the Floodplain Re-establish and manage riparian vegetation on watercourses throughout the catchment and ensure retention of existing riparian vegetation.</p>

**Table 4. Example of the format for a strategy as identified in the Herbert River Catchment Management Strategy (HRCCC 1996).**

#		*
CCC	Catchment Coordinating Committee	1. Immediate, commences within 6 months
DEH	Department of Environment and Heritage	2. Short-term, commences within 12 months
DNR	Department of Natural Resources	
DPI	Department of Primary Industries	
LG	Local Government (Hinchinbrook and Herberton Shire Council)	

What is to be done?	Who can do it? <sup>#</sup>	Priority <sup>*</sup>
<b>Strategy HM1: Promote the values of habitat retention and restoration to the broader community through awareness, technical support and incentives</b>		
a) Provide technical support in the areas of: <ul style="list-style-type: none"> <li>• land development planning</li> <li>• habitat retention</li> <li>• habitat management</li> </ul>	DEH, DPI, DNR	1
b) Encourage all levels of Government to provide for habitat management through realistic incentives and/or sufficient funding.	CCC, LG	1
c) Develop and promote awareness programs to highlight the values of habitat retention and implement through farm planning	DEH, CCC, DPI, DNR	2

*Riparian and wetland management*

The HRCCC has identified wetlands destruction and riparian zone management as some of the major issues needing to be addressed at a catchment level. The mangroves and wetlands of the Herbert River Catchment are of national and local significance. However their distribution has been dramatically reduced since European settlement due to the expansion of agriculture, particularly the rapid expansion of the sugar industry on the coastal floodplain of the Herbert River. Significantly, Vella (1997) found that the conservation of wetlands and mangroves has been ineffective in the Herbert floodplain because of fragmented management arrangements, a failure to address environmental issues in the rural land development process and limited ability of government authorities to control harmful land management practices particularly on freehold land. This potentially could lead to high transaction costs in negotiating the appropriate management of riparian areas with relevant authorities. To this end, the HRCCC has facilitated artificial wetland development on-farm (with sugar cane producers) and supported their development on public lands (eg. jointly with the local sugar miller and the Hinchinbrook Shire Council to establish a wetland using sugar mill liquid waste and treated sewerage effluent).

The HRCCC has been successful in bidding for funding, through DNR, and implementing the mapping of riparian vegetation on the Herbert River floodplain (Petroeschovsky 1997). This information has been used to encourage the adoption of a flexible system of riparian zone width assessment with landholders and which is now being incorporated within the new Hinchinbrook Shire Council planning scheme for the lower catchment. It is also underpinning the development of a catchment rehabilitation plan. In addition the HRCCC, initiated a Riparian Community Forum in the catchment involving key invited speakers from government, the research community and industry to raise awareness of the need for better riparian and wetland management on the Herbert River floodplain.

*Integrated pest management*

Closely associated with activities to manage vegetation in riparian zones have been activities to encourage farmers to engage in ecologically sustainable pest management practices. A specific activity undertaken by the HRCCC has been the establishment of approximately 55 owl boxes throughout the lower catchment. Owl populations on the Ingham coastal lowlands, including

both the Barn Owl (*tyto alba*) and the Barking Owl (*ninox connivens*) have dropped noticeably over the last five years (John Young 1998 *pers. comm.*). Reduced populations have been attributed to the clearing of native vegetation to accommodate the expanding sugar industry resulting in the destruction of nesting habitats and hunting perches. In addition, the possibility of secondary poisoning linked to rat baits has been suggested (John Young 1998 *pers. comm.*). By establishing nesting boxes and hunting perches for owls in areas which have virtually been cleared of native vegetation, hunting perches have been provided which has increased the owls' hunting range and increased their chance of survival in a changed habitat.

Halvorsen (1998) reports that "a single owl family can eat over 2,000 rats per year" (p.6). Aside from the number of rats an owl family can physically remove from the environment, there is some potential for owls to disrupt the breeding cycle of rats, further reducing their population. Rat damage to cane in the Herbert River District has been estimated by the Herbert Cane Protection and Productivity Board (HCPPB) to range from 28,265 tonnes in 1993 to 6,576 tonnes in 1997. The farm-gate value of the damage to cane in the Herbert District is estimated to have been \$763,155 in 1993 and \$177,552 in 1997, or, 7% of the value total cane production in the district in 1993 and 1% of the value of production in 1997. The cost of establishing 55 owl boxes across the lower catchment has been estimated by the HRCCC as \$4,000. The HCPPB as well as DNR have made contributions towards the cost. In addition, community members have made contributions in the form of voluntary labour.

