Improved Integrated Resource Planning in the Australian Sugar Industry

Final Report to the Sugar Research and Development Corporation

June 2002

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Project number CTA039

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Principal Investigators

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CSIRO Sustainable Ecosystems & CRC for Sustainable Sugar Production

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- Vickie Webb and Duncan Chalmers (Sugar CRC) took a lead role in the Moreton and Herbert case studies respectively.
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Executive summary

The Australian sugar industry is at the crossroads. Responding to the challenges that it faces requires technical, institutional and social innovation. In responding, the sugar industry requires a capacity to deal effectively and efficiently with the economic, environmental and social consequences of alternative change pathways. This requires working to improve the planning capacity in cane growing regions. This project attempted to address this difficult challenge in two cane growing regions (the Herbert and Sunshine Coast / Moreton Mill) with the intention of generating learnings that could be applied to other sugar cane growing regions.

The project sought to develop, apply and test a range of initiatives to underpin improved regional resource use planning by:

- facilitating structured negotiation between sugar industry sectors;
- facilitating use of technical information by the sugar industry;
 and
- supporting the industry to negotiate with other sectors and explore implications of future resource use options.

The Project has delivered a range of outputs and outcomes including the following:

- improved planning capacity within stakeholder groups:
- greater interaction among government, sugar industry and the community;
- improved negotiation processes through the development and implementation of novel participatory planning methodologies;
- a decision support framework that enables stakeholders to access, integrate and use R&D outputs; and
- a rigorous evaluation of the project that allows insights gained from this Project to be useful for planning in other sugar catchments.

Evaluation of the two case studies provides insights into the extent to which planning capacity has developed. Development was stronger on the Sunshine coast than in the Herbert. Increased participation of key stakeholders on the Sunshine Coast has been a notable achievement and is an important contribution of this research to the industry's future. The establishment of a Sunshine Coast working group and the Herbert Regional Industry Board demonstrates an ongoing commitment to integrated approaches in both case study regions. The sugar industry in the Sunshine Coast has a clearly articulated vision and plan for its future in the region. By contrast, this has not been achieved to the same extent in the Herbert.

The outputs and outcomes of this research have wider relevance. An immediate impact has been the transfer of tools and process innovation to underpin the development of agri-industry futures in the Douglas Shire. Structures, mechanisms and techniques developed will be accessible through a Resource Book that will be delivered by December 2002.

Two key conclusions emerge from this study. The first relates to the role of decision support systems in regional planning processes, while the second the deals with participatory approaches to underpin improved planning.

This Project provided insights into the role of decision support systems and requirements for success. We argue that decision support systems have an important role to play dealing with increased information, coping with complex decisions and providing decision-making transparency. Our experience in this project demonstrates that successes in the use of NRMtools (the decision support environment developed) and analogous systems relate to turning information into insight through user learning. Thus capacity building through learning may be a more appropriate objective for decision support projects.

In terms of participatory approaches to R&D, research organisations have only recently begun to understand the complexity associated with natural resource planning and management. Our experience in this project and others has demonstrated that adoption of participatory approaches required 'opening up' our scientific practice. This however, can present serious challenges. Some of the challenges in this Project were:

- *uncertainty and ambiguity* partnerships evolve unpredictably and understanding and objectives change.
- transaction costs building understanding, relationships and trust and managing expectations are extremely time consuming and expensive.
- representation working with the 'right' people is fundamental to success
- *mandate of the researcher to the region* ensuring that researchers have a clear view of their role and mandate in the region.

To respond to these challenges in the future, R&D providers will need to:

- build improved relationships and linkages with clients;
- recognise formal stakeholder analysis and client involvement in planning;
- ensure research evaluation for participatory projects;
- take a more active role in communication with clients and stakeholders:
- commit resources to facilitate the strengthening client and stakeholder capacity;

- enhance the capacity of their staff in participatory methods and their implications for project management;
- recognise the complex nature of participatory R&D by introducing greater flexibility to budget, recruitment, and project management;
- acknowledge the demands placed on scientists by participatory approaches; and
- improve mechanisms for facilitating client representation in research management.

As a consequence of this research, we make the following recommendations.

Recommendation 1: The sugar industry, local, State and Federal government and R&D providers work together to develop and implement regional action plans to underpin the industry's transition to the future.

Recommendation 2: Regional plans should be: underpinned by technical and economic analyses; embedded in whole-of-industry and government policy frameworks; linked to continuous economic, environmental and social improvement; challenge existing paradigms; and remove impediments to innovation.

Recommendation 3: Further research relating to decision support in the sugar industry should focus tools to help users to understand the systems that they are managing rather than tools for routine decision-making.

Recommendation 4: Further R&D investment should focus on building understanding, partnerships and capacity to facilitate evidence-based negotiation of resource use options in cane growing regions.

1. Background

The Australian sugar industry has made a major contribution to the economic and social development of northern Australia in general, and Queensland and northern New South Wales in particular. In the past, the industry has demonstrated that it is capable of adapting to changing conditions to remain competitive in the market place. This capacity for change is under intense pressure at present, with the industry needing to adapt to a commercial environment in which producer prices are at their lowest levels ever. In nearly all catchments where sugar cane is grown, land is also attractive to other agricultural uses, urban development, tourism, recreational uses, public utilities or forestry. The type of expansion experienced in the sugar industry following the introduction of the Sugar Industry Act 1991 is therefore unlikely to be possible in the near future. The expansion of other land uses is more likely, and this would reduce the area under production and hence threaten mill supply. Maintaining adequate mill supply to service capital investment and associated infrastructure and to return a profit is critical for mill sustainability. On top of this, the industry faces increasing public scrutiny of its environmental performance, specifically with respect to perceived negative impacts on ecologically sensitive areas of high conservation value adjacent to sugar growing regions.

In the free-market economy, profitability is the pre-requisite for sugar industry sustainability in the long term. Co-dependency among sectors of the industry means that, in order to have a viable industry, each of the sectors must be profitable in its own right. The emergence of Brazil as a low-cost, high-quality sugar producer with world market dominance has profound consequences for the economic viability of the Australian sugar industry. This challenge can only be met through innovative restructuring of the industry, which increases productivity, and drive costs down. These strategies might include value adding of growing, milling, and by-product utilisation systems to ensure long-term economic and environmental sustainability.

Intense controversy has arisen over the sugar industry's environmental performance. The location of the industry in a region of high conservation value, with an increasing profile, makes such controversy inevitable. The key issues currently relate to water quality and impacts on coastal and reef ecosystems. Land clearing would become a major issue again if the industry sought to expand onto the remaining fragments of ecosystems with high conservation value. The sugar industry is seeking continuous improvement in environmental performance. Being a partner in catchment-scale environmental and social planning processes, developing soundly based targets for environmental performance, supporting integrated land and water management practices and implementing monitoring programs are all integral parts of this strategy.

Responding to the set of economic and environmental challenges that face the sugar industry is likely to require a delicate and comprehensive blend of technical, institutional and social innovations. The sugar industry requires a capacity to deal effectively and efficiently with the environmental and economic consequences of its changing infrastructure needs, including strategic planning for expected expansions, contractions and re-allocations of land. Environmental impacts will need to be assessed against alternative land use options. This requires working to improve the planning capacity of all sugar industry groups and other stakeholder groups with responsibilities in natural resource management. involves improving the integration of data into the planning process. while, at the same time, improving the interactions between all stakeholder groups. Ideally, this is an on-going process, with built-in evaluation and adaptation that enables planning to keep pace with changing participants and demands.

This project specifically sought to take an integrated approach to facilitating the development of resource use planning processes that are better able to balance economic, social and environmental targets and constraints across all sectors. We focussed our efforts in two case study regions, with the intention of generating learnings that could be used or applied with modification to other sugar cane growing regions. At the outset, it was anticipated that successful completion of this project would result in the development of effective methods for evaluating the sustainable expansion, contraction and reallocation of land in the sugar industry, and that, effective collaboration with sugar industry stakeholders would ensure that these methods became an integral and accepted component of sugar industry planning.

2. Methodology

2.1 Overview

This project set out to develop, apply and test a range of research initiatives designed to underpin improved regional resource use planning in Australia.

The project was based on the following propositions:

- **1.** That the regional planning process in the sugar industry, as elsewhere, is constrained by:
 - limited capacity for evidence-based resource use negotiation in regional Australia,
 - poor integration of data and knowledge into planning,
 - limited structures for balanced negotiations among regional stakeholders,

- inadequate resources for regional stakeholders to build capacity, and
- limited evaluation of planning processes, and
- **2.** That, to be effective, research interventions should seek to:
 - build technical foundations in the form of appropriate, accessible and integrated bio-physical, social and economic data and knowledge,
 - build capacity (resources, infrastructure, skills, time) for participation by all sectors with an interest in an industry or resource base.
 - develop institutional effectiveness (the right structures for new challenges, appropriate relationships across scales of influence), and
 - evaluate learnings from these interventions to continuously improve practice

The project therefore sought to facilitate structured negotiation between sugar industry sectors, facilitate use of technical natural resource management information by the sugar industry, and to support the industry to negotiate with other sectors and explore implications of future resource use options.

The research was, by necessity, highly participatory. The specific contributions from the research team within the participatory framework were to:

- advance understanding of regional, natural, financial, physical, human and social capital of the industry through analyses,
- provide access to information and analytical frameworks for decision-making,
- work in partnership to broker analysis and build capacity, and finally,
- on the basis of this experience, develop generic approaches through the evaluation of case studies.

See Walker, Cowell and Johnson (2001) for a further discussion of these propositions.

The research team did not seek to develop resource use plans per se, as this was the role and mandate of our partners in industry, the community and government. Rather we sought to enable the development of planning process, outputs and outcomes.

2.2 Core Components

In order to facilitate strategic planning at the catchment / mill area scale, the research team undertook activities of five distinct categories, as follows:

- 1. analysis to underpin decision-making processes in regional scale resource use planning,
- **2.** development of improved tools to enable better integration of the information and other analyses into natural resource planning for the sugar industry,
- **3.** development of participatory planning activities to facilitate the development of negotiated approaches to integrated resource use planning.
- **4.** application of these participatory approaches in partnership with industry stakeholders.
- **5.** evaluation, reflection and adaptation.

2.3 Case study approach

The research methodology, by necessity, involved the development of partnerships with industry and regional stakeholders. In order to develop sufficiently effective partnerships to provide insights into issues of process and content, it made sense to adopt a case study-based approach. The two case study regions (the Herbert River district and the Moreton Mill area on the Sunshine Coast) were selected to provide a comparison of the range of regional challenges facing the industry. The two regions are compared in summary in Section 4.

2.4 Evaluative frameworks

An evaluation framework was developed and applied over the life of the project with the intent of ensuring that (a) the research was adaptive and responsive within case studies and (b) that the project resulted in generic insights into best practice that could be applied in other regions.

The evaluative process entailed a mix of methods. It involved formal evaluation by an external consultant (questionnaire and phone survey), participant observation, reviews of milestone reports, presentations, minutes of meetings, and so on, through the life of the project, and mapping of participation in the processes, mapping of changes in linkages and logging the use of information, resources and tools.

The results of the evaluations are reported in Section 7.

2.5 Pathways to implementation

The project was designed to have an on-going impact through its implementation in the case study regions, but also beyond those regions.

The partnerships established within the two case studies were designed to be self-sustaining beyond the life of the project. In addition, the evaluation of the case studies was designed to provide the basis for disseminating key findings beyond those case studies. The suite of approaches to disseminating results is described in Section 9.

3. Linkages

This research forms one axis of an integrated suite of three research activities:

- **1.** Improved integrated resource planning in the Australian sugar industry (CTA039) funded by the Sugar Research and Development Corporation,
- **2.** Integrated resource planning in the Australian sugar industry (1.2.2) funded by the CRC for Sustainable Sugar Production, and
- **3.** Implementation of a planning systems approach for improved management of natural resources in the Australian sugar industry (CTC17) funded by Land and Water Australia.

Previous research funded by the SRDC and CRC Sugar developed, implemented and evaluated a method and supporting software systems for participative and integrative decision support for natural resource management at a catchment scale (SRDC project CTA013). The activities reported here build upon this work.

There has been considerable overlap in the scope and direction of these activities, although each has had its own emphasis and focus, as follows.

The SRDC research reported here has explored the role and application of negotiated planning approaches for natural resource planning in sugar catchments. Particular emphasis has been placed in this work on the role of data, information and knowledge in informing, focusing and underpinning negotiated approaches to rural land use planning.

The Sugar CRC research reported here has (a) developed analytical approaches to the integrated evaluation of economic and environmental implications of land use changes in the sugar industry (b) facilitated their further development and application in the Herbert River district.

The LWA activity focused particularly on brokering the development of local capacity and structures for stakeholder participation, negotiation and implementation in the Moreton Mill district.

4. Case study regions

Management of resource use clearly operates at a variety of scales. Government and industry bodies generally function at the larger scale of the industry as a whole on a national or state-by-state basis. Their role is to interface the industry within the country with the international playing field, in terms of commodities and policies. At the other extreme, individual farmers make decisions about on-farm management practices within existing legislative constraints. The middle ground, the regional planning, is where broader-scale resource use management interface with actions on the ground. Hence changes occurring at international, national and state levels may have quite different impacts at regional scales

The sugar regions of eastern Australia are highly variable (see Figure 1 and Table 1), but can be divided into four groups: major sugar growing regions, such as the **Herbert**, Burdekin, Bundaberg and Mackay; significant sugar growing regions, but adjacent to large urban populations, such as **Sunshine Coast (Maroochy)**, Maryborough, and Mulgrave; medium level sugar regions, such as **Mossman**, Harwood (NSW), Tully, Proserpine, Sarina, and Innisfail; and small sugar regions such as the Tablelands, Ord (WA), Brisbane, Tweed (NSW) and Broadwater (NSW).

The Herbert and Sunshine Coast were used as case studies for this research as they represent contrast cases of the regional diversity of the sugar industry. This section presents a description of the two based on data available through the sugar industry and various other statistical sources. The Mossman Mill district is also included because lessons from the two principle case studies have been further developed and refined through application in that region (see Section 9, Pathways to Implementation).

These three regions can be demonstrated to be representative of different 'types' of sugar region.

Table 2 and Figure 2 represent a simple process of normalizing and then clustering regional characteristics



Figure 1: Initial sugar 'regions' used for determining statistical areas to produce Table 1.

Table 1: Initial Sugar regions

| Sugar Region | Statistical Local Area | Main residential areas | Mills | Cane Suppliers | Assignment Area ha (Qld - 1999, Other 1998) | Tonnes Cane (1999) |
|--------------|---|---|----------------------------------|-------------------|---|--------------------------|
| Mossman | Douglas | Craiglie, Mossman, Port Douglas | Mossman | 275 | 15,162 | 1,062,084 |
| Mulgrave | Cairns (C) - Barron, Mt Whitfield, Trinity, Western Suburbs, Pt B | Cairns, Gordonvale, Kuranda, Yarrabah, Babinda, Mirriwinni | Mulgrave, Babinda | 519 | 32091 | 1,997,694 |
| Tablelands | Atherton, Mareeba | Atherton, Mareeba, Yungaburra | Tableland | 78 | 6,712 | 480,442 |
| Innisfail | Johnstone (S) | Innisfail, Johnstone South, Mission Beach, Wongaling Beach | Mourilyan, South Johnstone | 581 | 35,336 | 1,900,006 |
| Tully | Cardwell (S) | Cardwell, Tully | Tully | 333 | 29,302 | 1,609,466 |
| Herbert | Hinchinbrook, Thuringowa (C) - Pt B | Allingham, Ingham, Lucinda | Macnade, Victoria | 814 | 65,582 | 4,151,742 |
| Burdekin | Burdekin (S) | Ayr, Home Hill | Invicta, Pioneer, | 797 | 83,888 | 8,492,601 |

| | | | Kalamia, Inkerman | | | |
|----------------|--|---|--|------|--------|-----------|
| Proserpine | Whitsunday (S) | Proserpine, Cannonvale, Airlie Beach | Proserpine | 256 | 24,716 | 1,956,154 |
| Mackay | Mackay (C) - Pt A, Mackay (C) - Pt B, Mirani | Glenella, Mackay, Marian, Walkerston | Farleigh, Racecourse, Pleystowe, Marian | 1174 | 97,287 | 6,627,998 |
| Sarina | Broadsound, Sarina | Sarina | Plane Creek | 214 | 23,086 | 1,768,288 |
| Bundaberg | Bundaberg, Burnett (S) - Pt A, Burnett (S) - Pt B, Isis, Kolan | Childers, Gin | Fairymead, Millaquin, Bingera | 836 | 53,003 | 3,806,672 |
| Maryborough | Hervey Bay, Maryborough, Tiaro, Woocoo | Hervey Bay, Maryborough, Tin Can Bay | Isis, Maryborough | 410 | 34,595 | 2,326,409 |
| Maroochy | Caloundra (C) - (Caloundra N., Kawana), Maroochy - (Buderim, Coastal North, Maroochydore, Mooloolaba, Nambour) | Caloundra, Coolum Beach, Maroochydore- Mooloolaba, Nambour | Moreton | 165 | 9,701 | 451,824 |
| Brisbane | Beenleigh, Eagleby, Mt Warren Park, Windaroo- Bannockburn, Coomera-Cedar Creek, Hope Island, Oxenford, Carbrook- Cornubia, Redland Bay | Beenleigh, Helensvale, Redland Bay, Victoria Point | Rocky Point | 105 | 9,047 | 334,555 |
| Tweed | Tweed, Currumbin Waters, Mudgeeraba | Bogangar, Gold Coast-Tweed Heads (Tweed Hds Pt), Murwillumbah | Condong | 142 | 8,324 | 668,818 |
| Broadwater | Ballina, Byron, Casino, Lismore, Richmond River | Ballina, Casino, | Broadwater | 192 | 13,994 | 983,390 |
| Harwood Island | Copmanhurst, Maclean, Ulmarra | Iluka, Maclean, Yamba | Harwood | 262 | 12,056 | 811,678 |
| Ord | Wyndham-East Kimberley | Kununurra, Wyndham | Kununurra | 20 | 3,585 | 411,658 |
| | | | | | | |

These regions were normalised (using 'z' scores) against population, cane farmers, tonnage and area of cane to produce Table 2.

| Regions | Populations | Cane | Areas of | Tons of |
|-------------|-------------|-----------|----------|---------|
| 8 | P | Suppliers | Cane | Cane |
| Mossman | 77 | 38 | 58 | 51 |
| Mulgrave | 2.03 | .37 | .04 | 10 |
| Tableland | 60 | -1.00 | 89 | 77 |
| Innisfail | 59 | .57 | .16 | 14 |
| Tully | 88 | 20 | 06 | 27 |
| Herbert | 76 | 1.29 | 1.27 | .86 |
| Burdekin | 61 | 1.24 | 1.94 | 2.79 |
| Proserpine | 75 | 44 | 23 | 11 |
| Mackay | .60 | 2.41 | 2.43 | 1.96 |
| Sarina | 90 | 57 | 29 | 20 |
| Bundaberg | .46 | 1.36 | .81 | .71 |
| Maryborough | 1.33 | .04 | .13 | .05 |
| Maroochy | 2.15 | 73 | 78 | 78 |
| Brisbane | .30 | 91 | 80 | 84 |
| Tweed | .33 | 80 | 83 | 69 |
| Broadwater | .23 | 64 | 62 | 55 |
| Harwood | 71 | 42 | 69 | 62 |
| Ord | 88 | -1.18 | -1.00 | 80 |

Table 2: Normalised values for clustering the Herbert with other sugar 'regions'.

Once normalised a simple cluster analysis 1 was undertaken using all variables (Figure X).

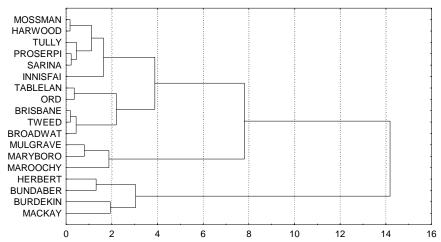


Figure 2: Cluster analysis using industry variables for sugar regions. Clustering was on basis of Euclidean distance and Wards Rule amalgamation..

Using this, the three regions can be seen to represent a broad cross section of region 'types'. These are:

- Main sugar growing regions: Herbert, Bundaberg, Burdekin, Mackay
- Sugar growing significant but adjacent to large urban populations: *Maroochy*, Maryborough, Mulgrave
- **Medium level sugar regions**: *Mossman*, Harwood (NSW), Tully, Proserpine, Sarina, Innisfail

A fourth group remains unrepresented:

Small sugar regions: Tablelands, Ord (WA), Brisbane, Tweed (NSW), Broadwater (NSW).

Figure 3 provides some summary characteristics for the case study regions $\ \ \,$

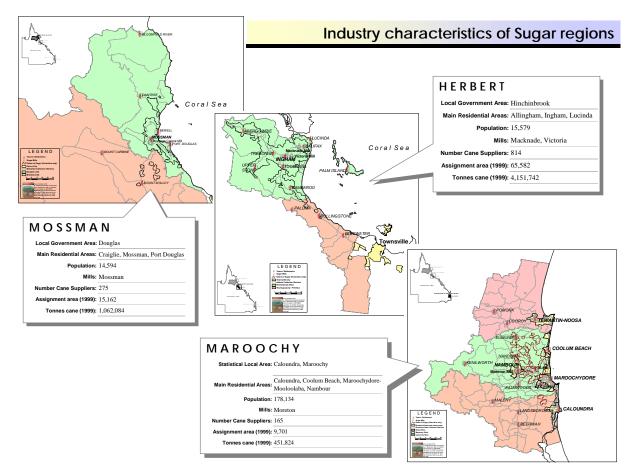


Figure 3: Key Industry characteristics of Mossman, Herbert and Sunshine Coast regions

5. Objectives, outputs and outcomes

The specific objectives of this project, as outlined in the Project Proposal, were as follows.

- **1.** To *develop and test* improved analytical tools to support natural resource planning for the sugar industry.
- **2.** To *identify* approaches and techniques to enable sugar industry stakeholder groups to develop negotiated approaches to integrated resource use planning within a planning systems framework.
- **3.** To *provide* a range of improved approaches to facilitate integrated resource use planning across the Australian sugar industry.

The anticipated outcomes/ benefits for the two focus catchments were identified in the Project Proposal as:

- **1.** improved, more sustainable, natural resource planning and management by the sugar industry;
- **2.** improved planning capacity within stakeholder groups;
- **3.** greater interaction among all spheres of government, the sugar industry and the community in regard to natural resource management;
- **4.** improved negotiation processes over existing and/or potential conflicts over land use and management;
- **5.** a decision support framework that enables the sugar industry, catchment and regional stakeholders to access, integrate and use outputs from a range of research agency activities; and
- **6.** a rigorous and systematic evaluation of the project to maximise value in the Herbert and Maroochy catchments, but also to allow insights gained to be useful for planning in other sugar catchments.

6. Results, outputs and outcomes

In this section we report the project's results, outputs and outcomes under three headings that equate to the core objectives: development of analytical tools; development of approaches to participatory planning; and application of the tools and approaches within case studies.

6.1 Development of analytical tools (Objective 1)

Objective:

To develop and test improved analytical tools to support natural resource planning for the sugar industry.

Outputs:

A decision support system that enables the sugar industry to access, integrate and use outputs from a range of R&D agencies in their planning activities (Output 3 in proposal). The NRMtools decision support environment and the suite of tools implemented within NRMtools enables rapid and flexible integration of research outputs (such as, analytical approaches or frameworks) into decision support tools. These tools enable sugar industry stakeholders to explore the implications of the insights from this research for resource use planning.

Outcomes:

A decision support framework that enables the sugar industry, catchment and regional stakeholders to access, integrate and use outputs from a range of research agency activities (Outcome X in proposal). This project has generated a decision support framework that is operational and available to the industry. The toolkit, the tools implemented in the toolkit and opportunities for the effective use of decision support are discussed the industry resource book under development. Key insights into barriers to adoption and impact have been gained through this research and reported in the literature (Walker, 2002). On-going application of the toolkit is anticipated, for example, the NRMtools framework and one of the tools implemented (the Regional Dynamics Model) will be applied in a process in the Mossman Mill district to explore the farm and millarea scale implications of the current industry downturn.

Introduction

A broad range of analytical approaches and tools have been developed and applied within this research in order to address some of the range of analytical challenges facing the industry in resource use planning.

In the following sections we outline the research undertaken from information integration through resource assessment, tools for catchment scale resource use planning, tools for enterprise scale resource use planning, analysis of regional dynamics to development of a decision support toolkit that provides an environment for all these analyses.

Information Integration

Background

Integrating information resources provides a basic but fundamental foundation for analysis in resource use planning (Figure 4). Our activities in information integration were based on an assessment of information needs for improved resource allocation and infrastructure development in the sugar industry. Information needs on biophysical, economic, social, political and institutional aspects of industry operations were assessed through iterative interaction

between the research team and stakeholders. This demonstrated that inadequate information has been an impediment to effective planning. A range of agencies provide information of relevance to the industry, however, many industry stakeholders have a limited awareness of the nature of information required and the extent of availability from various sources.

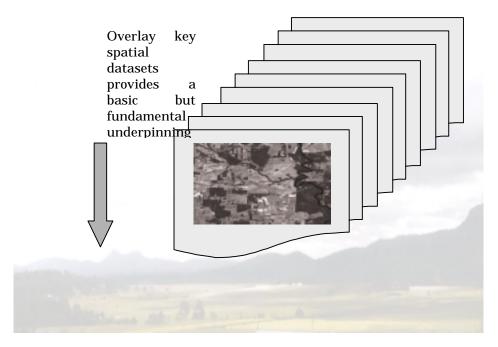


Figure 4. Data overlay for resouce use planning.

Because the level of information required for specific planning purposes is highly variable, reflecting the changing nature of issues and the context in which the information is sought, information requirements for sugar industry planning cannot be comprehensively mapped out. However, a number of key datasets can be identified which are likely to be relevant to many planning processes.

Datasets for the Herbert River catchment

The lower Herbert River catchment is now one of the most data-rich rural regions in Australia. A number of spatial datasets for the Herbert were available from various agencies, but high quality data coverage was limited. A total of over 100 spatial datasets were assembled for the Herbert River catchment (see Appendix 1). Examples of key datasets include the unique mapping area (UMA) data, land cover mapping, average rainfall distribution, digital cadastral database (DCDB), the TOPO250K dataset and the Herbert Mapping Project datasets (HMP).

The unique mapping area (UMA) dataset, which came from the Queensland Department of Natural Resources and Mines (NR&M), contains fundamental land-based information including soils, geology, landform and vegetation. For each UMA, the suitability of the land for various agricultural crops was rated according to a variety of land-

based limitations (e.g., erosion, rockiness). This type of information is fundamental to land management and planning. The UMA data were collected at a scale of 1:50,000, which is useful for strategic level planning.

The Digital Cadastral Database (DCDB) from NR&M is a register of the boundaries that delineate different types of land ownership including national parks, reserves and private land. The DCDB was generously supplied by QDNR for research purposes.

GeoScience Australia's (formerly AUSLIG) TOPO250K dataset provided consistent coverage of the entire study area with topographic data, which was essential for cartographic applications and many different spatial analyses. The TOPO250K dataset provided a consistently accurate and complete coverage of fundamental land-based information including the location of water bodies, road and rail infrastructure, urban areas and elevation.

The Herbert Mapping Project (HMP) provided detailed (1:10 000) spatial information for the lower Herbert River catchment flood plain. The project was initiated in order to overcome the lack of accurate and detailed data on the Herbert River floodplain. The project assembled information from 64 map sheets including a series of orthophoto maps, digital images, and associated digital spatial data. The maps include information on elevation, road and rail infrastructure, vegetation boundaries, water features, utilities and cane field boundaries.

CSR mills in the Herbert Sugar District provided sugarcane block boundaries to describe 1996 cane assignment locations, and cane assignment details for the years 1993 to 1996. These data supported research into the spatial and temporal aspects of allocation equity and environmental impacts of the assignment of land to sugarcane (Shrubsole et al, 1999). The Herbert Resource Information Centre (HRIC) later completed farm scale (1:5,000) mapping of the cane fields to produce a more current and accurate dataset to support farm level management

Aspatial data (i.e., data that do not have an explicit geographical reference within the catchment) were collected in relation to:

- local and regional planning activities;
- services and funding programs;
- legislation and policy arrangements;
- research and data;
- on-ground natural resource management projects; and
- organisational details for the region.

Datasets for the Sunshine Coast and hinterlands

The Sunshine Coast study area contrasts with the Herbert in having more diverse land usage and a much larger urban population. Because the area has been more intensely managed, more detailed and extensive digital datasets were available. Spatial digital data were obtained from the four shires and one city council that collectively constitute the local government across the Sunshine Coast study area. Data were also obtained from industry, and from state and federal government and non-government organisations. In addition, CSIRO assembled some key datasets. As with the Herbert study area, over 100 spatial datasets were assembled (see Appendix 1).

As with the Herbert case study, key datasets included the cadastre (DCDB), topographic (TOPO250K) and sugar industry cane block data.

Key data collected by this project (land cover and suitability, rainfall distribution and transport time to mill have been described under Resource Assessment (below).

A similar range of aspatial data was collected as for the Herbert.

Resource Assessment

Base resource assessments were required to underpin further work in both catchments, but particularly on the Sunshine Coast. CSIRO and the University of Queensland (UQ) completed land cover mapping for the Sunshine Coast study area using remote sensing and GIS techniques. Where land cover classes were not totally distinguishable using only remote sensing techniques, CSIRO used supplementary data describing pine plantations, urban areas, sugarcane and other land covers, along with manual digital editing to improve the classification accuracy. The Shire Councils assisted with data verification by providing spatial data and local knowledge to further improve the dataset. This collaboration has produced regional-scale spatial information (location, area, patterns of distribution) about land cover suitable for broad level analysis and planning across the entire Sunshine Coast study region. The land cover mapping provides information that is important in the assessment of alternative land uses (e.g., currently cleared areas available for agricultural development).

One of the most pressing issues facing the sugarcane industry in the Sunshine Coast was the viability of the relatively small local industry. In order to remain economically viable the sugar industry needed to consider its options for either expansion of its total cropping area or other diversification possibilities. To explore and assess options for expansion, three key datasets were compiled: land suitability for sugarcane, average rainfall, and a road network assessment.

Land suitable for sugarcane was identified and mapped to establish whether there was sufficient suitable land available for expansion. To identify land suitable for sustainable sugarcane farming, criteria were added to describe a broader range of environment constraints beyond slope (erosion) or flooding limitations, such as riparian buffer zones. The environmental criterion supported a more comprehensive assessment of limitations and assisted with the identification sustainable agricultural lands.

It was recognised that profitability in some of the expansion areas might be severely impacted by the availability of adequate and reliable rainfall. As a consequence, rainfall analysis was undertaken. Developing a better understanding of the spatial and temporal variation of rainfall in the Sunshine Coast case studies was achieved through the interpolation of average annual and average monthly rainfall surfaces. The surfaces were developed using ANUSPLIN software that interpolated a best-fitting surface to rainfall station and digital elevation data. This analysis was also successfully applied in the Herbert. The software determined the spatially varying relationship between rainfall and elevation across the landscape, thereby extending the limited usefulness of available point-based data to a continuous estimation of rainfall across the broader area. Both average annual and average monthly rainfall distributions were estimated for the study area and maps were subsequently produced (Murray, 2000, 2001).

The viability of expansion into the areas identified through the land use suitability mapping is also strongly determined by transport costs. An **analysis of transport costs** generated a map of distances and travel times between the mill and both existing cane areas and potential expansion areas. The cost of transporting cane to the mill is one of the major constraints on the viability and sustainability of the sugar industry in the Sunshine Coast region. The road transport analysis could also be used to assist in discriminating between alternative transport options, which could improve the long-term sustainability of the industry. This innovative analysis is described in more detail in Kininmonth (2002)

Tools for improved catchment scale resource use planning

One of the primary aims of this research was to produce a generic framework for the assessment of environmental and economic trade-offs involved in land use decisions at a strategic level. Following a review of different conceptual approaches, an analytical framework was developed to assess the economic and environmental trade-offs associated with natural resource use within the industry. Accepted impact assessment methodologies (for strategic environmental assessment) were used. The framework includes the following key components:

assessment of community values for environmental management;

- spatial analysis of bio-physical attributes of natural resources; and
- economic assessment of trade-offs between land use options for cane production and environmental conservation.

This framework was developed as a case study in the Herbert and then applied to the Sunshine Coast case study.

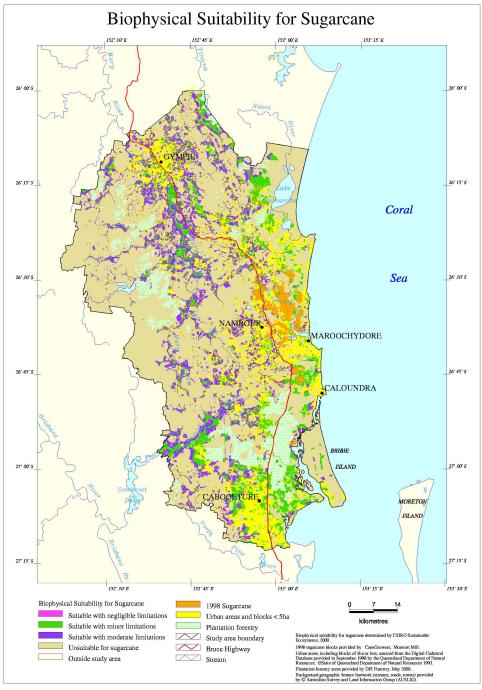
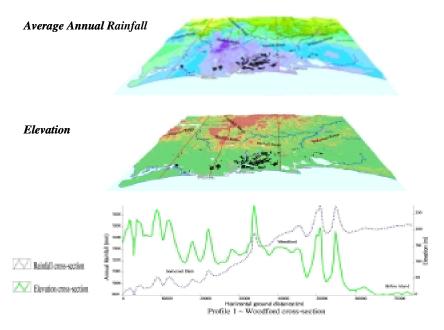


Figure 5. Biophysical suitability for sugarcane.



 $Figure\ 6. Rainfall\ surface\ for\ the\ Sunshine\ Coast.$

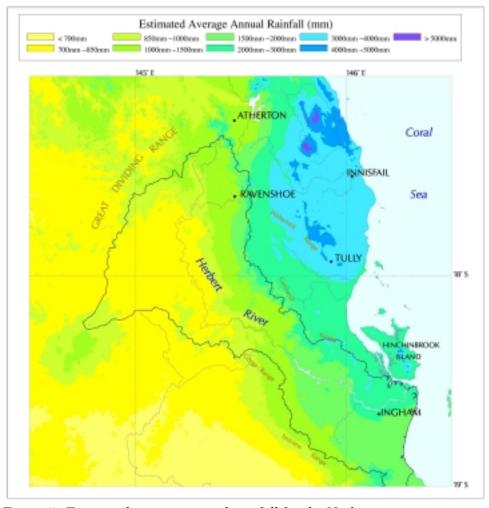


Figure 7. Estimated average annual rainfall for the Herbert region.

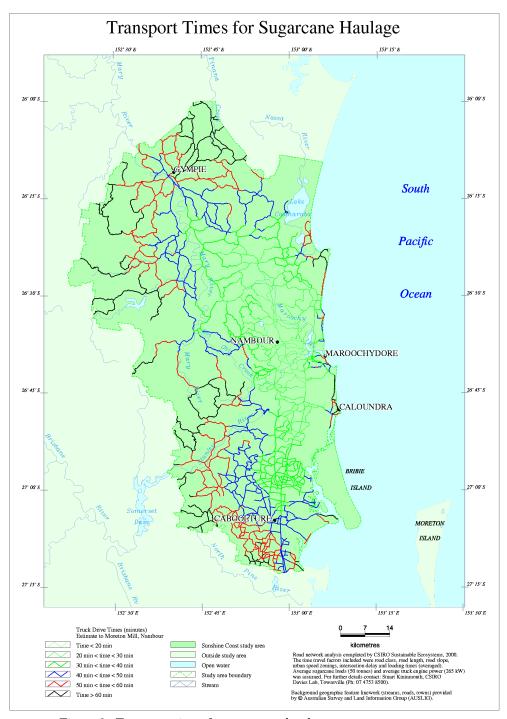


Figure 8. Transport times for sugarcane haulage.

Assessment of non-use values of environmental assets

The value of the sugar industry output is measurable in dollar terms. However, similar estimates of the values of the environmental resources such as woodlands and wetlands are have not been available in the sugar industry. A major problem arising from this

situation is that the industry, community and the government has no firm basis to debate the extent of costs and benefits of sugar industry development in the region. Estimates of the non-use values of environmental assets in in the Herbert and Moreton districts were derived through the administration of a multi-attribute Choice Modelling survey. Choice modelling is an emerging approach to valuing environmental assets. It consists of two stages (i) a random sample survey where a series of 'choice sets' incorporating attributes of the environmental resource being valued are presented to the respondents; and (ii) a statistical analysis incorporating advanced econometric techniques to estimate the willingness-to-pay for alternative states of the environment based on responses to the survey.

The willingness-to-pay estimates so derived represent an estimate of the 'value' each responding household places on maintaining the status quo versus alternative states of the environment modelled. This is the first time such estimates have been produced for land uses related to the Australian sugar industry.