The value of reduced rat damage to cane production does not need to be significant to show a return to the investment to establish owl boxes across the catchment. Specifically, the value of the avoided cost of lost cane production would need to be approximately \$350 per annum (constant 1998 prices) over a 20 year period to offset the initial establishment costs and periodic maintenance work (assuming a discount rate of 0.06 per cent). Possibly the primary value of establishing owl boxes around the cane growing district is that they have raised the awareness of the catchment community to the advantages of encouraging farming practices to manage riparian vegetation as a wildlife habitat. Not only was this activity undertaken with the objective of promoting ecologically sensitive farming practices by cane farmers, it also represents a coordinated effort with the HCPPB, DNR, local wildlife enthusiasts and landholders.

#### *Land development planning*

A major achievement for the HRCCC has been its role in influencing the incorporation of ICM principles into the new Hinchinbrook Shire Planning Scheme (McDonald and Bellamy 1997). This Plan makes a strong commitment by local government to natural resource management on rural lands for the first time. It establishes a broad intent to conserve natural resources such as wetlands and riparian lands that will be implemented through development assessment and environmental impact assessment. Most importantly the scheme defines sugar production as intensive agriculture which is a regulated use in the scheme. If the political will is there to implement this plan to its full potential, it will enable the Shire Council to conserve significant habitats and implement ICM objectives by placing conditions on new agricultural land development.

Significantly, this development has contributed to the improved communication and coordination of effort between local government, state government agencies and stakeholder groups within the catchment, which has reduced the possibility of high transaction costs when the plan is implemented. It is currently being formalised as a streamlined process for agricultural land development involving the HRCCC, Hinchinbrook Shire Council, the Department of Natural Resources, the Department of Environment and the Local Sugar Board (DNR 1998).

### *Water quality*

Water quality has increasingly been recognised within the local community as a major issue of concern, both in relation to town water supplies in the lower catchment and the potential detrimental impact on the adjacent Great Barrier Reef lagoon. To address this issue the HRCCC has supported two key activities. The HRCCC first negotiated funding for an inventory in the upper catchment of relict alluvial mines and tailing dams, which could adversely affect downstream water-users, natural drainage in the Lower Herbert, and the biodiversity of aquatic habitats. This was a potentially divisive issue between the upper and lower catchment communities resulting from poor domestic water quality at certain times in the lower catchment, as well as concerns that increased sedimentation from abandoned mine waste was reducing the river capacity and contributing to greater flooding problems. Secondly, the HRCCC has promoted and publicised the risk of acid sulphate soils in the lower floodplain in the public media (eg. in the local newspaper), by distributing informative pamphlets to residents and by facilitating a community workshop. Of particular importance is the risk of acid sulphate soils in the coastal wetlands of the Herbert floodplain. Disturbance of wetlands as a result of drainage works and agricultural development in the Herbert coastal wetlands has led to acidification of adjacent waters (with pH levels as low as 2 or 3) and have been locally linked to fish kills.

### *The outcome*

These issues show that ICM in the Herbert River Catchment is contributing to improvement in the engagement of catchment stakeholders in ESD through increased community participation and better coordination of decision-making on natural resource management and planning in the catchment which could lead to reduced transaction costs when management plans are implemented. In addition, ICM in the Herbert has contributed to improved understanding and communication of information on natural resource management issues amongst catchment stakeholders. However a major challenge to achieving significant ESD outcomes relates to cost-sharing, that is, the distribution of public and private costs and benefits and their social implications. Importantly those who bear the costs of sustainable resource management may not either directly or indirectly reap the benefits. In addressing natural resource management issues, private benefits accrue to resource users and other private individuals, while public benefits accrue to the broader community (ANAO 1997, MDBC 1996). This issue poses real challenges for a voluntary community-based process like ICM in Queensland in achieving real on-ground outcomes. The next section of this paper uses a case study of the economic evaluation of activities to manage riparian vegetation undertaken by the HRCCC to discuss this challenge. This discussion is based on the findings of a more detailed economic evaluation of ICM as an organisation in the Herbert River catchment reported in Robinson *et al.* (1999).

### **Costs and benefits of riparian vegetation management: a case study**

Although previous studies (CANEGROWERS 1998, LWRRDC 1996, SEAC 1996) have listed the potential benefits of revegetating riparian areas, few studies have established the distribution of the costs and the potential benefits (Robinson *et al.* 1999). This is important information because authorities cannot rely on moral suasion alone to encourage farmers to undertake the required investment. Farmers need to know what are the likely initial outlays, the likely loss of income and the potential return. In situations where farmers cannot be shown to benefit then there is potentially room for assistance.

### *Riparian vegetation management and the Herbert River Catchment*

Protecting riparian vegetation has been a contentious issue for the HRCCC. McDonald and Bellamy (1997) cite a number of planning issues that need to be addressed by the HRCCC in relation to the management of vegetation in riparian zones. These include: should there be a

buffer zone along watercourses or preferred flow-paths? What constitutes a watercourse? How wide should the buffer zone be? And what management requirements apply to the buffer? There is currently no legislation to protect riparian vegetation beyond the top of the stream bank, except on leasehold land. Although there is no legislation to protect riparian vegetation on freehold land, it is recommended that, for the wet tropical coast, the vegetated riparian zone should be at least 20m each side of the banks of all minor watercourses, wetlands and drainage lines, and at least 40m each side of major watercourses (DNR 1998, p.13).

A report on the state of the rivers and streams in the Herbert River catchment describes the general state of vegetation in riparian zones as being poor to very poor (DNR 1996). The poor quality of the vegetation is attributed to the narrowness of the vegetation that has not been cleared for agricultural purposes and to the level of exotic plants present within the area (p.ii). Two issues arise for management of riparian vegetation: increasing the area and improving the quality of the vegetation.

A recent mapping project of riparian vegetation areas in the lower Herbert River catchment, supported and partly funded by the HRCCC, recommends that the riparian zone requirement be re-addressed to be sensitive to the local circumstances and needs. Specifically, it is suggested that the width of the buffer zone should be a product of consideration towards the risk of flood and bank erosion (Petroeschovsky 1997). This recommendation is supported by the DNR (1998) which suggests that riparian vegetation zone boundaries should be determined by consideration to ecological factors including a combination of topography, vegetation type as well as its effectiveness in flood conditions.

As the majority of agricultural land in the lower catchment is freehold land, the only course of action available to authorities managing these areas is to improve landowner and community awareness of the importance of maintaining vegetation in riparian zones. Activities undertaken by the HRCCC to address the management of vegetation in riparian zones meet their stated objectives of encouraging the retention of significant natural habitats within the catchment and also of promoting ways to prevent and reduce natural resource degradation (see Table 3).

#### *Overview of costs and benefits*

There is considerable support for riparian zone vegetation management from natural resource research organisations including SEAC (1996), LWRRDC (1996), DNR (1996, 1998) and sugar industry support organisations including the CANEGROWERS (1997, 1998), Sugar Research and Development Corporation and the Bureau of Sugar Experimental Stations. Management of riparian zones to encourage the retention, revegetation or rehabilitation of these areas with appropriate vegetation is believed to contribute towards:

- Stabilising the banks of rivers and creeks and helping to reduce slumping and undercutting. In addition, some of the energy of water flow during flooding is absorbed by riparian vegetation that can reduce erosion and scouring of adjacent land.
- Providing a natural habitat and source of nutrients for river plants and wildlife.
- The provision of shade which inhibits the growth and spread of grass and exotic plants. This results in the improved drainage of natural watercourses, which might otherwise be choked by exotic weeds and grasses. By reducing the light and heat reaching the stream, riparian vegetation improves the habitat for fish and crustaceans. In addition, the reduction in the growth of grass reduces the population of rats in these areas protecting the cane from destruction by rats.
- Water quality improvements. Riparian zones provide a buffer between terrestrial and aquatic ecosystems preventing nutrient and insecticide run-off into watercourses. Water quality improvements may reduce the number and/or size of fish-kills.