In the Herbert survey, estimates were derived for tea-tree woodlands that are widely available but being replaced by cane in the region, and Herbert wetlands, which have become increasingly limited due to past expansion of the sugar area. The survey indicates that Herbert residents who benefit significantly from the sugar industry are willing to pay for environmental protection (Table 3). The results also indicate that between the two environmental choices presented to the community during the study, the preference for wetland preservation is much higher than for tea tree woodlands. This observation is consistent with actual experience where the available area of wetlands have declined faster than the area of tea-tree woodlands. This behavior is consistent with relative scarcity of wetlands in the Herbert. Moreover, the Herbert residents have a direct use of the Herbert wetlands for recreation. Details of the Choice Modelling analysis for Herbert are given in Mallawaarachchi et al. (1999 and 2001).

Table 3 Estimated 1999 values per hectare of cane production and grazing (derived from profitability data) and teatree and wetland habitat (from Choice Modeling)

| Option | \$/ha/year |
|-------------------|----------------|
| Sugar cane | \$2500 ha/year |
| Cattle grazing | \$34 ha/year |
| Teatree woodlands | \$18 ha/year |
| Herbert wetlands | \$2800 ha/year |

A Choice Modelling study conducted in the Sunshine Coast region considered three main land uses – urban areas, sugar cane, and rare or unique vegetation. The survey (mailed to 1650 residents) elicited the willingness to pay to support each scenario by considering hypothetical changes to land rates to provide the revenue needed to fund policies to achieve each scenario. The survey responses were

used to derive preliminary estimates of the collective value placed by the regional community in terms of total willingness to pay to achieve each planning target (Table 4).

Table 4. 2000 Estimates of willingness to pay for land use management in the Sunshine Coast region

| Option | Total willingness to pay |
|------------------------------------|--------------------------|
| _ | \$/ha/year |
| Urban area expansion | -1100 |
| Expansion of the area of sugarcane | -75 |
| Protection the area of unique and | 1980 |
| rare vegetation | |

These estimates indicate that the Sunshine Coast community places a very high value for preserving rare and unique vegetation, while expansion of areas under sugar cane is not seen as worthwhile. In the light of this study, planning restrictions may be placed on developing any areas under unique and rare vegetation. The value estimates in Table 4. were used in the regional land allocation model to determine socially optimal land allocation strategies for the region described below.

Economic Optimisation Model

The non-use values of environmental assests derived in the Choice Modelling study were incorporated in a total economic valuation framework for the assessment of various allocation options, within a economic optimisation model.

The Cane Land Allocation Model (CLAM) is the core of the economic modelling framework developed to determine the joint environmental and economic net benefits of different land allocation strategies. The model combines the marginal physical productivity of cane production determined by spatially differentiated bio-physical attributes and environmental values estimated through a multi-attribute choice experiment described above. The regional analysis employs allocation rules based on land use suitability attributes that differentiate land parcels of varying potential productivity. Technological options to augment land quality under different states of nature are modelled using a dynamic formulation under alternative assumptions for sugar price and mill assignment. The model captures the interdependency between area expansion and intensification of production, as a behavioural response of cane growers to an increasing demand for cane output. Given these inputs (areas of land in different land use suitability classes, technological inputs, commodity prices and production costs as well as the environmental opportunity cost of loss of habitat) the model determines the economically optimal land allocation sugar cane and other competing land uses in a catchment across different land quality classes.

CLAM was applied to the Herbert River district cane production region to analyse the tradeoffs between environmental preservation

and sugar cane area expansion using data for 1996 as the baseline. Analysis in CLAM was based on 102 composite land units, where each land unit represented a series of non-contiguous parcels of land that were unique in the nature of bio-physical attributes used to delineate land quality classes within the Geographic Information System (GIS).

CLAM-Herbert is a simple, deterministic linear programming model of lower Herbert catchment to optimise the net social pay-offs in land allocation. The model integrates natural resource, social and economic attributes of land allocation decisions at a catchment level.

The aim of the model is to find the socially optimal land allocation that meets the resource development and conservation objectives. Given the development objective of profit maximisation through cane growing, the aim is to design a model that derives the highest possible net revenue over two successive cane production cycles.

Production objectives can be met in two ways: intensification of the existing cane area (intensive margin) and through the expansion of current cane production area (extensive margin). Obviously, a combination of the two would most likely be the most efficient.

The model determines the optimal strategies for allocating different classes of land based on land capability assessments for different land uses to generate regional income, under alternative cane price scenarios Mallawaarachchi & Quiggin (2001).

The analysis confirms that cane production contributes significantly to regional income. However, expansion of cane into more 'marginal' land as classified under existing land capability assessments is not viable when the value of forgone environmental benefits and the costs of initial development are taken into account. This has significant implications to the Herbert region, because most of the land converted to cane over the recent past is in this category.

The analysis indicates that the exclusion of environmental values in the allocation of land for cane production in the past has led to an excessive level of allocation of natural areas for cane leading to a suboptimal level of preservation of important natural vegetation and wetland areas in Herbert. Inclusion of such environmental values and detailed site information to assess the suitability of land for sugar production will prevent further environment losses in the allocation process. The details of CLAM, including specification and simulation results are given in Mallawaarachchi and Quiggin (2001).

A key feature of the model is its integration of bio-physical and economic variables at a regional level. The modelling framework in CLAM is therefore suitable for application to other analysis involving the assessment of likely farmer responses. The focus of immediate attention is to expand the spatial representation in the model and to apply it to examine canegrower responses to environmental and economic incentives at a regional level.

Spatial Disaggregation

The output of CLAM provides an optimal allocation regime for a given level of resource availability and mill capacity for the whole mill region.

Land use allocation policies at a catchment scale need to be understood in terms of their operational implementation at the property scale in order for the criteria applied to be considered in terms of their operational feasibility. Furthermore, there are many landscape management imperatives associated with the specific distributions of the areas allocated at a catchment scale. CLAM used a broader disaggregation for allocating land at a strategic level. Using that allocation as the basis, the GIS rule based approach developed evaluates the operational feasibility of strategic objectives through a constraint satisfaction algorithm.

Geographic Information System (GIS) tools were used to divide the catchment into unique land units. These individual spatial units representing biophysical and tenure characteristics of land parcels were then used as input data to the rule based algorithm, which includes a series of decision criteria. The algorithm implements strategies for allocation to both cultivation and conservation purposes, based on the sugar cane assignment process in the Herbert River catchment and principles of landscape ecology and reserve design criteria. A detailed description of this allocation algorithm is given in Walmsley et al (1999). Further development of this approach is reported in Zhu et al (2001).

Tools for enterprise scale resource use planning

Many of the changes in resource use needed to meet regional targets or objectives will occur at an enterprise scale – particularly on-farm. As a consequence, industry stakeholders were interested in exploring the use of decision support tools to facilitate on-farm resource use planning activities.

In recent years, community expectation of farm management of native vegetation has shifted from clearing to conservation and rehabilitation, with special emphasis on revegetating riparian areas along rivers and streams. In the case of management of riparian zones within sugar producing regions, management regimes on-farm has been of particular concern. The rate of revegetation has been slower in Queensland than in the rest of Australia, although the Choice Modelling survey of farmers in the Herbert River (Mallawaarachchi et al, 1999) found a growing willingness and desire by farmers to revegetate parts of previously cleared areas of their farms. Following discussions with stakeholders in 1998, riparian zone management was identified as one of a range of issues that might usefully be tackled with NRMtools. A case study was undertaken on provide decision support in assessing the feasibility of revegetating cleared land.

Given that significant areas of the riparian zone are already under cultivation in existing cane holdings, cost-effective options have been sought to enable reintroduction of riparian vegetation into areas of riparian importance. Examination of such options includes questions of private and public interest, including responsibility, community obligations, lost economic opportunities, cost sharing and appropriation of benefits. Because of the presence of both monetary and non-monetary costs and benefits with both direct and spillover effects the analysis of issues is complex. In practice, however the funding and institutional and legislative arrangements for cost sharing remain limited, such that much revegetation on-farm must rely predominantly on the landholders as most costs accrue on-farm.

In designing a decision support tool to facilitate deliberations in relation to on-farm vegetation, the farm financial viability of riparian revegetation was therefore the principal focus. Thus the analytical tool developed conducts an on-farm analysis of the costs and benefits of riparian vegetation despite the fact that many of the benefits of such conservation practices are in fact experienced off-farm.

The perceived benefits of riparian revegetation have been categorised and listed in many ways by various authors. A good summary is available in CANEGROWERS (undated) publication Is there a rat in your hip pocket? which identifies nineteen key benefits of revegetating. Although desirable, it is extremely difficult to take all of the factors identified into account in a cost-benefit analysis based on readily available data. The approach taken was therefore to identify key quantifiable determinants as a basis for cost-benefit analysis. During the course of this research project, the sugar industry has gone in to a major downturn. As a consequence, resource-planning issues have shifted from managing the potential impact of expansion to managing the impacts of the downturn at farm and regional scales.

The spreadsheet model developed includes estimates of the costs of revegetating a particular site, (site preparation and planting), maintenance costs, costs in terms of lost cane revenue from the area removed from cane production, potential financial incentives (e.g. rates reductions/rebates, income tax deductions for landcare related activities), possible internal benefits of riparian buffers to cane farmers (rodent damage reduction or reduction in cost of rodent control, reduced flood/storm damage, reduced land loss, windbreaks and reduced "lodging", timber production, aesthetics, real estate values) and external benefits of riparian buffers to the region.

Collation of literature from a range of sources enabled reasonable quantification of a number of these costs and benefits while others proved difficult to quantify with current data and had to either be highlighted as unquantifiable issues for consideration or left to the user to estimate in dollar terms.

The application of the on-farm revegetation tool for a range of sites within the Herbert River catchment with a range of input data

demonstrates that for most farmers who use the tool, the analysis will point strongly against revegetation on financial grounds. Access to the tool therefore details and quantifies the gap between the costs and benefits and thus gives an indication of the levels of subsidies (from the farm business or from the wider community) or incentives that may need to be applied for an area of riparian land to be revegetated. Thus the tool helps to establish the size of the gap between the readily quantifiable costs and benefits and helps to focus consideration on the important but less-readily quantifiable costs and benefits.

Regional dynamics

During the course of this research project, the sugar industry has gone in to a major downturn. As a consequence, resource-planning issues have shifted from managing the potential impact of expansion to managing the impacts of the downturn at farm and regional scales.

Accordingly, the research team was asked to examine the regional implications that projected changes to the sugar industry may have economically and socially. The resulting Regional Dynamics Model can be used by farmers to analyse the economic returns from cane production and run "what if?" analyses, and it can be used by the industry and planners to analyse the pressure on social and community services. The model is based on the assumptions that the key drivers of farm financial profitability are sugar price and CCS, debt/equity, yield and access to land. Combinations of these drivers are considered through a farm scale production and financial analysis (area of production, equity and farm income) over a given period of time.

In order to explore the relationship between farm and regional scale changes, farm scale financial information is aggregated to provide regional information on financial flows and sugar production, providing information on changes, if any, to primary employment, secondary employment and service providers (Figure 9). This analysis is based on the assumptions that changes in the sugar industry will be felt by the community both through direct impacts on farming families and through changed employment through the remainder of the community. Two levels of employment change are considered: direct employment in the sugar industry (eg growing, harvesting, milling, and R&D), indirect employment through service provision to the industry and their dependents (eg education services, professional services) through expenditure on goods and services.

The model runs all the farms in the district in parallel over the period of the scenario. Given different farm sizes, land class and starting level of indebtedness, farms run on different financial trajectories under the same global conditions (interest rate, cane price, input costs per unit etc.). The model includes assumptions about the level of debt that will put farms out of business and then allows other enterprises to purchase the land from farms that are no longer solvent. Hence, land is re-allocated if certain debt limits are exceeded

and land is then available for other farming units to purchase given certain constraints.

In summary therefore, the Regional Dynamics Model allows the exploration of questions such as if sugar price was at \$290(AUS) for five years, inflation is 3% p.a. average yield is down by 15% for three years what might be the impact on:

- Cane farmer numbers?
- Cane supply?
- The amount of cane required to support a farming family?
- Local employment & services?

Development of a decision support system

Overview

In the previous sections, we have summarised the key analytical approaches and tools developed in this research. Here we discuss the development of an integrated environment for analysis. The project was based on the view that analytical tools to underpin resource use planning activities have to be integrated in, and disseminated through, a common decision support environment that allows for the flexible development and application of existing and new tools. One of our core activities has therefore been the further development of a decision support environment (or toolkit) for natural resource management called NRMtools, originally developed as part SRDC project CTA013.

The NRMtools toolkit is designed to provide the flexibility of application demanded by users, in combining and recombining analytical functionality to meet the demands of particular tasks. As such, NRMtools is a powerful environment in which to package and deliver research outputs and provides a mechanism whereby decision-makers can make use of quantitative models.

As a result of this project, NRMtools is available for use over the Internet, so that hardware, software and data storage requirements for clients are kept to a minimum. These resources are held, maintained and updated on a central server. This approach to delivering our research has allowed us to provide planners in the sugar industry as tools and models as they are developed.

The fundamental assumptions underpinning the design of the software are as follows.

 Owing to the diversity of analyses that managers may wish to perform with the same data sets and analytical tools, flexibility in application of a decision support system is highly desirable.

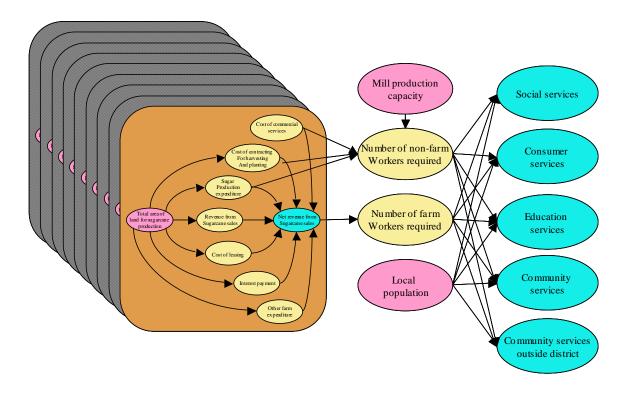


Figure 9. A conceptual view of the relationship between farm scale financial performance and regional scale impacts.

- This flexibility in operational application of a system means that the user must be able to customise analyses to suit their purposes.
- The application of procedural analyses on data sets using a range of analytical tools is of operational relevance and acceptability to natural resource managers.
- Managers or decision-makers may often require some support in identifying issues demanding attention before they are able to design a procedural analytical tool to help them to explore that issue.
- Even with a clear idea of the issues meriting consideration, natural resource managers may require assistance in the process of generating a decision support tool that will facilitate decision-making.

Evolution of the current environment

NRMtools has evolved considerably over the course of this project, with the current version having significant structural and operational differences to the earlier design and implementation. The original NRMtools incorporated a Tool Language Editor (Client Software) and Common Gateway Interface (Server Software) tied together via a Web service.

The Tool Language Editor was a tool-kit environment in which individual 'decision support tools' (similar to macros implemented in spreadsheets and word processing or GIS packages) are created to meet a user's particular need at any particular time. Under this scheme, there were two fundamental ways of interacting with the system:

- 1. operational use, in which the user selects an existing decision support tool from a menu and is guided through the decision support tasks to generate outputs; and
- **2.** tool development, where the user undertakes an analysis of tasks and implements them as a decision support tool to generate custom outputs.

The environment comprised a task language, a task language interpreter and tool language editor that enabled users to create a decision support tools for analysis by linking external resources such as data in a GIS, simulation models, knowledge databases and inference mechanisms. The tool language editor created an environment which allowed users to create their own tools by accessing and linking elements from a list of the primitives (categorised according to broad functionality) and control structures. A syntax checker was included as part of the task language interpreter and a trace facility allowed the tool developer to debug any illegal operations.

There were various problems with the initial client server design as the tool language editor and task language interpreter made direct calls to the Web service. Unexpectedly, these calls were often blocked by the security software (and physical firewalls) that had been installed in the client's IT environment. These problems had not been anticipated in the original design, as the security technology was not widely used at the time.

The fundamental structural design of the NRMtools environment was revised in order to overcome the operational deficiencies of the product. It was decided that the best option would be to remove the client software (tool language editor) and embed these operations into the server environment.

Significant changes were made to the server environment with the functionality of the tool language editor and the task language interpreter being replicated in respective components and linked to the common gateway interface. Furthermore, generic routines to produce HTML input and output pages were produced so that the NRMtools environment could be delivered entirely from a browser interface. The resulting stateless server environment is able to manage complex requests, manage the transitional data deposits and the various add-on components (for instance the GIS layers, GAMS, Excel and other modelling engines) to produce information which can be easily interpreted by decision makers.

The fundamental core elements behind the original design of NRMtools still form the main functional basis of the product. These are:

- A server based tools environment with a task language interpreter.
- A stateless server environment
- The management of complex data requests and the ability to combine data from various different sources.
- The seamless integration of various third party components.
- A generic reporting facility for the compilation and presentation of data from various sources.

Accessing NRMtools

NRMtools is maintained by CSIRO and can be accessed at http://NRMtools-tvl.tag.csiro.au:81/. The site provides access to a range of implemented tools (as outlined below) and documentation.

Current tools

Table 5 summarises the suite of tools developed as part of this project that have been implemented within NRMtools.

| Revegetate Caneland, Revegetate Noncaneland; Clear Riparian Vegetation: | Our work on farm-financial analysis of options for riparian vegetation management has been described above. The NRMtools riparian tool represents three management options to the user: revegetation of the riparian zone, removal of the riparian zone and retaining the riparian zone in its current state. The model behind the tool will present both quantifiable (value) and non-quantifiable (non-value) costs and benefits of employing each of the management options for properties within the Herbert River valley of North Queensland. The on-farm revegetation tool, as implemented, allows the user to navigate a map to identify the block of land that they are interested in. Data on that block are returned to the user to confirm that the correct selection has been made. The user is then prompted for a number of input values, with defaults provided for all values. These inputs and data from the GIS are then passed to an Excel spreadsheet on the server and the cost-benefit analysis is run. The results are returned to the user and displayed within the web browser (Figure 9). The user can then download a report of the tool execution including site maps, spreadsheet outputs and explanation. |
|---|---|
| Create Land use Change Map: | This tool allows a user to view land use change data for the Herbert region. Then by selecting themes, a map is generated and served via the browser. |
| Load Library: | This tool allows the user to load a limited number of maps contained in the CSIRO GIS library. It has limited use due to various data licensing issues. |
| Cane Land Allocation model (CLAM): | The development of CLAM has been described above. The model evaluates and explores different scenarios of land allocation for cane production. It assesses the feasibility of land for cane and spatially allocates land for cane at a landscape level, based on a set level of cane production, land use constraints, a set of socioeconomic and biophysical criteria and users' value judgments. It provides the user with a real-time solution to a complex array of inputs and modelling information. The tool integrates the GAMS modelling package that is used to determine what allocation is optimal given the current constraints. Users are able to change the main factors associated with the allocation. |
| Land Use Allocation Model (LUAM) simulation | The Land Use Allocation Tool integrates economic assessment of alternate land allocation strategies with spatial land use allocation technologies to generate simulated and spatially disaggregated land use patterns on the basis of economic optima and land use constraints and objectives. The allocation model developed generates spatial scenarios of land use allocation based on a range of strategies for allocation of land to alternate uses. Strategies for land use are evaluated using a weighted cumulative algorithm that alternatively allocates to competing land uses. |
| Regional Dynamics Model: | This tool examines the regional implication that projected changes to the sugar industry may have socially and economically. It can be used to run simulations of farm financial performance for individual enterprises or of regional responses to aggregate farm financial performance. |

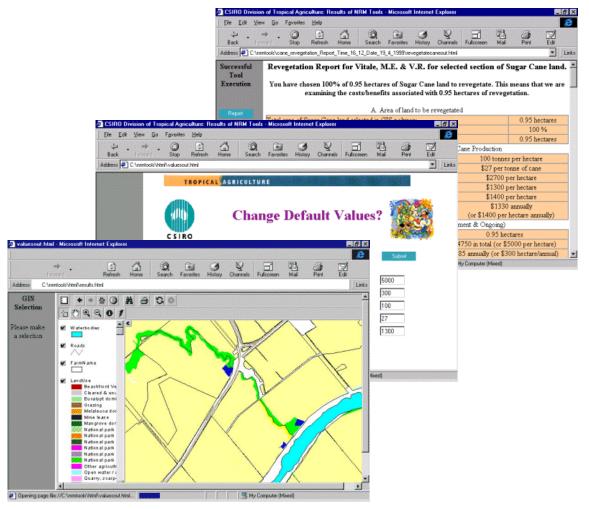


Figure 10. Some of the interfaces for the riparian vegetation tool.

6.2 Development of approaches to participatory planning (Objective 2)

Objective:

To identify approaches and techniques to enable sugar industry stakeholder groups to develop negotiated approaches to integrated resource use planning within a planning systems framework.

Outputs:

Methods and approaches for improved planning with sugar industry stakeholder groups (Output 1 in proposal). The suite of methods for improved planning with sugar industry stakeholders is described below.

Outcomes:

The outcomes associated with the application of this framework are reported in the next Section.

This project has developed a framework for engaging a broad range of stakeholders in a stakeholder-driven approach to resource use planning that not only puts significant emphasis on communication of aspirations and negotiation of their implications, but also ensures that debates are evidence-based – making use of a range of data and analytical approaches as appropriate. The framework was developed through literature review, assessment of best practice in other industry and from community initiatives. It was refined through application

Its application in two regional case studies is described in the next section.

The approach to resource use planning adopted is based around a series of Resource Use Fora bringing together key stakeholders to negotiate aspirations and actions iteratively on the basis of a growing suite of analyses. The conceptual framework is represented in Figure 11.

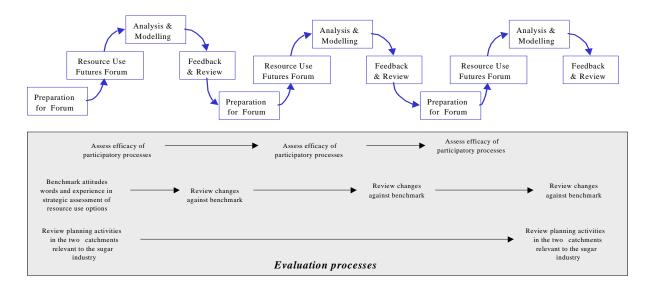


Figure 11. The conceptual framework for the participants planning process.

The framework includes the following series of steps (which need not be applied strictly sequentially and may involve several iterations):

- 1. negotiation of resource use aspirations within the industry;
- **2.** assessment of the resource base in relation to aspirations;
- 3. dialogue with other key stakeholder groups;
- **4.** integrated consideration of economic, social and environmental impacts;

- **5.** negotiation of design principles for new initiative and exploration of implications; and
- 6. negotiation on, and support for, implementation

Step 1. Negotiation of resource use aspirations within the industry One of the aims of this research was to assist the sugar industry and other relevant stakeholders to plan for future development of natural resources used by the industry. This was to be achieved by a series of plan-to-plan workshops and Resource Use Futures Fora, which determined aspirations for the industry agreed to by all stakeholders.

Step 2. Assessment of the resource base in relation to aspirations
The biological, physical, financial, social and human capital that the
industry has at its disposal determines the extent to which
aspirations are achievement. The types of analyses described in the
previous section illustrate key inputs into the process of assessment
of the resource base against aspirations.

Step 3. Dialogue with other key stakeholder groups

The framework developed is structured on the basis that an increasing number of stakeholder groups now have an interest in the use of natural, social and economic capital by the sugar industry. This makes dialogue and negotiation with a range of stakeholder groups critical for successful strategic planning, and for implementation of resource use options. The framework was designed to be flexible so as to include stakeholders and organisations in a progressive process once the groups already involved saw a need and had the confidence and information need to draw in new groups.

Step 4. Integrated consideration of economic, social and environmental impacts

One of the key intentions of this research has been to seek improved integration of assessment of the economic, social and environmental implications. The land suitability and rainfall models were developed with environmental impacts being considered. The transport model was developed to assist with economic and social implications of changes to the transport system.

Step 5. Negotiation of design principles for resource use plans and exploration of implications

The framework is based on the view that resource use planning needs to be highly participatory and furthermore needs to be adaptive to the industry's complex and fluid operating environment. Furthermore, while planning needs to be achieved through debate, negotiation and consensus across a broad range of sectors and stakeholder groups, implementation of elements of the plan will occur in a less integrated way as each sector meet their individual needs through conduct of their core business. As a consequence, the framework focuses on the development of consensus on principles for design of future resource use strategies rather than the development of rigid and formal planning outcomes.

Step 6. Negotiation on, and support for, implementation
The approach taken in this project has involved collaborative decision-making, establishing trust by building relationships with participants, and enhancing communication between industry, government and community arenas. All initiatives and research has been agreed to and supported by stakeholders. The process and

6.3 Application of the tools and approaches within case studies (Objective 3)

Objective: To provide a range of improved approaches to facilitate integrated resource use planning across the Australian sugar industry.

Outputs:

Improved structures, mechanisms and techniques for the negotiation of existing and/or potential conflicts over land use and management within sugar catchments (Output 2 in proposal). As detailed below, analytical tools and the framework for participatory resource use planning outlined above, have been applied and refined within the two case study catchments. Structures, mechanism and techniques, refined through this experience, are being made available to the industry through the Resource Book (Appendix 1).

Stakeholder generated plans for sugar industry resource use in the Herbert and Maroochy catchments (Output 4 in proposal). As a consequence of this research, the sugar industry in the Moreton Mill area has a clearly articulated vision and plan for its future in the region. By contrast, this has not been achieved in the Herbert. These differing outcomes are discussed below.

Outcomes:

Improved, more sustainable natural resource planning and management by the sugar industry (Outcome 1 in proposal). Outcomes in terms of improved natural resource use planning within the case study catchments are discussed below.

Improved planning capacity within stakeholder groups (Outcome 2 in proposal). The results of the case study evaluations (see Section 7 and Appendix 3) provide insights into the extent to which planning capacity has developed in the two regions. Development has been stronger on the Sunshine Coast than in the Herbert (which started at a higher base level).

Greater interaction among all spheres of Government the sugar industry and the community in regard to natural resource management (Outcome X in proposal). Increased interaction on the Sunshine Coast has been a notable achievement and may be the most important contribution of this research to the industry's future in the region. Changes in interaction have not occurred in the Herbert, to the same extent.

Improved negotiation processes over existing and/or potential conflicts over land use and management (Outcome 3 in proposal). The establishment of the Sunshine Coast working group (detailed below), whose development is directly attributable to this project, and the Herbert Regional Industry Board, whose genesis we believe has been facilitated by this project illustrate an on-going commitment to integrated approaches to resource use planning.

Implementation of the Workshop – Forum cycle

Using the framework outlined in the previous section, the research team worked closely with the sugar industry in the two districts to:

- enhance the industry's capacity for rural land-use planning;
- prepare for, and undertake negotiations with other stakeholders to establish and implement agreed catchment and regional priorities and rural land resource management strategies; and
- identify and implement rural land-use strategies and plans over which the sugar industry has responsibility as well as strategies and plans that will require negotiated solutions with other stakeholders in sugar catchments.

In doing so, we sought to develop and adapt the framework to seek innovative ways to involve the industry and other catchment stakeholders in the process of planning to meet their catchment and regional land-use planning responsibilities and objectives. Application of these approaches was evaluated in order to provide a range of improved approaches to facilitate integrated resource use planning across the Australian sugar industry.

As outlined in the previous section, the Research Use Futures Fora in each of the case studies were central and integrating events. However, an effective forum depended on significant preparation. Each stakeholder group needed significant preparation to develop their priorities and to enable an adequate exchange with other stakeholders in developing a combined strategic vision and direction. Accordingly, each forum was the culmination of a series of meetings conducted by the research team. In addition to these formal meetings, face-to-face meetings were conducted on an individual basis where required to ensure that all members of stakeholder groups had up-to-date information on the planning process and any outcomes.

These preparatory discussions culminated in plan-to-plan workshops held with each stakeholder group to develop their research and analysis priorities. These workshops usually took place a few months prior to the associated Resource Use Futures Forum so that there was time to obtain additional information or conduct additional research for presentation at that forum. The workshops were designed to explore new issues with individual groups, which could then be taken to the next forum and explored and discussed by all stakeholder groups.

The intensity and range of these preparatory meeting processes is demonstrated by the list of meetings by core project staff (Section 11.1).

The Resource Use Futures Fora were conducted to provide stakeholders with an opportunity to collectively identify and debate key development issues, objectives and strategies for the regions economic development and implications for natural resources management. The Fora provided an opportunity for stakeholders to listen to each other (sometimes for the first time), identify common strategies and objectives, and expose and explore conflicts. Future progress rests on this critical foundation, which provides a way to explore alternatives and shows how to choose effective, equitable and sustainable courses of action. The objective of these fora was to enhance the capacity of the stakeholders in the sugar industry to strategically and constructively address important issues related to natural resource management.

After each forum, the research team conducted research and modelling focussed on the preferred options and strategies developed at the forum (as outlined under Objective 1). The research and modelling evaluated the economic, social and environmental costs and benefits of strategies, and quantified the impacts on the regions of implementing each option, e.g. spatial analysis of changing landuse and developing transport networks has been used to determine the availability of land suitable for cane assignment.

Each forum resulted in an implementation strategy in relation to the issues canvassed and agreed. These in turn lead to action by stakeholder groups individually and collectively.

Each forum was also the focal point for the external evaluation process. Questionnaire surveys were filled out by participants and the consultant followed up with telephone interviews of the participants.

Implementation on the Sunshine Coast

The first Resource Use Futures Forum on the Sunshine Coast was held in December of 1999. The meeting involved the Moreton CANEGROWERS Committee, Moreton Mill Management, Bundaberg Sugar representatives and the research team. The meeting between the CANEGROWERS Committee and the key mill staff was in itself a significant event. Both groups expressed some concern about broadening the membership of this discussion group.

The forum concluded that in order to keep the mill viable and the local industry sustainable, resource use planning needed to focus on increased cane production. The forum therefore concentrated on ascertaining whether there was suitable land for additional cane production. Potential areas for expansion needed to be analysed for their environmental suitability for cane production and the viability of production in those areas. Suitable rainfall (and consequent irrigation requirements) and the costs of transporting cane to the mill were identified as the two key constraints to expansion

The land suitability mapping, rainfall analysis and transport analysis outlined under Objective 1 were carried out as a result of this meeting.

A working/management group was formed after first forum to act as a contact point and to make decisions that needed to be made between meetings. This group, formed through consultation with the stakeholders, consisted of representatives from the mill and canegrowers, ensured that all stakeholders were represented in the planning process between fora.

The second forum was held in November 2000 and involved BSES, Noosa, Cooloola and Maroochy Councils, Noosa, Mary River and Maroochy CCCs, Moreton CANEGROWERS Committee, Moreton Mill Management, Bundaberg Sugar representatives and the research team. The forum concentrated on refining the draft expansion plan developed by the mill, and discussed different harvesting and farming options.

The key outcome was the establishment of three working groups for attracting new growers to the industry, assessing cane transport systems options and designing farming systems options.

The forum identified the need for additional analyses to assist in defining which agricultural industry is best suited to agricultural land in the Sunshine Coast region. It was envisaged that this model would assist potential cane growers in deciding whether or not to move into cane production. The specified model would incorporate economic values, such as net present value, to determine the potential viability of cane in comparison to other agricultural industries. This analysis has yet to be completed and is not reported here.

The third and final forum was held in March of 2002. A total of 50 people attended representing the following groups:

- 1. INDUSTRY: Moreton CANEGROWERS, Brisbane CANEGROWERS, Moreton Mill/Bundaberg Sugar, individual growers
- LOCAL GOVERNMENT: Maroochy, Cooloola, Caloundra & Noosa Councils
- 3. STATE GOVERNMENT:Local Member for Nambour, NRM, DPI –Policy Analysis & Industry Development Group, State Development, Premier's and Cabinet, EPA Sustainable Industries
- **4.** ENVIRONMENT NGOS: Mary River CCC, Maroochy CCC, Noosa CCC, Sunshine Coast Environment Group, Noosa Environment Committee, Landcare, Qld Biodiversity Network
- **5.** BUSINESS INTRESTS: Mary Valley Enterprise & Tourism Association, Cooloola Regional Development Bureau, Nambour District Chamber of Commerce, Gympie Business Association, Regional Communities Committee
- **6.** R&D: BSES, CSIRO, CRC Sugar, SRDC

Proposals for cane expansion in the region, options for cane harvest and transport reform, land management issues, the costs and benefits

associated with various pathways of industry change, and intangible values were canvassed and debated at the Forum. This resulted in a consensus that:

- the sugar industry is of significant importance to the region for a range of economic, environmental and social reasons;
- the intent of the proposed plans for the reform of transport infrastructure and expansion of area of production were fundamental to the industry's viability; and
- the planning processes developed to date needed to move urgently into an implementation phase to maintain a viable and sustainable industry in the region.

As a consequence, a Task Force was developed and charged with the responsibility of moving towards implementation of a regional action plan for the sugar industry. This Task Force consists of:

Peter Wellington Local MLA (Chair)

Trevor Thompson Deputy Mayor, Maroochy Council

Kevin Bailev Chairperson, Moreton

CANEGROWERS

Graham Coleman Bundaberg Sugar

David Cohen Manager, Regional Communities Ken King Manager, State Development

Scott Grimley Local resident

Alan Stephens Department of Primary Industries Les Hadlow Chair, Nambour & District Chamber

of Commerce

Greg Pitman Old. Council of Unions

Shirley Williamson Noosa Catchment Coordinating

Committee

Vickie Webb CSIRO Sustainable Ecosystems

One of the participants in the process told the external evaluator that "...the formation of the Task Force is a very positive outcome and it should ensure the process continues despite the fact that this particular project is coming to a close." (Macgregor, C.J. 2002b).

Approaches to resource use planning have demonstrably changed in the Sunshine Coast case study, as a consequence of access to an improved information base, improved analytical tools and improved negation processes. For example, the cane land suitability model and resulting assessment of areas for expansion is being used by a joint working group of major stakeholders to:

- identify areas suitable for expansion of cane land (i.e., land and land holders for whom cane production might be a viable alternative to the current land use);
- develop ways of encouraging new growers into the Moreton mill region; and
- target these efforts to attract new growers to optimal areas.

Similarly, the rainfall models have been used to verify the suitability of areas for expansion, and to demonstrate differences between new areas and existing cane growing areas in terms of rainfall conditions.

This has generated discussions about investigating different harvesting systems. A working group has been formed with the major stakeholders to investigate different farming system operations, and this model is being utilized as a tool to inform their decision-making. The analysis of transport costs is now being used in discriminating between alternative transport options, which could improve the long-term sustainability of the industry.

These analytical tools and information sets have supported the development of a plan for expansion of the sugar industry in the Sunshine Coast region to increase production for the Moreton Mill to 800,000 tonnes. The analyses indicate that the Mary Valley area is the most promising area for the initial expansion phase. As part of the plan, different transport options have been proposed, such as 100% road transport, or retaining the existing cane railway and increasing the road transport from the current 20% to 50% under the This plan has been the catalyst for looking at new structure. different farming systems options, as well as reviewing harvesting There is currently a task force, with and transport systems. representatives from the sugar industry, local councils, the economic development board, catchment coordinating committees, and State and Federal governments assessing the introduction of an integrated harvest and transport system. Such a system would be an industry first, incorporating economic, environmental and social aspects.

This project's life spanned a period in the sugar industry's history in which Government and community interest in the sugar industry has increased dramatically motivated both by concern about the economic and social impacts of the sugar industry downturn and by perceptions of the environmental impacts of the industry. Therefore there have been greater interactions across the industry but much of this has been highly divisive and polarizing. While the sugar industry on the Sunshine Coast faces substantial challenges, the nature of the relationships established between stakeholder groups provides an impressive foundation that contrasts experience in other regions.

One of the participants in the process told the external evaluator that "The CSIRO has kicked off a very positive process; one that I think is sure to continue into the future. I feel very positive about the future despite the challenges the industry faces." (Macgregor 2002b)

Implementation in the Herbert

The First Resource Use Futures Forum for the Herbert was held on the December 1999. There were a total of 19 industry representatives participating in the forum representing CANEGROWERS Herbert Area Committee, Hinchinbrook Shire Council and CSR Mill Management. The forum focused on:

- assessment of the current situation;
- identification of major industry issues;
- identification of available options to move forward;
- exploration of alternative pathways; and

development of an agreed action plan.

The participants developed an implementation strategy to achieve their aspirations for the sugar industry. The strategy developed in the Herbert required an ongoing collaborative effort between all industry stakeholders and the research team to develop a consultative process, an information service and the analysis of socioeconomic issues and opportunities. The participants a following workshop also developed procedures for involving additional stakeholders for the next series of workshops and forum.

Unfortunately a range of other events, increasingly strained relationships between the growers and millers, subsequently overtook the enthusiasm and good will generated at the first forum. This was in part a consequence of the proposed sale of the mills and the unsuccessful bid by CANEGROWERS to purchase them. Additionally three key champions of the process at the first forum were no longer able to participate.

The declining trust between key stakeholder groups (notably growers and millers) and increasing ambivalence towards the resource use futures process is reflected in the external evaluation.

One of the participants in the process told the external evaluator that "...people have changed and even the technologies have changed. But one thing that hasn't changed is the relations between the millers and growers." (Macgregor 2002d)

As a consequence, the research team was repeatedly advised by industry stakeholders to delay the second forum. CSR, in response to its perception of declining cooperation within the district instigated a community based change process of its own, culminating in a three day Landmark Education forum involving 120 people. Again we were advised to postpone, and eventually cancel the second Resource Use Futures Forum to avoid clashes with this important CSR initiative. This resulted in the loss of momentum and further fragmentation of the key stakeholder groups.