- In addition to these potential benefits it is claimed that rivers and creeks which have retained vegetation are aesthetically appealing and provide a valuable asset for local enjoyment as well as for eco-tourism.

There are, however, significant costs associated with the management of vegetation in riparian zones that need to be considered. These include the cost of establishing or rehabilitating vegetation in the area as well as loss of production from land, currently under crop, which would need to be revegetated. In the lower catchment, loss of agricultural production would be primarily sugar cane. This agricultural land, because of its proximity to a river or creek, is generally regarded as highly productive. In the upper catchment, grazing properties would potentially lose stock access to a water source.

To off-set reduced production resulting from loss of farm land in the lower catchment, there is the possibility of reduced rat damage to cane and a reduction in the infestation of cane land by exotic weeds. In addition, riparian vegetation can absorb some of the force from flood waters, reducing cane loss attributable to scouring and deposition of sediments. CANEGROWERS (1997) estimates the potential value of the avoided loss of cane production resulting from scouring, which has a probability of occurring during a major flood event (1:10 years), to be \$1,000 for a 100 ha farm. Some protection of river or creek banks from erosion and protection of farmland from scouring and sediment deposition is possible in the Herbert River catchment if riparian zones are suitably vegetated (Kinhill Cameron McNamara 1991). These benefits are not necessarily enjoyed by all cane farmers but by those located in susceptible areas where washaways and scouring have historically been a problem. The period over which the cane is waterlogged and the maturity of the cane would determine the magnitude of the cane loss following a major flood event.

In some areas, the riparian vegetation provides a buffer, acting as a barrier between aquatic and terrestrial ecosystems. Water quality improvements are cited as a benefit of riparian vegetation, which can act as a sink for agricultural run-off and inhibit the growth of exotic aquatic weeds that can deplete oxygen levels in streams. These water quality improvements could potentially reduce the magnitude of fish kills.

Qualitatively, there are potentially significant benefits if vegetation of riparian zones is established where there is none, rehabilitated where it is not sufficiently wide or requires more appropriate vegetation or rehabilitated if it is infested with exotic plants. To quantify and estimate a monetary value for all of the potential benefits is difficult because detailed information about the willingness of people to pay for these benefits, which are not marketed, is currently unavailable. However, estimates can be made of the potential productivity benefits and of some water quality benefits. The costs associated with the initial establishment of vegetation in riparian zones and of reduced production resulting from land being taken out of production also can be estimated.

The potential benefits associated with the establishment of vegetation in riparian zones do not accrue to specific persons or groups of people. Specifically, a farmer undertaking investment to increase or establish the vegetation of a riparian zone on his/her property is not able to exclude others from enjoying the benefits associated with the establishment of this area. These potential benefits include improved water quality flowing down stream, or catching fish in a natural habitat on the farm. In addition, the removal of exotic plants from the area is likely to not only improve the drainage of water through an individual farmer's property but could also improve flows upstream. In brief, the farmer does not have a property right over the benefits (externalities) created as a result of establishing or rehabilitating vegetation of a riparian zone on his/her property. Neither is the farmer able to exclude others from enjoying all of the benefits he/she

has created. This raises the issue of “user pays” where those who enjoy the benefits from vegetation of riparian zones are not necessarily the same people as those incurring the costs. The distribution of the costs and benefits associated with establishing vegetation in riparian areas is contentious.

*The estimated cost of establishing vegetation in riparian zones*

There are two primary sources of cost associated with the establishment of appropriate vegetation in riparian zones. The first is the cost of planting trees in these areas (assuming trees are appropriate). The second is the opportunity cost of the land. This cost is primarily on-farm loss of production as land is taken out of agricultural production (in the lower catchment this is assumed to be sugar cane production). Estimates of the cost of establishing vegetation in riparian zones require assumptions to be made about the extent to which an area requires re-establishment or rehabilitation. In particular, many riparian areas will require some level of restoration rather than complete revegetation.