The evaluation process shows that in the Herbert where commitment to negotiated and partnership approaches from the grower sector seems to have declined. The milling sector remains committed. The Herbert Regional Industry Board sponsored by CSR is in many ways a continuation of the structures for negotiation developed within this project.

The Herbert case study has occurred over a span of time that has seen unprecedented changes in the industry's operating environment. The research started shortly after a period of substantial expansion in the district that had been accompanied by significant resource use conflict. The priority for the industry and community stakeholders therefore appeared to be finding analytical means of assessing and managing economic and environmental trade-offs in land use. As a consequence a suite of analytical methods were explored to tackle this

issue. However, as it became clear that substantial further expansion was unlikely in the short to medium term, the focus shifted to consideration of approaches to improving resource use at an enterprise scale, either through diversification into complementary activities or in managing environmental services. As a consequence, enterprise scale tools for riparian vegetation management were developed. However, during this period, the industry entered a period of severe downturn, resulting in a shift in focus to the link between enterprise scale economic health and regional scale economic, environmental and social impacts. As a consequence, analyses of regional dynamics were undertaken, resulting in the Regional Dynamics Model outlined under Objective 1.

The on-going challenges in re-linking the development of analytical tools with the participatory planning processes in the Herbert led to an extension of the timelines of this project by over six months after discussion with SRDC.

The third Resource Use Futures Forum was held in Ingham in March 2002 and involved CANEGROWERS Herbert Area Committee, Herbert Young Farmers, DEFOS, Hinchinbrook Shire Council and WorkNorth. The Forum revolved around presentation of the regional dynamics model and outputs and discussion about their relevance to industry planning process and the implications of the insights the model provided.

While no consensus was achieved on either the issues or solutions, robust debate occurred. There was agreement that the RDM was a solid foundation for further investigation into social and economic issues for the region and participants provided a list of that they believed were the major drivers/issues of concern to the local sugar industry.

Concerns were raised about the reliance of the town on the sugar industry and the possible impacts both socially and economically of a continued industry downturn.

During the post interview telephone survey, the external reviewer was told that "We're concerned about the industry's viability which must impact on the wider community. The community is very dependent on the industry – too dependent." (Macgregor 2002d)

In summary, no industry resource use plan has been developed in the Herbert River catchment. Clearly, any plan would need to be developed as a close partnership between all stakeholder groups. The inability of key stakeholders to reach consensus on issues and objectives, and the inability of the research team to facilitate consensus has meant that it has been impossible to move to the development of resource use plans. One of the participants summarized the process as follows "...the fact that the process was rail-roaded had a big impact. To be fair, they did their job but it was a bit disappointing in the end. What is lacking is leadership – certainly, the growers didn't demonstrate any." (Macgregor 2002d)

Information dissemination

The research team's activities in information dissemination were also initiated by and informed by the discussions within the workshop – Forum cycle. The participants of the first 'Resource Use Futures' Forum in the Herbert developed an implementation strategy to achieve their aspirations for the sugar industry. The strategy identified the need, for the development of an information service. In response to this, a web-based database of the contact details of key stakeholders and organizations that have an interest in natural resource management and planning was developed. The provision of a common information base that was accessible to all stakeholders was believed to provide a fundamental underpinning for successful negotiation of resource use futures. As a consequence, this initial activity was broadened out to a data access strategy across the two case studies. Databases of aspatial and spatial data were developed for the Herbert catchment and for the Sunshine Coast.

These databases provide a resource for direct use by local stakeholders in informing planning processes. Thus, the development of the databases has constituted a service delivery to the community in terms of providing access to a wide range of information about natural resource management in both catchments. For this reason, the spatial and aspatial databases have been made available to stakeholders through the web as follows.

Herbert - http://NRMtools-tv.tvl.tag.csiro.au/herbert/,

Sunshine Coast - http://NRMtools-tv.tvl.tag.csiro.au/sunshine/

The web-based delivery gives access to much of the content of the data bases through user-friendly interfaces. Unfortunately a number of data sets cannot currently be served across the web due to restrictions in data licensing agreements. The search-engines for the aspatial data provide access to hyperlinks to other websites; one-page summaries of, for example, institutional arrangements; and entire documents. Similarly, the spatial data is available in the form of maps. For example, the on-line Herbert River Catchment Atlas provides detailed information about the natural resources of the Herbert River catchment. It aims to improve the stakeholders' awareness of natural resource management issues in the region, and to enhance their knowledge of the natural resources and the impact of human activity on these resources. This atlas has been made available on the Web at

http://NRMtools-tv.tvl.tag.csiro.au/herbert/atlas.htm.

As part of a follow-up workshop to the introduction of the Herbert contacts database website, stakeholders articulated that the regional community needed, in addition to the contacts database, the ability to promote the positive aspects of the region and communicate to all stakeholders not just the key industry stakeholders. A working group was formed consisting of Hinchinbrook Shire Council,

CANEGROWERS, the Hinchinbrook Regional Economic Development Bureau, the Ingham Chamber of Commerce and was facilitated the research team. As a result of this collaborative process, a regional website was developed. The website, Hinchinbrooknq, provided links between industry stakeholders, local businesses, tourism and research organisations. The site address is http://www.hinchinbrooknq.com

A comparison across the Sunshine Coast and Herbert case study areas.

The sugar industry in both the Herbert and Sunshine Coast is grappling with the environmental, economic and social consequences of its changing structural and infrastructure needs. These include strategic planning for expected expansions, contractions and reallocations of land. The two case study regions face issues such as the world sugar price, climatic variability and increased pressure on their environmental performance. In addition both regions faced the challenges of major change or potential change in the milling sector, in the case of Moreton mill, purchase by a new owner and in the Herbert, the proposed sale of CSR's sugar business.

Despite these similarities there were major differences in the planning results achieved. The differences essentially can be attributed to the differing assessments of the value of participating in a negotiated process to deliver future outcomes to the industry. This need for change was recognised and accepted by the participants in the Sunshine Coast because of their circumstances at the time. However, it was not recognised and accepted by key participants in the Herbert case study area through most, or all, of the project. In fact, it is our assessment that commitment, which was initially higher than the Sunshine Coast, has declined substantially.

The Sunshine Coast case study benefited from the participation of non-sugar industry stakeholders. This provided a greater variety of viewpoints and provided an external perspective on issues. Combined with this there was greater drive within a key stakeholder group of three young, vibrant and interested growers as part of the CANEGROWERS collective on the Sunshine Coast, who could recognise a need for change both within the region and within their organisation.

The involvement of the local member in the Sunshine Coast case study provided an "emerging champion" to keep the process moving after completion of CSIRO/CRC involvement. The ultimate result was the establishment of a task force to oversee the process in the future.

7. Research evaluation

In the previous section, we have described and reflected on our activities in the two case studies. The design of this project recognised the need to have a focused investment in two case studies

to ensure necessary depth on participatory processes with stakeholder groups but also the need to ensure that experience from these case studies could be distilled for dissemination to other regions (see Section 11, Dissemination of Results). An evaluation process was therefore designed and implemented as an integral part of the research cycle (see Section 2, Methodology). The evaluation was designed both to maximise value in the Herbert and Sunshine Coast case studies, but also to allow insights gained to be useful for planning in other sugar catchments.

Evaluative activities were undertaken by an external consultant, Colin Macgregor (Macgregor Consulting Pty Ltd) in order to bring an impartial perspective to the analysis and to the research team throughout the project. External evaluation involved benchmarking at initiation followed by annual assessment of progress against objectives (in terms of impact and outcomes from the participants perspectives) in conjunction with the Resource Futures fora. The final report from the consultant, including methods, results and discussions, is attached as Appendix 3.

The following points summarise our reflection on the contribution of this process to the outcomes achieved.

- 1. The external evaluation data collection process provided participants with a vehicle for reflecting on and expressing their thoughts on the process openly.
- **2.** The anecdotal evidence gathered by the research team provided insights that are very similar to the results of the formal evaluation.
- **3.** Analysis and synthesis by the external reviewer proved challenging given the reviewer's limited insight into the context. For example the evaluator states that during the 1st Forum in the Sunshine Coast tensions were strained and some participants almost left the room. His view was that this was a problem. The research team, however, saw this incident as important in getting engagement from participants, and moving beyond entrenched positions. It was also an acknowledgement of the trust given by the participants to the research team, that they felt they could voice their concerns in the forum.
- 4. While the conclusions of the external evaluation accurately reflect outcomes, the limited numbers of participants in the process made measurement of key changes difficult. We propose that a formal external evaluation of changes in perspectives and practice might be more valid in processes involving a substantially larger community of participants.
- **5.** In as far as the external evaluation provided an impartial assessment of the research, it provides a contribution to research accountability. However, it is not clear that the insights, given potential duplication with existing accountability processes such as milestones and final reports, merit the level of investment.

In conclusion, not withstanding the value of the evaluation conducted, in future initiatives we would seek an external role in eliciting the reflections, views and concerns of participants and handing them back to the research team for reflection and action but would leave the synthesis and analysis of the evaluation process to the research team rather than an external individual.

8. Research Conclusions

This research has sought improved outcomes in regional resource use planning through activities that build analytical tools for planning and participatory approaches to planning. As well as regional and generic approaches, it has resulted in a number of research conclusions.

8.1 The role of decision support systems in regional resource use planning processes

This research has made a considerable investment in the development of decision support tools to underpin the analyses required for evidence-based decision-making. This process has provided substantial insight into the role of decision support systems and requirements for success (see Walker, 2002 for detailed discussion).

On the basis of this experience we believe that decision support systems have an important role to play in three distinct functions, as follows.

- **1.** Dealing with increased information decision support systems may provide a structured mechanism for accessing relevant information and turning it into insight.
- **2.** Coping with increasingly complex decisions being required decision support algorithms or heuristics can provide important analytical structure in complex analyses such as optimisation routines in, for example, the land use allocation model.
- **3.** The "professionalisation" of resource management systems decision support systems can provide a record of decision making and demonstrated that decision-making has followed due process or required standards.

Despite these clear potential contributions, decision support systems have widely failed to live up to expectations. Our experience and analysis demonstrates that decision support interventions may fail through:

- non-delivery where the development of the tool proves intractable:
- non-adoption because the content of the tool proves irrelevant, inflexible or inaccessible to users, users lack confidence in the output or there are institutional and political barriers to application; and

• unanticipated (negative) impacts on decision-making processes and quality where systems are adopted.

The toolkit-based approach adopted here helps to avoid all these risks through a flexible environment for developing and evolving decision support. However, the use of NRMtools, as with the application of decision support in rural resource management in general, has been disappointing.

As our understanding of the challenges in decision support-based research and development increases, and in the face of diminishing technological constraints, considerable progress can be made in moving towards improved approaches to developing and delivering decision support, thereby, reaching a more appropriate balance between the technology and user-centred approaches.

As decision support seeks to improve the quality of decision-making processes and outcomes, its provision needs to be thought of more broadly than the development of decision support systems. Whilst partly a scientific and technical undertaking, it also aims to change decision-making processes and, therefore, the decisions made; as such it is influenced by institutional, social, policy and political contexts and needs to be informed by a sophisticated understanding of the role of research products, such as, DSS, in these domains.

Our experience demonstrates that successes in the use of NRMtools and analogous systems usually relate to turning information into insight – in other words through learning on the part of the user. Learning may often not be directly linked to decision-making or different decisions, but may be more the vehicle for effecting change than a more traditional view of decision support. Thus capacity building through learning may be a more appropriate objective for decision support projects than adoption in the decision-making progress.

We recommend that further research relating to decision support in the sugar industry should focus on the role of such tools in helping users to understand the systems (regional, farm or paddock-scale) that they are managing rather than tools envisaged for use in routine decision-making.

8.2 Participatory approaches to research to underpin improved regional resource use planning.

Sustainable resource use and participative democracy have emerged as increasingly influential paradigms in the evolution of approaches to natural resource use planning and management in the post-war period. Traditionally, most decision-making has been vested with regulatory authorities, however in recent years significant changes have occurred to involve the community in the decision-making process. Assumptions about what is required to achieve sustainable resource use, particularly the role of scientists, resource users and the broader community, in resource use decision-making have been challenged accordingly.

Research organisations have only recently begun to understand the context of complex problem settings, multiple stakeholders, divergent interests and scales of relevance associated with integrated natural resource planning and management activities. These shifts raise fundamental methodological and institutional questions as to how science is conducted, what constitutes an outcome, who controls the agenda and scientist's accountability to others. The research undertaken in this project has sat squarely in this emerging reappraisal of the roles of research providers and their modus operandi in response to new roles.

Our experience has demonstrated that adoption of participatory approaches required 'opening up' our scientific practice. This response, however, can present serious challenges. It is axiomatic that researchers should not engage in participatory research unless they are willing and able to respond to the requirements of the participatory process itself as well as the results generated by participatory processes. This places researchers in a negotiating rather than a controlling role: even in instances that they would normally consider the domain of science. In addition, engaging in dialogue with stakeholders and clients rather than communicating results challenges the basis by which scientific judgements are made. It opens scientific processes to scrutiny and questioning, necessitating major changes in culture and management. A fundamental question then is how can R&D providers redefine their traditional role in the research process by adopting a "negotiative" role with its clients and stakeholders?

Participation processes also lead to the formation of new partnerships. Increasingly this is occurring with non-traditional clients such as local government, regional strategy groups, Chambers of Commerce and community action groups. Moving beyond traditional client bases is problematic because of the effort required to build an understanding of common purpose and strategy, explicit agreement about role and responsibilities, define new operating principles and acceptable forms of behaviour, and explicit indicators or measures of performance. Hence, all the things that the majority of R&D providers take for granted and that define and regulate their behaviour, may have to be re-negotiated with others whose

perspectives and perceptions, beliefs and values may be very different from their own. It will frequently be necessary to enter into more formal and protracted discussions, analyses and negotiations to define what the problem is and to build a common vision for action.

Some of the particular operational challenges we have tackled during the course of this research are as follow:

- uncertainty and ambiguity partnerships evolve unpredictably and understanding and objectives change as an inevitable consequence of working in partnership;
- transaction costs building understanding, relationships and trust and negotiating and managing expectations are extremely time consuming and therefore expensive processes for the researcher, but they cannot be rushed;
- representation experience demonstrates that working with the 'right' people is fundamental to success, however the people with whom partnerships best facilitate the expedient conduct of the research and the full set of people who need to be involved in the development of effective, long term and equitable change is likely to be an other issue entirely; and
- mandate of the researcher to the region embarking on research to facilitate change demands that the individual researcher and the research agency have a clear and unambiguous view of their role and mandate in the region, however, participation in such processes may often challenge perceptions of that role.

In response, we anticipate that a range of research challenges relating to participatory research. Areas requiring attention include the development of the following.

1. R&D into:

- the ethics of participative approaches, particularly within a public participation context;
- further adapting systems methodologies within a participatory framework;
- the cost effectiveness of participatory approaches; and
- improved understanding of the appropriate balance between science push and client pull within a participatory framework.

2. Tools and or methods to:

- facilitate inter-organisational collaboration to promote peopleoriented R&D;
- facilitate interaction between different levels of organisations in agricultural and natural resource systems where there are constraints to innovation and change;
- monitor and evaluate the impact of participatory approaches to R&D;
- better characterise and analyse stakeholders; and

- enable scientists to analyse critically their own practices and to enter into dialogue with their stakeholders.
- 3. Improved understanding of the role of:
 - facilitators, motivators etc., in ensuring R&D delivery;
 - information technology in enhancing the capacity of clients and stakeholders to adopt R&D products;
 - information technology tools such as simulation models and decision support systems to facilitate participatory learning; and
 - traditional methods for experimentation, participatory conflict resolution and negotiation.

To respond successfully to the challenges of participatory approaches to resource use planning, R&D providers will need to:

- build improved relationships and linkages with internal and external clients:
- recognise formal stakeholder analysis and client involvement in research planning as a fundamental component of their behaviour;
- ensure that formal research evaluation of impact and output is a necessary requirement for research projects that have a participatory focus;
- take a more active role in communication with clients and stakeholders, and acknowledging this commitment by deploying sufficient resources (human and financial) to meeting this demand;
- commit resources to facilitate the strengthening of capacity within client and stakeholder groups and particularly community groups;
- enhance skill development and training of their researchers and research managers in participatory methods and their implications for project design and implementation;
- recognise the dynamic and conceptually complex nature of participatory R&D by introducing greater flexibility to budget, recruitment, and project management requirements;
- acknowledge through the performance assessment and rewards systems (e.g., via provision of incentives), the special demands placed on scientists by participatory approaches; and
- improve existing mechanisms for facilitating client representation in research planning and budgetary decisions.

9. Pathways to implementation

The intent of this research was to not only to deliver outcomes within the two case study regions, but also to derive generic insights for application across the sugar industry. Pathways to implementation within the case study regions have already been reported under our performance against objectives, outputs and outcomes.

Our first step in broader implementation has been trial application of the ideas developed here to another region. Many of the ideas developed within this research are being applied, tested and modified in the Douglas Shire Agri-Industry Futures Initiative. This is a three-year collaborative joint venture between the Douglas Shire Council, Mossman Central Mill, Mossman Agricultural Services, Mossman CANEGROWERS and CSIRO.

The initiative, its origins and its intent are outlined in Berwick *et al.* (2001)

As outlined in the Case Study section, the Mossman Mill district provides a useful contrast to the Herbert and Sunshine Coast case studies.

The initiative builds on aspirations in the Mossman Mill area to see expansion, integration and innovation in sugar industry development, diversification of the sector (for example, integration of tourism or other agriculture, aquaculture, etc.), industry contributions to the community through profitability, employment, lifestyle, local industry benefits to the local community, economic resilience, a culture of innovation and, with all this in mind, a local governance framework for profitability and sustainability.

These aspirations are summarised in the following quote.

"We wanted agriculture not just to be profitable but also to deliver real benefits to the local community and to be environmentally sustainable. ... Hence the Sustainable Futures initiative. " (Mike Berwick, Mayor of Douglas Shire, quoted in Berwick et al. 2001).

The Agri-industry initiative therefore aims to build on local innovation, aspirations, skills and resources and to undertake activities to best position agri-industry to respond to external influences on the region's future.

Priorities identified for the initiative as a whole include:

- access to information (including market research),
- access to planning skills, coordination and cooperation,
- finding resources to allow innovation, and
- a cultural shift to value added local products.

The insights, tools and decision support infrastructure developed in the current project are being applied and further developed as part of the Agri-industry Futures initiative. A proposal is currently under consideration with regional partners that would use the Regional Dynamics Model (as implemented in NRMtools) as a key agent for exploring enterprise-scale and mill area-scale responses to the current financial pressures on the industry.

Our primary vehicle for broader dissemination and implementation of the approaches developed by this project is through a resource book for industry stakeholders. This book does not seek to report on this project per se, but rather, to use the experience derived from this research to provide generic concepts, frameworks and guidelines for the range of stakeholders who might be involved in planning regional strategies for the industry. The book is in advanced stages of development and will be completed by the end of 2002. The current title, table of contents and synopsis for the resource book are attached as Appendix 2. The CRC for Sustainable Sugar Production has provided further resources for its completion and publication. The completed book will be disseminated across stakeholder groups in all districts in the Australian sugar industry.

10. Recommendations

It is our recommendation on the basis of the research reported here that the sugar industry, local, State and Federal government and R&D providers seek to work together to develop and implement effective regional action plans across the industry to underpin the industry's transition to the future.

This research, our assessment of its conduct and impact and our assessment of the challenges facing the sugar industry led us to the conclusion that developing and implementing effective regional action plans is of fundamental importance for the future of industry.

We believe that such regional actions should be:

- underpinned by comprehensive technical and economic analyses;
- focused on regional approaches, but set in whole-of-industry and whole-of-government policy frameworks;
- explicitly linked to the search for profitability, sustainable land management and continuous improvement in environmental performance; and
- prepared to challenge the existing paradigms in the industry and to remove impediments to innovation related to protection of entrenched sectoral positions.

Such processes need to be planned, managed and implemented regionally, but in partnership with government and with contributions from R&D providers. These R&D contributions can be divided into two broad categories (1) descriptive, analytical and integrative research, and (2) participatory research to facilitate and manage change.

Along with the more familiar research activities, we propose that the descriptive, analytical and integrative activities should include research aimed at:

- understanding communities (characterising community resource relationships);
- understanding aspirations and values within and between communities (benchmarking);
- understanding regional economies (in context of resource base and communities); and
- assessing institutional structures (effectiveness, efficiency, equity).

We propose that further investment should focus on building understanding, partnerships and capacity (infrastructure, skills...) to facilitate evidence-based negotiation of resource use options.

This work should be regionally focussed and highly participatory. It should define technical questions, identify capacity gaps and develop new institutional models and decision-making technologies. It needs to be subject to rigorous evaluation to underpin adaptive development.

11. Dissemination of results

Given the participatory nature of this research, dissemination of results has been an inherent part of the research process. The nature of the participatory processes employed and the role of decision support systems in making research results accessible to decision makers have been described in previous sections.

In this section we provide more detail on dissemination strategies within the case studies, specifically the formal meetings that structured the two regional case studies and the development of websites to enable further access to collated data. In addition to information dissemination within the case studies, substantial environment dissemination has occurred to the broader industry through workshops and conference paper and to the research community through conference and journal papers. These are detailed below.

In addition to these dissemination activities to date, our key strategy for broader dissemination of the insights gained from this research is through the development of a Resource Book for industry and community. The current title, table of contents and synopsis for this book are provided in Appendix 2. The resource book will be completed by the end of 2002 (with support from the CRC for Sustainable Sugar Production) and will be widely disseminated across sugar regions.

11.1 Meetings within case study regions

The following list records some of the meetings in the case study regions undertaken by project staff. The list is not comprehensive.

Chalmers, D.R. 16 July 1999. Meeting with four representatives from CRC Sugar, five representative from CANEGROWERS, and one representative from Hinchinbrook Shire Council.

Chalmers, D.R. March 2000. Sugar Industry Resource Use Futures. Presentation to CANEGROWERS Herbert Area and Queensland Mechanical Harvesters Association.

Chalmers, D.R. 8 May 2001. Resource Use Futures and Regional Dynamics Model. Presentation to CSR Mills Union Representatives, Victoria Mill, Ingham.

Chalmers, D.R. February 2002. Sugar Industry Resource Use Futures. Presentation to CANEGROWERS Herbert Area.

Chalmers, D.R. March 2002. Regional Dynamics Model. Presentation to WorkNorth Board Meeting, Townsville.

Chalmers, D.R. and D.H. Walker. 21 September 1999. Plan-to-plan with key staff and the mayor from Hinchinbrook Shire Council.

Chalmers, D.R. and D.H. Walker. 28 September 1999. With all the councilors from Hinchinbrook Shire Council.

Chalmers, D.R. and D.H. Walker. 5 October 1999. Plan-to-plan workshop with four staff from CSR Ltd.

Chalmers, D.R. and D.H. Walker. 5 October 1999. Plan-to-plan workshop withnine members of the CANEGROWERS Herbert River District executive.

Chalmers, D.R. and D.H. Walker. 8 December 1999. With CANEGROWERS executive (lal 7 members present) to finalise their "aspiration document".

Chalmers DR, and VA Webb, 11th April 2001, Management group meeting

Chalmers, D.R. and D.H. Walker. 24 April 2001. Sugar Industry Resource Use Futures. Presentation to Hinchinbrook Shire Council, Hinchinbrook Shire Chamers, Ingham.

Chalmers, D.R. and D.H. Walker. 26 April 2001. Sugar Industry Resource Use Futures. Presentation to CSR Mill Management, Victoria Mill. Ingham.

Chalmers, D.R. and D.H. Walker. 30 April 2001. Sugar Industry Resource Use futures. Presentation to CANEGROWERS Herbert area Executive, CANEGROWERS Building, Ingham.

Chalmers, D.R. and D.H. Walker. 12 December 2001. Resource Use Futures. Presentation to Hinchinbrook Shire Council and CSR Mill Management, Ingham.

Chalmers, D.R., D.H. Walker, and S. Ebert. 22-23 October, 1999. Plan-to-plan workshop conducted with the Moreton Canegrowers (5 member of the executive) and the Moreton Mill (4 staff).

Chalmers, D.R., D.H. Walker, and V.A. Webb. March 2002. Resource Use Futures and Regional Dynamics Model. Presentation to CANEGROWERS Herbert Area, Hinchinbrook Shire Council, Herbert Young Farmers, WorkNorth and DEFOS, Ingham.

Johnson AKL October 1997 . Report on progress of CRC project. Presentation to Sunshine Coast canegrowers, millers and Maroochy ICM.

Johnson AKL October 1997. Report on progress of CRC project. Presentation to Canegrowers, millers and ICM in Ingham.

Johnson AKL, November 1997, Presentation to canegrowers, millers and ICM in Sunshine Coast.

Johnson AKL, November 1997, Presentation to canegrowers, millers and ICM in Ingham

Johnson AKL December 1997, Presentation to Noosa ICM re sugar work

Johnson AKL December 1997, Presentation to Moreton Canegrowers Johnson AKL, December 1997, Presentation to Moreton Mill Management

Johnson AKL, April 1998, Evaluation of DSS and HRIC with stakeholders in Herbert

Johnson AKL, April 1998, Needs analysis for Sugar CRC work and choice modelling framework discussed with stakeholders in Herbert and Sunshine Coast

Johnson AKL, June 1998, Presentation to Sunshine Coast stakeholders re progress of CRC project.

Johnson AKL, September 1998, Presentation to SEQ Regional Managers in Maroochydore

Johnson AKL, September 1998, Presentations to Maroochy and Herbert Aac meetings

Johnson AKL, October 1998, Negotiations with University of Queensland re land cover mapping in Sunshine Coast region

Johnson AKL, November 1998, Presentation on the progress of the project to stakeholders in Ingham

Johnson AKL, November 1998, Presentation on the progress of the project to stakeholders in Sunshine Coast

Mallawaarachchi, T. 2001 . Managing production-environmental economic trade-offs in the sugar industry: maximising net farm income under environmental compliance.

Vella, K.J. Proposed vertical expansion of sugar industry on the Sunshine Coast: A regulatory check. Presentation to Sunshine Coast Sugar Millers, Growers and Local governments and Catchment Groups.

Vella, K.J. November 2000. Proposed vertical expansion of sugar industry on the Sunshine Coast: A regulatory check. Sugar Futures Forum, Nambour.

Webb, V.A. October 16-30 November 1999. Individual visits to all members of the CANEGROWERS executive (7 members) and two visits to the Moreton Mill.

Webb, V.A. and D.R. Chalmers. 12 October 1999. Vickie Webb and D.R. Chalmers visited both the Moreton Mill and Moreton Canegrowers to discuss minutes of the Pre-forum meetings, and the next stage of the project.

Webb VA, November 1999, Caloundra City Council, Presentation to advise progress of project and seek continuing commitment from council

Webb VA, November 1999, Maroochy Council, Presentation to advise progress of project and seek their continuing commitment.

Webb VA, November 1999, Moreton Mill, discuss mill aspirations

Webb VA, AKL Johnson, November 1999, Noosa Shire Council, Presentation of progress of project and seek their continuing support and commitment.

Webb VA, December 1999 Moreton Canegrowers, Discuss grower aspirations

Webb VA and research team, December $1999-1^{st}$ Resource Use Futures Forum

Webb VA, February 2000, Cooloola Council, Presentation on project and discussions about possible involvement of Council

Webb VA, February 2000, Moreton Canegrowers, Forum follow up – discuss plans to move forward.

Webb VA, February 2000, Moreton Mill, Forum follow up – discuss plans to move forward $\,$

Webb, VA, April 2000, Economic Associates Pty Ltd, Discussion on transport survey work and relationship to sugar project

Webb VA, April 2000, Maroochy/Mooloolah Catchment Co-ordinating Committee, Presentation on progress of the project and seek their continued commitment to the project

Webb VA, D R Chalmers, C J Mayocchi, April20 00, Management Group – discussion re development of website, the use of NRMtools and the timing of introducing other stakeholders into the project.

Webb VA, May 2000, Economic Associates Pty Ltd – further discussion re transport survey.

Webb VA, May 2000, Qld Department of Natural Resources, Presentation on progress of project in Nambour

Webb VA, DR Chalmers, July 2000, Plan to Plan meeting with Moreton Canegrowers, Nambour

Webb VA, DH Walker, July 2000, Plan to Plan meeting with Moreton Mill and Bundaberg Sugar

Webb VA, August 2000, Meeting Moreton Mill management team to discuss project

Webb VA, September 20 00, Presentation to Noosa CCC reproject

Webb VA, September 2000, Presentation Noosa Council – re progress of project

Webb VA, September 2000, Meeting with Moreton Canegrowers reproject

Webb VA, DH Walker, D Chalmers, September 2000, Presentation to CRC in Nambour

Webb VA, October 2000, Meeting with Moreton Mill management

Webb VA, October 2000, Meeting with Moreton Canegrowers

Webb VA, October 2000, Presentation to Maroochy Council, re progress of project and invite them to participate in next forum.

Webb VA, November 2000, Presentation to Noosa, Maroochy and Cooloola Mayors, re progress of project and to invite them to participate in next forum

Webb VA, November 2000, Presentation to CSIRO re progress of project

Webb VA, and research team, November 2000, - 2^{nd} Resource Use Futures Forum

Webb VA, February 01, Moreton Canegrowers – re progress of project Webb VA, March 2001, Presentation to CANEGROWERS organisation in Brisbane

Webb VA, April 2001, Presentation at shed meeting for growers in Moreton Mill region re progress of project

Webb VA, May 2001, Presentation at new growers meeting in Kyborg Webb VA, D R Chalmers June 2001, Management group meeting re project

Webb VA, July 2001, Moreton Mill – discussions re progress of project Webb, V.A. and D.R. Chalmers. October 2001. Sugar Industry Resource Use Futures. Presentation to CANEGROWERS Moreton Area, Moreton Mill Management Committee

Webb VA December 2001, Caloundra City Council presentation re progress of project

Webb VA, January 202, Moreton Mill - progress meeting

Webb VA, January 2002, Moreton Canegrowers - progress meeting

Webb VA, February 2002, EPA – presentation on project and discuss their involvement in next forum

Webb VA, February 2002, State Development – presentation on project and discuss their involvement in next forum

Webb VA, February 2002, QDPI, Brisbane – presentation on project and discuss their involvement in next forum

Webb VA, March 2002, QDPI Nambour – presentation on project and discuss their involvement in next forum

Webb, V.A., D.H. Walker, and D.R. Chalmers. March 2002. 3rd Resource Use Futures Forum. Presentation to CANEGROWERS Moreton Area, Morton Mill, Maroochy, Cooloola, and Caloundra and Noosa Councils.

Webb VA, April 2002 – 1^{st} Task Force Meeting to discuss future of sugar industry in Sunshine Coast

Webb VA, May 2002 – 2nd Task Force Meeting

Webb VA, June 2002 – 3rd Task Force Meeting

11.2 Workshops / presentations to broader industry groups

Chalmers, D.R. 21 November 2000. Resource Use Futures. TechnologyTransfer Program Consultative Group. Presentation to CANEGROWERS, Brisbane.

Chalmers, D.R. March 2002. Sugar Industry Resource Use Futures. Presentation to CRC Sugar Annual Planning and Review Meeting, Townsville.

Chalmers, D.R. July 2002 . Sugar Industry Resource Use futures. Presentation to CRC Sugar Advisory Committee.

Chalmers, D.R. and D.H. Walker. 11 September 2000. Resource Use Futures. Program 1 Protecting the Environment Program Consultative Group. Nambour Canegrowers Building, Nambour.

Vella, K.J. November 2000. Environmental management and the sugar industry: Are current laws, policies, plans and organisations hitting the spot? Progress Report - Program 1 Protecting the Environment. Program Consultative group.

Vella, K.J. 30 April 2001. International standards for environmental management: ISO 14001 and the sugar industry. Briefing to CANEGROWERS. 8 Pages.

Walker, D.H. March 2002. Sugar Industry Resource Use Futures. Presentation to CRC Sugar Annual Review and Planning Meeting, Townsville.

Walker, D.H., M. Grundy, D.R. Chalmers, and R. de Lai. 2000. Improved foundations for resource use planning. in R.C. Bruce, M.

Johnson, and G.E. Rayment (Editors), Environmental Short Course for Sustainable Sugar Production. CRC Sugar occasional publication, Townsville.

11.3 Evaluation documents

Macgregor, C.J. 1999a. Benchmark Report 1. Sugar Industry Planning Workshops. Series 1: Benchmark Workshops.

Macgregor, C.J. 1999b. Benchmark Survey document. The questions. Macgregor, C.J. 1999c. Sugar Industry Planning Evaluation framework.

Macgregor, C.J. 1999d. Sugar Industry Planning Workshops. Herbert Telephone Responses Workshop 1.

Macgregor, C.J. 1999e. Sugar Industry Planning Workshops, 1st Part of External Review Process. Benchmark Telephone Questions.

Macgregor, C.J. 1999f. Sugar Industry Planning Workshops - Series 1: Benchmark Workshops. Ammendment to Report 1: Answers to Open-ended questions.

Macgregor, C.J. February 2000a. Sugar Industry Planning Workshops. Responses to Telephone Questions. 1st Nambour workshop.

Macgregor, C.J. May 2000b . Improved Integrated Resource Planning in the Australian Sugar Industry. External Evaluation Progress Report.

Macgregor, C.J. 2002a. Herbert 3rd Workshop Report. Sugar Industry Planning Workshops. Series 3 Workshop: Herbert.

Macgregor, C.J. 2002b. Sugar Industry Planning Workshops. Series 3 Post-workshop interviews: Nambour. External Review.

Macgregor, C.J. 2002c. Sugar Industry Planning Workshops. Series 3 Workshop: Nambour. External Review.

Macgregor, C.J. 2002d. Sugar Industry Planning Workshops. Series 3 Post-workshop interviews: Herbert.

11.4 Websites

NRMtools: http://NRMtools-tv.tvl.tag.csiro.au:81

Herbert data resources: http://NRMtools-tv.tvl.tag.csiro.au/herbert/,

Sunshine Coast data resources:

http://NRMtools-tv.tvl.tag.csiro.au/sunshine/

The Herbert Atlas online:

http://NRMtools-tv.tvl.tag.csiro.au/herbert/atlas.htm.

HinchinbrookNQ: http://www.hinchinbrooknq.com

11.5 Posters

The following poster were developed and displayed at Sugar CRC meetings.

Byron, P., D.H. Walker, C. Mayocchi, T. Mallawaarachchi, and S. Ebert. 1999. Options for on-farm management of riparian vegetation: farm financial assessment using NRMtools. Poster.

Chalmers, D.R., V.A. Webb, and D.H. Walker. 2001. Implementation of integrated resource use planning in the Australian sugar industry. Poster.

Chalmers, D.R., V.A. Webb, and D.H. Walker. 2002. Implementation of integrated resource use planning in the Australian sugar industry. Poster.

Johnson, A.K.L., D.H. Walker, and D.R. Chalmers. 1999. Implementation of integrated resource use planning in sugar production. Poster.

Mallawaarachchi, T., A.K.L. Johnson, and S.P. Ebert. Assessing economic - environment trade-off in sugar production: land allocation in the Herbert catchment and Sunshine Coast. Poster.

Mallawaarachchi, T., E. Qureshi, M. Grundy, F. Cook, G. Rayment, R. Beattie, H. Bohl, D. Rassam, F. Cook, and E.A. Gardner. 2001. An irrigation trial in an acid sulphate soils cane field. Poster.

Vella, K.J., G. McDonald, A.K.L. Johnson, and M. Wegener. Assessing institutional arrangements for sustainable development of the Australian sugar industry. Poster.

Vella, K.J., G. McDonald, M. Wegener, and A.K.L. Johnson. 2001. Institutional arrangements for sustainable development: Florida's environmental approaches. Poster.

Vella, K.J., G. McDonald, M. Wegener, and A.K.L. Johnson. 2001. Institutional arrangements for sustainable development: Project overview. Poster.

Vella, K.J., G. McDonald, M. Wegener, and A.K.L. Johnson. 2001. Institutional arrangements for sustainable development: The importance of institutional arrangements. Poster.

Walker, D.H. CRC Activity 1.2.2: Evaluating the environmental and economic impact of land use change and related infrastructure development and planning within the sugar industry. Poster.

Walker, D.H., D. Stehlik, and S. Lockie. Identification of grower, miller and community stakeholder attitudes to socio-economic change in the sugar industry, including extended season length. Poster.

11.6 Conference Papers

Berwick, M., Walker, D., Taylor, J., Keating, B., Muchow, R. and Walker, P. (2001). CSIRO-local government partnership in the Douglas Shire. Proceedings of the National Outlook Conference, Canberra, 27 February-1 March 2001. 4: 59-64

Chalmers, D.R., V.A. Webb, and D.H. Walker. 2001. Integrated resource use planning in the Australian sugar industry. Pages 34-40 in "Unpresented papers" Australian Pacific Estension Network (APEN) International Conference. Toowoomba, 3-5 October 2001.

de Lai, R., J.R.P. Hardman, and D.H. Walker. 2000. Community-based GIS for catchment management - an evaluation of the impact of the Herbert Resource Information Centre in north Queensland. 3rd Queensland Environment Conference - Sustainable environmental solutions for industry and government. Brisbane, Australia, 25-26 May 2000.