A number of assumptions have been made to estimate the cost of establishing vegetation in a riparian area. In the interests of reasonable brevity, these assumptions are provided in Table 5. More detailed discussion about these assumptions is provided in Robinson *et al.* (1999). Estimation of the possible income loss to individual farmers as caneland is taken out of production, to establish riparian vegetation, highlights the possible disparity in the ability of growers to absorb the loss. The potential income loss and the ability of the grower to absorb the loss will impact on the willingness of a grower to engage in environmentally sustainable farm management practices.

**Table 5. Assumptions underlying cost estimates for vegetating a riparian zone**

<b>Cost Component</b>	<b>Cost Assumption</b>	<b>Range of Estimate</b>
Extent of Vegetation Required	a) Total re-vegetation (5,000 trees per ha)	3,000 – 5,000 trees per ha
	b) Some re-vegetation and Rehabilitation (2,000 trees per ha)	1,000 – 3,000 trees per ha
	c) Minor tree planing (500 trees per ha)	100 – 1,000 trees per ha
Cost of planting and maintaining trees	\$3.00 per tree	\$2 - \$4 per tree
Width of buffer zone	40metres	15 - 40metres

The estimated income loss, expressed as a proportion of total income from the growing of sugar cane, across the entire cane growing district is relatively small (approximately 0.5 of one per cent per annum). However, if the income loss is expressed as a percentage of an individual farmer’s total income, the loss can be shown to be significant. A number of scenarios have been developed to show the magnitude of the estimated relative income loss to cane farmers according to the size of their cane assignment. Three sizes of cane assignment have been considered distinguishing between cane farmers with an assignment which reflects the financial position of farmer who is marginally viable (40 ha assignment); secondly, a farmer who has a slightly larger assignment and is able to absorb some of the income loss (65ha assignment), and thirdly, a farmer who has a 100 ha assignment and is able to achieve economies of scale and where the income loss is likely to be absorbed. If these individual farmers had a one-kilometre length of their farm riparian to the Herbert River or Stone River and were required to vegetate a 40 metre zone which was currently under cane, they would incur a loss of their annual income. The results are provided in Table 6. Table 6 shows that if a cane farmer with a 40ha assignment to grow cane was to take 4ha out of production to revegetate a riparian zone, then his/her income loss would be 10 per cent of his/her total income from cane production per annum. On the other hand, a cane farmer with a 65 ha assignment would incur an income loss per annum of 6 per cent and for

a farmer with a 100 ha assignment, the per annum income loss is estimated to be 4 per cent of total income from cane. Thus the costs to farmers of taking the riparian zone out of cane (that is, the opportunity cost of the land) is not equitably distributed across all growers.

**Table 6. Likely cost to cane farmers to revegetate a 4ha riparian zone**

<b>Size of Cane Assignment (ha)</b>	<b>Cost to Establish Vegetation (\$)</b>	<b>Percentage annual Income Loss (%)</b>
40	60,000	10
65	60,000	6
100	60,000	4

*Summary of findings*

For an individual cane farmer required to totally revegetate a 4ha riparian area and for whom the only benefit is a reduction in damage by rats, the return on his/her investment over a period of 20 years, using a discount rate of 6 per cent is estimated to be \$206.00. This is not substantial. Indeed, it would take 20 years for the farmer to show a positive return. This situation has important implications for the HRCCC and for all organisations promoting the revegetation of riparian areas. The investment is not significantly attractive for farmers and additional incentives may need to be offered.

There are other benefits however, many of which are potentially enjoyed by the catchment community and society as a whole. These benefits include those associated with improved water quality, specifically an improvement in fish habitat and a reduction in the size and number of fish kills as well as the aesthetic improvement of water courses. Summary information about the magnitude of potential costs and benefits is provided in Table 7.

The implications arising from these estimates, which it is stressed are based on a number of simplifying assumptions, is that there are considerable costs associated with the establishment of vegetation in riparian zones. The cost to individual landowners is potentially significant. The benefits arising from re-vegetating these areas are not contained solely on an individual farm and an individual farmer cannot prevent others from enjoying the benefits from these areas. It would therefore appear to be appropriate for authorities wishing to encourage the establishment of vegetation in riparian zones to offer incentives to individual farmers.