Johnson, A.K.L. and J.A. Bellamy. 2000. Managing for ecological sustainability: Moving from rhetoric to practice in the Australian

sugar industry. Pages 163-174 in P. Hale, A. Petrie, D. Moloney, and P. Sattler (Editors), Management for Sustainable Ecosystems. Conservation Biology, University of Queensland, Brisbane.

Johnson, A.K.L. and D.H. Walker. 1999. Science, communication and public participation for integrated resource management in the wet tropics of northern Australia. XIX Pacific Science Congress. Sydney, July 1999. Pacific Science Association, Sydney.

Leitch, A.M. 2001. The role of communication in natural resource management: a case study in the Herbert region. National Conference of the Australian Science Communicators. Powerhouse Museum, Sydney, Australia, 23-26 September 2001.

Leitch, A.M., D.H. Walker, A.P. Dale, and J.A. Bellamy. November 2000. Community-based information systems: two Queensland case studies. Presentation to Murray-Darling Basin meeting at Roma.

Mallawaarachchi, T. 2001 . Conflicts and value trade-offs in the management of common property: insights from land use studies in the Australian sugar industry. Inaugural Pacific Region Meeting of the International Association for the Study of Common Property. Brisbane, Queensland, Australia,

Mallawaarachchi, T., R.K. Blamey, M. Morrison, A.K.L. Johnson, and J. Bennett. 1999. Measuring community values for environmental protection: a choice modelling study of a cane farming catchment in North Queensland. 43rd Annual Conference of the Australian Agricultural and Resource Economics Society. Christchurch, New Zealand, 20-22 January 1999.

Mallawaarachchi, T. and B. Jacobsen. 2000. Determining non-market benefits in environmental management in the sugar industry: Concepts and applications. Proceedings of the 2000 Conference of the Australian Society of Sugar Cane Technologists 22: 308-314

Mallawaarachchi, T., M.D. Morrison, and R.K. Blamey. 2001. Determining the community value of peri-urban land: The significance of environmental amenity and production alternatives. 45th Annual Conference of the Australian Agricultural and Resource Economics Society. Stamford Plaza, Adelaide, South Australia, 23-25 January 2001. Australian Agricultural and Resource Economics Society,

Mallawaarachchi, T., M.D. Morrison, and S.P. Ebert. 2000. Integrating economic, environmental and social choice criteria in landuse planning: case studies in cane land allocation in coastal Queensland, Australia. 4th International Conference in Integrating GIS and Environmental Modeling (GIS/EM4): Problems, Prospects and Research Needs. Banff, Alberta, Canada, 2-8 September 2000. http://www.colorado.edi/research/cires/banff/upload/455/

Mallawaarachchi, T. and J. Quiggin. 1999. Determining public welfare values in land allocation: a case study of the sugar industry in northern Australia. 43rd Annual Conference of the Australian Agricultural and Resource EconomicsSociety. Christchurch, New Zealand, 20-22 January 1999.

Mallawaarachchi, T., J. Quiggin, and S. Ebert. 2000. Integrated assessment methods for land-use planning: Combining economic, environmental and social objectives. Congress 2000 of the International Society of Ecological Economics. The Australian National University, 5-8 July 2000. Canberra, Australia.

Mallawaarachchi, T., D.H. Walker, and A.K.L. Johnson. 1997. Towards a systematic approach to multiple resource use in catchment management for nothern sugar regions. The 2nd National Workshop on Integrated Catchment Management. The Australian national University, 29 September - 1 October, 1997. River basins management society, inc., Canberra, Australia.

Morrison, M., R. Blamey, and T. Mallawaarachchi. 2001. Ethical design of stated preference questionnaires: Results from a split-sample test. 45th Annual conference of the Australian Agricultural and Resource Economics Society. Stamford Plaza, Adelaide, South Australia, 23-25 January 2001. Australian Agricultural and Resource Economics Society,

Murray, A.E. 2000. Rainfall surface interpolation and applications for the sugar industry. Proceedings, 28th Annual Conference of AURISA Shrubsole, D., A. Johnson, A.E. Murray, S. Ebert, P. Chalk, P. Jones, and M. Green. February 1999. Ecologically sustainable development in a global economy, environmental management in the sugarcane assignment process, Herbert River district, Queensland, Australia, 1993-1996. CSIRO Tropical Agriculture and The University of Western Ontario, Indooroopilly, Queensland, Australia.

Vella, K.J. 2001. Thinking outside the square: The rise of rural and environmental land use planning n Queensland and the role of RAPI. Queenslander Planner. Queensland Division of Royal Australian Planning Institute, Brisbane 41: 7-10

Vella, K.J., A.E. Bellamy, and G.T. McDonald. 1999. Looking beyond the fences: Institutional challenges to integrated approaches to catchment management. Pages 24 in International Symposium on Society and Resource Management: Application of Social Science to Resource Management in the Asia Pacific Region. University of Queensland, 7-10 July 1999. Brisbane, Australia.

Vella, K.J. and G.T. McDonald. 2000. Institutional arrangements for environmental management and the sugar industry. Pages 15-18 in R.C. Bruce, M. Johnston, and G.E. Rayment (Editors). Environmental Short Course for Sustainable Sugar Production, course notes. CANEGROWERS, Mackay, Queensland, 14-15 June 2000. Sugar CRC, James Cook University, Townsville.

Vella, K.J., G.T. McDonald, and A.K.L. Johnson. 2000. Using ISO 14001 to evaluate Institutional Arrangements for Ecologically Sustainable Development. Pages 2-15 in Sustainability: The Triple Bottom Line - Reality or Fantasy. Queensland Environment Law Association Conference. Kooralbyn, 11 - 13 May 2000.

Walker, D.H., P. Byron, and C.J. Mayocchi. 1999. Decision support for integrated natural resource management: Helping resource managers explore new issues. Proceedings MODSS'99 Conference. 1-6 August 1999. Brisbane.

Walker, D.H., S.G. Cowell, and A.K.L. Johnson. 1998. Integrating R & D into decision-making for natural resource management at a regional scale. Pages 89-99 in Process-based Research in Sustainable Agricultural Development: Integrating Social, Economic and ecological Perspectives. Petoria, South Africa, 3 December 1998. A joint meeting between the IUFRO research group on agroforestry and the AFSR-E,

Walker, D.H., S.G. Cowell, and A.K.L. Johnson. 1998. Integrating R & D into decision-making for natural resource management at a regional scale. Proceedings of an International Conference on Agricultural and Farming Systems Research and Extension. Petoria, South Africa, November 1998.

Walker, D.H. and X. Zhu. 2000. Decision support for rural resource management. Pages 23-35 in I. Guijt, J.A. Berdegue, and M. Loevinsohn (Editors). Deepening the Basis of Rural Resource Management. INSAR, The Hague, 16-18 February 2000. ISNAR & RIMISP, The Netherlands.

Walmsley, A.J., D.H. Walker, T. Mallawaarachchi, and A. Lewis. 1999. Integration of spatial land use allocation and economic optimisation models for decision support. Pages 1075-1080 in Les Oxley and Frank Scrimgoeur (Editors). Proceedings, MODSIM 99: International congress on Modelling and Simulation, Volume 4. University of Waikato, Hamilton, New Zealand, Modelling and Simulation Society of Australia, Inc., Canberra, Australia.

Webb, V.A. and D.R. Chalmers. 2001. Improved integrated resource use planning in the Australian sugar industry. Creating a Climate for Change? Australasia-Pacific Extension Network National Conference. Melbourne, 26-27 October 2000.

Zhu, X., D.H. Walker, and C.J. Mayocchi. 2001. Integrating multicriteria modelling and GIS for sugarcane land allocation. Pages 1103-1108 in F. Ghassemi, M. McAleer, L. Oxley, and M. Scoccimarro (Editors). MODSIM 2001, International Congress on Modelling and Simulation. Integrating models for Natural Resources Management Across Disciplines, Issues and Scales. Volume 3: Socioecnomic Systems. The Australian National University, 10-13 December 2001. Modelling and Simulation Society of Australia and New Zealand Inc., Canberra, Australia.

11.7 Journal Papers

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Johnson, A., J. Bellamy, and V. Webb. (submitted). Public participation in natural resource management: Lessons from contemporary action in rural Australia.

Johnson, A.K.L. and S.P. Ebert. 2001. Quantifying the inputs of pesticides and other contaminants to the Great Barrier Reef Marine Park - a case study in the Herbert River catchment of northeast Queensland. Marine Pollution Bulletin 41: 320-309

Johnson, A.K.L., S.P. Ebert, and A.E. Murray. 1999. Distribution of coastal freshwater wetlands and catchments adjacent to the Great Barrier Reef Marine Park. Environmental Conservation 26: 229-235 Johnson, A.K.L., S.P. Ebert, and A.E. Murray. 1999. Spatial and and

temporal distribution of wetland and riparian zones and opportunities for their management in catchments adjacent to the Great Barrier Reef. Environmental Conservation 26: 229-235

Johnson, A.K.L., S.P. Ebert, and A.E. Murray. 2000. Land cover change and its environmental significance in the Herbert River catchment, North-east Queensland. Australian Geographer 31: 75-86

Johnson, A.K.L. and A.E. Murray. (submitted). Modelling the spatial and temporal distribution of rainfall: A case study in the wet and dry tropics of NE Australia. Australian Geographer

Johnson, A.K.L. and D.H. Walker. 2000. Science, communication and stakeholder participation for integrated natural resource management. Australian Journal of Environmental Management 7: 82-90

Kininmonth, S. (2002) in press. Road network analysis of sugar cane haulage in the Sunshine Coast region, Queensland. Australian Journal of Agricultural Research

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Improved Integrated Resource Planning in the Australian Sugar Industry

Appendices

To the

Final Report to the Sugar Research and Development Corporation

June 2002

Appendix 1 – Datasets

List of datasets (coverages) in the SUNSHINE COAST spatial database.

Tilde (~) indicates an estimated scale. Detailed list of acronyms below.

| COVERAGE THEME | DESCRIPTION | SCALE | CUSTODIAN |
|--|--|---|--------------------------------------|
| ADMINISTATIVE | | | |
| BOUNDARIES Cooloola Shire Maroochy Shire Maroochy Suburbs Noosa Shire Study Area | Cooloola Shire boundary. Subset of DCDB. Maroochydore Shire boundary. Maroochydore suburb areas. Noosa Shire boundary. Study area boundary for REG CSIRO Sunshine Coast integrated resource planning project for sugar industry. | 1:50000 1:50000 1:50000 1:50000 1:50000 | CoolSC MSC MSC NSC CSIRO |
| CENSUS | | | |
| 1986 Census | 1986 Census figures for Maroochydore Shire. | 1:2500 to 1:250000 | ABS |
| 1991 Census | 1991 Census figures for Maroochydore Shire. | 1:2500 to 1:250000 | ABS |
| 1996 Census | 1996 Census figures for Maroochydore Shire. This dataset is incomplete, not all data entered. | 1:2500 to 1:250000 | ABS |
| CLIMATE Average Annual Rainfall | Average annual rainfall surface for the Sunshine Coast and hinterland area. | 1:250000 | CSIRO CSE |
| Average Monthly Rainfall | Average monthly rainfall surface for the Sunshine Coast and hinterland area. | 1:250000 | CSIRO CSE |
| GEOLOGY | | | |
| Geology ~ Caboolture | Geology for the Caboolture area. Generated in 1994 for the Atlas of Natural Resources. | ~1:25000 0 | CSC |
| Geology ~ Caloundra | Geology for the Caloundra area. | ~1:25000 0 | CCC |
| HYDROLOGY | | | |
| Catchments Dam Catchments | Water catchments in the Caboolture area. Catchments for major (3) dams in the Maroochydore area. | ~1:50000 ~1:50000 | CSC MSC |
| Dams Drainage | Major (3) dams in the Maroochydore area. Drainage in the south-eastern part of the Caboolture Shire, excluding Bribie Island. Includes dams. | ~1:50000 ~1:25000 | MSC CSC |
| Floods ~ Caboolture | One in 100 year floods levels for the Caboolture River, Burpengary Creek, Six Mile Creek, Gympie Creek and Saltwater Creek. | ~1:50000 | CSC |
| Floods ~ Caloundra | Flood levels for the Caloundra City area. | 1:100000 | CCC |
| Floods ~ Noosa | One in 100 year flood levels in the Noosa area. Linework from raster source. | ~1:10000 0 | NSC |
| Hydrology ~ Maroochy | Hydrology in the Maroochydore area. | ~1:10000 0 | MSC |
| Hydrology ~ Noosa | Hydrology in the Noosa area. Includes rough linework for Mary River. | 1:25000 | NSC |
| Hydro250 | Hydrology on the Gympie 1:250000 mapsheet. | 1:250000 | AUSLIG |
| Islands | Islands on the Gympie 1:250000 mapsheet. | 1:250000 | AUSLIG |

| COVERAGE THEME | DESCRIPTION | SCALE | CUSTODIAN |
|---------------------------------------|--|---------------|-----------|
| Ocean area | Ocean mapping in the Noosa area. Linework not detailed. | 1:25000 | NSC |
| Open Water | Open water mapped for the Gympie 1:250000 mapsheet. | 1:250000 | AUSLIG |
| Open Water ~ Cooloola | Open water mapped for the Cooloola area. | ~1:10000 0 | CoolSC |
| Rivers | Rivers in the Caboolture area. | ~1:10000 0 | CSC |
| Rivers | Rivers in the Cooloola area. Main streams only. | ~1:10000 0 | CoolSC |
| Shorelines | Shorelines mapped for the Gympie 1:250000 mapsheet. | 1:250000 | AUSLIG |
| Subcatchments | Subcatchments mapped for the Maroochydore area. | ~1:50000 | MSC |
| IMAGES | | | |
| 1979 Landsat MSS | 12 September 1979 Landsat MSS Imagery for the | 57m | ACRES |
| Imagery | Sunshine Coast. Systematic level 8 corrections applied. | pixel | |
| 1979 Classified | 1979 Landsat MSS Imagery for the Sunshine | 57m | CSIRO |
| Landsat MSS | Coast, classified according to land cover by UQ, as | pixel | |
| Imagery 1988 Landsat TM | consultants for CSIRO. 29 September 1988 Landsat MSS Imagery for the | 25m | ACRES |
| Imagery | Maroochy, Mooloolah and entire Sunshine Coast areas. | pixel | ACILLS |
| 1988 Classified | 1988 Landsat MSS Imagery for the Maroochy, | 25m | CSIRO |
| Landsat TM Imagery | Mooloolah and entire Sunshine Coast areas, | pixel | |
| | classified for land cover by UQ, as consultants for CSIRO. | • | |
| IMAGES | | | |
| 1991 Landsat TM | 2 July 1991 Landsat MSS Imagery for the | 25m | ACRES |
| Imagry | Sunshine Coast. | pixel | CCIDO |
| 1991 Classified Landsat TM Imagery | 1991 Landsat MSS Imagery for the Sunshine Coast area, classified for land cover by UQ, as consultants for CSIRO. | 25m pixel | CSIRO |
| 1997 Landsat TM | 6 September 1997 Landsat MSS Imagery for the | 25m | ACRES |
| Imagery | Maroochy, Mooloolah and entire Sunshine Coast areas. | pixel | ACKES |
| 1997 Classified | 1997 Landsat MSS Imagery for the Maroochy, | 25m | CSIRO |
| Landsat TM Imagery | Mooloolah and entire Sunshine Coast areas, | pixel | |
| | classified for land cover by UQ, as consultants for CSIRO. | • | |
| LANDFORM | | | |
| Biounit | Biounit mapping for Cooloola area. All biophysical units on which veg, landform and soils were based are shown. | ~1:50000 | CoolSC |
| Landform | Landform mapping for the Caboolture Shire area. | ~1:10000 0 | CSC |
| Landscape | Landscape mapping for the Caboolture Shire area. Generated in 1994 for the Atlas of Natural Resources. | ~1:10000 0 | CSC |
| Land Resource Units | Land resource and terrain units for Cooloola Shire. Generated in 1994 for the Atlas of Natural Resources. | ~1:50000 | CSC |
| LANDUSE | A . 1. 11 1 2 2 2 2 2 2 2 2 2 | 4 #0000 | aga |
| Agri Land Suitability ~ Caboolture | Agricultural land suitability in the Caboolture area. General classes only. | ~1:50000 | CSC |
| Agri Land Suitability ~ Caloundra | Agricultural land suitability in the Caloundra area. | ~1:50000 | CCC |

| COVERAGE THEME | DESCRIPTION | SCALE | CUSTODIAN |
|---|--|--------------------------------------|----------------------------|
| Agri Land Suitability ~ Cooloola | Agricultural land suitability in the Cooloola area. | ~1:50000 | CoolSC |
| Agri Land Suitability ~ Moreton | Agricultural land suitability in the Moreton Sugar Mill area, which overlaps Maroochydore & Caloundra areas. Refer to the 1987 Caplin Report, (categs 1-6). | ~1:25000 | QDNR |
| Agri Land Suitability ~ Noosa | Agricultural land suitability in the Noosa area. Note: linework from raster source. | ~1:25000 | NSC |
| Land Use ~ | Land use mapping for the Caloundra City Council area. | ~1:50000 | CCC |
| Land Use ~ Maroochy | Land use mapping for the Maroochydore Shire area. | ~1:10000 0 | QDNR |
| Land Use ~ Noosa UMA ~ Noosa | Land use mapping for the Noosa Shire area. Unique Mapping Areas for the Noosa Shire area. Includes geology, soil, slip hazard and land suitability ratings. | 1:25000 1:25000 | NSC NSC |
| LOCALITIES | | | |
| Airports Localities Urban Areas | Airports on the 1:250000 Gympie mapsheet. Localities on the 1:250000 Gympie mapsheet. Urban areas located on the 1:250000 Gympie | 1:250000 1:250000 1:250000 | AUSLIG AUSLIG AUSLIG |
| Urban Areas ~ Cooloola | mapsheet. Urban areas mapped for the Cooloola Shire. | 1:50000 | CoolSC |
| PLANNING 1993 Strategic Plan | 1993 Strategic Land Use Plan for the Caboolture Shire. | 1:50000 | CSC |
| QLID QLID ~ Maroochy | Queensland Land Information Directory (QLID) for the Maroochydore area. | Various | QDNR |
| RAIL Railways ~ Cooloola Rail250 Cane Tramways | Railways in the Cooloola area. Railways mapped for the Gympie 1:250000 mapsheet. Moreton mill cane tramways | 1:50000 1:250000 | CoolSC AUSLIG |
| RELIEF | | | |
| Contours | Contours for the Caloundra City Council area. Interval: 5m. | 1:5000 | CCC |
| DEM ~ Caboolture | Digital elevation model data for the north Caboolture area. Point elevation data measured to the nearest metre. | ~1:50000 | CSC |
| DEM ~ Caloundra Elevation250 Slope ~ Caboolture | Digital elevation model for the Caloundra area. Spot heights for the Gympie 1:250000 mapsheet. Areas with slope > 1 in 6 mapped in the Caboolture area. | 1:50000 1:250000 ~1:10000 0 | CCC AUSLIG CSC |
| Slope deg ~ Caloundra | Degree slope mapped for the Caloundra area. | ~1:50000 | CCC |
| Slope % ~ Caloundra Slope ~ Cooloola | Percentage slope mapped for the Caloundra area. Slope classified into general classes for the Cooloola area. | ~1:50000 ~1:25000 | CCC CoolSC |
| Slope % ~ Noos a | Percentage slope classified into general classes for Noosa. | ~1:25000 | NSC |
| Spot Heights | Spot heights for the Sunshine Coast area, excluding Caloundra. | 1:25000 | QDNR |
| Topography ~ Caloundra | Contours for the Caloundra 1:25000 mapsheet. | 1:25000 | QDNR |