**Table 7. Summary estimates of potential costs and benefits of riparian vegetation**

<b>COSTS</b>		<b>BENEFITS</b>	
<b>Component of Cost</b>	<b>Estimated Value</b>	<b>Identified Benefits</b>	<b>Estimated Value</b>
Re-vegetation (105 km)	\$2,055,100	Integrated Pest Management – reduced rat damage to cane	\$171,460 per annum
		Improved water quality – reduced fish kills	\$19,500 per annum
Loss of cane production	\$27,165per annum	Reduced cane loss from scouring	\$97,200 (1:10 years)
		Reduced cane loss from weed inundation	\$54,000 (1:7 years)
		Aesthetic benefits including increased owl population	Not valued

**CONCLUSIONS**

The principal challenge for the HRCCC has been to ‘break down the fences’ and facilitate a move toward a coordinated effort that extends across traditional land management decision-making boundaries so that the priority natural resource issues in the catchment can be addressed. The

community-based ICM process has revealed that although there is significant agreement amongst the diverse stakeholder interests in the catchment on the key issues that need to be addressed, understanding on the underlying causes and potential solutions vary considerably. The HRCCC has to-date largely focussed on issues for which in general there is much common ground on the way to proceed amongst stakeholder groups. It has yet to take a lead role, however, in progressing some of the more contentious resource management issues within the community (eg. drainage coordination, and fish kills in the lower floodplain adjacent to areas of intensive use). In an evaluation of the initial progress after four years of ICM in the Herbert, Bellamy and Johnson (1999) have identified the key HRCCC achievements as:

- (i) Initiating a limited range of focussed land management projects to establish credibility and raise awareness of ICM process and natural resource management in general with the Herbert community (rather than focussing on issues of strategic importance to catchment management).
- (ii) Gaining recognition as a legitimate community referral agency for the state and local government authorities on proposed developmental and infrastructure projects and other natural resource issues in the catchment.
- (iii) Development of a Herbert River Catchment Management Plan that provides the essential elements of a 'sustainable' vision for the catchment.
- (iv) Establishing a lead role within the Herbert River community as principal broker negotiating funding for industry and community groups to undertake natural resource management projects and activities in the catchment.
- (v) Providing an effective community forum for discussing and progressing catchment issues, including revealing the range of different stakeholder perspectives on these issues as well as highlighting potential areas of community conflict.
- (vi) Information provider and disseminator through HRCCC meetings providing a 'community forum', initiating focussed activities that locally have a relatively high profile, as well as through the existing communication networks of HRCCC member organisations.

Although progress may be perceived to be slow and limited to-date, these achievements indicate that significant improvements have occurred. These improvements are laying the foundation for a fundamental change in the attitudes and behaviours of key community leaders, as well as the overall approach to the management and planning of the catchment resources.

In summary, the Herbert River ICM process has revealed that the potential benefits from a community-based ICM approach to engaging stakeholders in ESD primarily relate to three key factors. The first relates to better coordination and communication in stakeholder planning processes. Improved coordination has a range of potential impacts including better identification of the underlying dimensions of natural resource problems, improved communication on natural resource issues amongst catchment stakeholders and better negotiation over ways of addressing problems. These in turn can potentially provide a basis for the avoidance of infrastructure damage and a reduction in downstream impacts of resource use. Secondly there is potential for a significant reduction in transaction costs with increased collaboration between catchment stakeholder groups. This will lead, for example, to greater exchange of information on natural resource issues and related decision-making through the HRCCC providing an effective community forum, as well as improved processes for negotiation over property rights leading to the potential avoidance of legal or regulatory action. In brief ICM can be regarded as a vehicle to reduce transaction costs which will in turn improve the allocation of resources. Finally, ICM has the potential to reduce uncertainty amongst stakeholders through, for example, raised awareness of others views, raised awareness of natural resource issues amongst stakeholders, better exchange of information, an improved technical knowledge base, and greater cooperation amongst catchment stakeholder groups. In this regard, information about the distribution of the

potential costs and benefits associated with activities to improve the condition of natural resources could assist ICM organisations to apply for funding to support or improve the uptake of on-farm natural resource management. As such, ICM can support the development of greater community trust in decision-making process. In conclusion, through fostering focussed activities, the ICM process has engaged the members of the Herbert community in practices, which if they continue to be more widely adopted will contribute significantly to a move toward ESD in the long term.

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