| COVEDACE | DECCRIPTION | SCALE | CUSTODIAN |
|---|---|----------|-------------|
| COVERAGE THEME | DESCRIPTION | SCALE | CUSTUDIAN |
| Topography ~ | Contours & spot heights for Cooloola 1:25000 | 1:25000 | QDNR |
| Coolooola | mapsheet. | 1.05000 | ODNID |
| Topography ~ Coolum | Contours & spot heights for Coolum 1:25000 mapsheet. | 1:25000 | QDNR |
| Topography ~ Maroochy | Contours & spot heights for Maroochy 1:25000 mapsheet. | 1:25000 | QDNR |
| Topography ~ Noosa | Contours & spot heights for Noosa 1:25000 mapsheet. | 1:25000 | QDNR |
| Topography ~ Teewah | Contours & spot heights for Teewah 1:25000 mapsheet. | 1:25000 | QDNR |
| ROAD | | | |
| Road250 | Roads mapped for the Gympie 1:250000 mapsheet. | 1:250000 | AUSLIG |
| Roads ~ Cooloola | Roads in the Cooloola Shire area. | 1:50000 | CoolSC |
| Roads ~ Sunshine Coast | Main roads in the Sunshine Coast area and inland. | 1:250000 | DMR |
| SOILS | | | |
| Acid Sulphate Soil | Areas of potential acid sulphate soils in the Caboolture area. Generated by QDNR in 1998. | 1:50000 | QDNR |
| Risk ~ Caboolture Acid Sulphate Soil | Areas of potential and affected acid sulphate soils | 1:50000 | CCC |
| Risk ~ Caloundra Acid Sulphate Soil | in the Caloundra area Potential acid sulphate soils mapped along the | 1:50000 | QDNR |
| Risk ~ Sunshine | coast from Noosa to the Gold Coast. | 1.00000 | QDIVIC |
| Coast | | | |
| Soils ~ Cooloola | General soil types mapped for the Cooloola area. | 1:50000 | CoolSC |
| Soils and Land | Soils and land suitability of the Kenilworth- | 1:50000 | QDNR |
| Suitablty | Conondale area | | |
| SUGAR | | | |
| 1997 Sugarcane | 1997 Sugarcane assignment boundaries mapped for | ~1:50000 | MSM |
| 1998 Sugarcane | the Moreton Mill. 1998 Sugarcane assignment boundaries mapped for | ~1:50000 | MSM |
| 1000 Sugarcane | the Moreton Mill. | ~1.50000 | WISIVI |
| Land Suitability for | Land suitability for cane in the Caloundra area. | ~1:50000 | CCC |
| Sugarcane | I and make hilter for any and the Manatan Mill | 1.100000 | CCIDO |
| Land Suitability for Sugarcane | Land suitability for cane across the Moreton Mill sugar district and surrounds. | 1:100000 | CSIRO |
| Land Suitability for | Land suitability for sugarcane in the Maroochydore | ~1:50000 | MSC |
| Sugarcane | area. Based on Capelin, 1987. | | |
| Land Suitability for | Land suitability for horticulture in the | ~1:50000 | MSC |
| Horticulture | Maroochydore area. Based on Capelin, 1987 (includes classes 1 - 6). | | |
| Moreton Sugar Mill | Boundary of the Moreton Sugar Mill cane area. | ~1:25000 | QDNR |
| Boundary | Boundary of the Moreton Sugar Min cane area. | 0 | QDIVIC |
| Sugarcane Extent | Extent of sugarcane areas along the Sunshine Coast, 1995. | 1:100000 | QDNR |
| Sugar Transportation | Analysis of sugar transportation times across the | 1:100000 | CSIRO |
| Times | road network servicing the Moreton Mill district | | |
| G | and surrounds. | | |
| Sugarcane | Sugarcane productivity data for 1991- 1999 for the | na | CaneGrowers |
| Productivity | Moreton Mill growing area. See data supply agreement for conditions. | | |
| | apreciment for conditions. | | |

| COVERAGE | DESCRIPTION | SCALE | CUSTODIAN |
|---------------------------------|--|--------------------|-------------------|
| THEME | | | |
| TENURE DCDB ~ Caboolture | Digital and actual database for the Cabacitum Shine | 1.50000 | ODND |
| DCDB ~ Caboorture | Digital cadastral database for the Caboolture Shire. | 1:50000 | QDNR QDNR |
| | Digital cadastral database for Caloundra City. | 1:50000 1:50000 | QDNR QDNR |
| DCDB ~ Cooloola | Digital cadastral database for the Cooloola Shire. | | • |
| DCDB ~ Kilco y DCDB ~ | Digital cadastral database for the Kilcoy Shire. | 1:50000 | QDNR |
| | Digital cadastral database for the Maroochydore | 1:50000 | QDNR |
| Maroochydore | Shire. | 1.50000 | ODND |
| DCDB ~ Noosa MSC Crown Land | Digital cadastral database for the Noosa Shire. | 1:50000 1:50000 | QDNR MSC |
| MSC Land sub 5K | Maroochydore Shire Council crown land. Land parcels smaller than 0.5ha for Maroochy | | MSC |
| MSC Land Sub 5K | Shire. | ~1:50000 | MSC |
| MSC Owned Land | Maroochydore Shire Council owned land. Derived | 1:50000 | MSC |
| MSC Trustee Land | from MSC Zones. Maroochydore Shire Council trustee land. Derived | 1:50000 | MSC |
| | from MSC Zones. | | |
| MSC Zones | Maroochydore Shire Council land zoning. | 1:50000 | MSC |
| TENURE | | | |
| National Parks ~ | National Parks in the Caboolture Shire area. | ~1:50000 | CSC |
| Cabool. | State forest in the Caboolture area. Subset of the | 1:50000 | QDNR |
| State Forest ~ | DCDB. | 1:50000 | QDNR |
| Caboolture | State forest in the Caboolture area. Subset of the | | |
| State Forest ~ | DCDB | | |
| Maroochy | | | |
| VEGETATION | | | |
| Bioprovinces | Bioregions and provinces for Queensland. | 1:100000 | QDoE/EPA |
| Estates | Estates are the QDoE protected areas for | 1:100000 | QD ₀ E |
| | Queensland. | | • |
| Forestry Plantations | Queenslands forestry plantations. | 1:10000 | QDPI |
| Old Growth | Old growth forest classes defined by the SEQ Old | 1:100000 | QDNR |
| | Growth Forest Assessment Project (1998) | | |
| Parks & Gardens | All the areas maintained by the Maroochy Council's | ~1:25000 | MSC |
| | Parks section. | | |
| Pine Forests | Pine forests mapped for the Caloundra area. | ~1:10000 | CCC |
| Forestry Plantations | Public plantations, predominantly softwood. | 1:10000 | QDPI |
| _ | Current to May 2000. | | |
| Remnant Vegetation | Remnant vegetation mapped for the Caboolture | ~1:25000 | CSC |
| | area. Note, much of this mapping is now out of | | |
| Remnant Vegetation | date. | ~1:25000 | MSC |
| | Remnant vegetation mapped for the Maroochy | | |
| | Shire. Veg type, veg community and veg | | |
| | disturbance are described. | | |
| Vegetation ~ | Vegetation mapped for the Caloundra area. Olsen | ~1:10000 | CCC |
| Caloundra | vegetation classification used. | 4 400 | 999 |
| *** | Vegetation mapping completed in 2001 for | ~1:10000 | CCC |
| Vegetation ~ | Caloundra City. | | |
| Caloundra | | 4.07000 | G 100 |
| Vegetation ~ Cooloola | Vegetation units mapped for the Cooloola Shire. | ~1:25000 | CoolSC |
| Vegetation ~ Moreton | Vegetation mapped for the Moreton Mill and | ~1:25000 | MSC |
| 77 | Maroochy areas, includes a veg value classification. | 1.05000 | NICC |
| Vegetation ~ Noosa | Vegetation mapped for the Noosa area. | 1:25000 | NSC |
| Vegetation ~ Rainbow | Vegetation units mapped for the Rainbow Beach | ~1:10000 | CoolSC |
| T | area. | 1 10000 | 0 100 |
| Vegetation ~ Tin Can | Vegetation units mapped for the Tin Can Bay area. | ~1:10000 | CoolSC |
| Veg Units ~ | Vegetation units mapped for the Maroochydore | ~1:25000 | MSC |
| Maroochy | area. Point data. Complements the Moreton | | |
| | vegetation mapping. | | |

| COVERAGE THEME | DESCRIPTION | SCALE | CUSTODIAN |
|-------------------|--|----------|-----------|
| VEGETATION | | | |
| CLEARING | | | |
| 1995 Pre-Clearing | Pre-clearing Vegetation Survey and Mapping of the South-Eastern Queensland Biogeographic Region (1997) | 1:100000 | Qld Herb |
| 1997 Remnant Veg | Remnant 1997 - Vegetation Survey and Mapping of the South-Eastern Qld Biogeographic Region (1997) | 1:100000 | Qld Herb |

List of datasets (coverages) held in the HERBERT spatial database.

Tilde (~) indicates an estimated scale. Detailed list of acronyms below.

| COVERAGE THEME | DESCRIPTION | SCALE | CUSTODIAN |
|----------------------------|---|-----------------------|-----------------------------|
| BATHYMETRY | | | |
| Bathymetry | Continental Shelf seabed - point dataset, depths in metres. Covering Proserpine to Cairns. | 1:250000 | Royal Australian Navy |
| CADASTRE | | | |
| Cadastre | QDNR Digital Cadastral Database (DCDB) for covering the following shires: Cardwell, Herberton, Hinchinbrook & Thuringowa. | 1:50000 | QDNR |
| Cadastre & SCAR | DCDB linked with the Sugar Cane Assignment Register (SCAR) data. | 1:50000 | QDNR |
| CLIMATE | | | |
| Automatic Weather stations | CSIRO automatic weather stations in the Herbert River catchment | 1:50000 | CSIRO |
| BoM Rainfall stations | BMet Rainfall stations in the Herbert River catchment | 1:50000 | BoM |
| CSR Rainfall stations | CSR rainfall stations in the Herbert River catchment | 1:50000 | CSR |
| Isohyets | Annual rainfall contours for the Herbert River catchment | 1:500000 | CSIRO |
| Isopleths | Rainfall intensity isopleths - 12 hour duration. (lines of equal rainfall intensity). | 1:1millio n | BoM |
| Rainfall Intensity | Rainfall intensity data points - 12 hour duration. | 1:1millio n | BoM |
| Rainfall Surfaces | Annual and monthly rainfall surfaces covering the Herbert River catchment and surrounds. | 225m pixel | CSIRO |
| River heights | River height stations in the Herbert River catchment | 1:50000 | BoM |
| Water Quality stations | CSIRO water quality monitoring stations | 1:50000 | CSIRO |
| DEMOGRAPHY | | | |
| 1991 Census | 1991 ABS census data for Hinchinbrook and Herberton Shire collection districts | 1:2500 to 1:250000 | ESRI Aust. |
| FORESTRY | | | |
| Forestry | Abergowrie and Lannercost forestry compartments. | 1:10000 | Dept. Forestry |
| Management | | | |
| GEOLOGY | | | |
| Geology | Geology of the Herbert River catchment (subset of UMAs) | 1:250000 | CSIRO |
| Geology (Cox) | Geology; by Randel B.Cox, Hydrogeology of the Herbert Delta, Ingham. | 1:300000 | CSIRO |
| Geology Grid | Atherton, Einasleigh, Innisfail & Ingham geology rasterized map sheets. | 20m pixel | DME |
| HYDROLOGY | | | |
| Aquifers | Aquifers - lower Herbert River Catchment {Cox, 1979} | 1:50000 | CSIRO |
| AUSLIG Hydrology | Hydrology covering the 1:250000 mapsheets of Atherton, Einasleigh, Ingham and Innisfail | 1:250000 | AUSLIG |
| Coastline | Coastline from Herbert River to Cairns. | 1:50000 | CSIRO |

| COVERAGE | DESCRIPTION | SCALE | CUSTODIAN |
|---------------------------------------|---|--------------|-----------|
| THEME | | | |
| Drainage | Drainage network - Cameron McNamara study. | 1:5000 | HSC |
| Drainage | Drainage management boundaries (SIIP) in the | 1:100000 | QDNR |
| Management Drainage Subsidy | lower Herbert River catchment. Categories indicating works required for drainage | 1:5000 | HSC |
| Dramage Subsidy | subsidy purposes. | 1.3000 | 1150 |
| Flood Extents | 1900, 1967 & 1977 Flood extents for lower Herbert | 1:50000 | HSC |
| 11004 2.1101145 | River catchment. | 1.00000 | 1100 |
| Flood Contours | 1967 & 1977 Flood contours for lower Herbert | 1:50000 | HSC |
| | River flood plain. | | |
| Flood Levels | 1967, 1977, 1986 & 1991 Flood spot height levels | 1:50000 | HSC |
| G 1 . D | for lower Herbert River catchment. | 4 50000 | GGIDO |
| Groundwater Bores | Bore water quality sampling points - lower Herbert | 1:50000 | CSIRO |
| Herbert Catchments | River catchment Catchments for the Herbert River catchment. | 1:100000 | CSIRO |
| Herbert Catchinents Herbert Coastline | Coastline - Herbert River Catchment | 1:50000 | CSIRO |
| Herbert Hydrology | Hydrology and coastline - Herbert River Catchment | 1:50000 | CSIRO |
| Herbert River | | 1:50000 | CSIRO |
| Catchment | Herbert River Catchment boundary | 1.30000 | CSIRO |
| HMP Hydrology | Hydrology - linear features | 1:10000 | HMP via |
| Third Trydrology | Trydrology - Inlear leadures | 1.10000 | QDNR |
| HMP Hydro Areas | Hydrology - area features | 1:10000 | HMP via |
| Third Hydro Areas | Trydrology - area reatures | 1.10000 | QDNR |
| Hydrology | Hydrology from 1:50000 mapsheets covering the | 1:50000 | WTMA |
| 11) at orogy | Herbert River Catchment & surrounds. | 1.00000 | ******* |
| Lower Catchments | Catchments - lower Herbert River Catchment | 1:50000 | CSIRO |
| Main Rivers | Main rivers network for the Herbert River | 1:50000 | CSIRO |
| 1114111 1011 015 | catchment & areas to the north to Cairns. | 1.00000 | 001110 |
| Micro Catchments | Micro catchment divisions - Cameron McNamara | 1:5000 | HSC |
| | study | | |
| Streams & Drains | Streams and drains digitised from 1993 1:25000 | 1:25000 | QDNR |
| | colour aerial photos. (Perry, 1993) | | |
| Stream Guages | Stream height gauge locations - Herbert River | 1:50000 | CSIRO |
| | catchment | | |
| Stream Ordering | Stream ordering was determined for streams in the | 1:250000 | CSIRO |
| | Herbert River catchment using the Strahler | | |
| | ordering method. Ordering was completed | | |
| | manually. | 4 7000 | 1100 |
| Subcatchments | All subcatchments delineated by the Cameron | 1:5000 | HSC |
| | McNamara study. Includes Abergowrie, Cattle | | |
| | Creek, Palm Creek and Trebonne Creek | | |
| Water Ovelity | catchments. | 1.50000 | CCIDO |
| Water Quality | Stream water quality sampling pnts -upper & lower | 1:50000 | CSIRO |
| | Herbert River catchment | | |
| INDEX | | | |
| Herbert Map Index | Index of 1:5000, 1:10000, 1:20000, 1:50000 & | 1:5000 | CSIRO |
| - 1012012 Map Huch | 1:250000 scale mapsheets for Herbert River | => | 22270 |
| | catchment | 1:250000 | |
| Qld Mapsheet Index | Index of 1:100000 & 1:250000 mapsheets for all of | 1:100000 | QDNR |
| | Queensland | 1:250000 | - |
| Tic Reference Points | Base tic (reference point) coverage for the Herbert | 1:50000 | CSIRO |
| | River catchment | | |
| | | | |
| INFRA- | | | |
| STRUCTURE | | | |
| Annotation | Names of features (eg: streams, towns, mts) | 1:100000 | CSIRO |
| Buildings | Buildings - Cameron McNamara study area | 1:5000 | HSC |
| Herbert Localities | Names of major places and features -Herbert River | 1:250000 | CSIRO |
| COVEDACE | catchment | SCALE | CUSTODIAN |
| COVERAGE THEME | DESCRIPTION | <u>SCALE</u> | CUSTODIAN |
| Localities | Points indicating localities on 1:250000 mapsheets | 1:250000 | AUSLIG |
| Locanties | 1 onto marcating rotanties on 1.200000 mapsileets | 1.200000 | AUDLIG |

| | | | 1 |
|--------------------------------------|--|-----------|-----------|
| | of Atherton, Einasleigh, Ingham and Innisfail | 107 111 | CCIDO |
| Qld State Outline | Queensland State border and Herbert River | 1:2.5mill | CSIRO |
| m 1. | catchment bnd. | 4.050000 | CCIPO |
| Templates | Templates (major roads & streams) - Herbert R. | 1:250000 | CSIRO |
| Urban Areas | Urban areas on 1:250000 mapsheets of Atherton, | 1:250000 | AUSLIG |
| T.T. 114.4 | Einasleigh, Ingham and Innisfail | 4.40000 | 111 CD . |
| Utilities | HMP Utilities (eg: airports, buildings, etc.). | 1:10000 | HMP via |
| | | | QDNR |
| | | | |
| LAND COVER | T 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | 4.400000 | CCIPO |
| Land Cover | Land cover mapping over the Herbert River | 1:100000 | CSIRO |
| C . N. d | catchment for every decade since the 1940's. | 1 100000 | ODND |
| Sugarcane North | Sugarcane in northern Queensland, north of the | 1:100000 | QDNR |
| | Herbert. | | |
| LANDLICE | | | |
| LAND USE | | 1 70000 | CCD |
| CSR Cane Blocks & | CSR Cane blocks and cane assignment applications | 1:50000 | CSR |
| Cane Assignment | for the Victoria Mill area. | | |
| Applns | | 1.70000 | CCIDO |
| Cane Farms & | Cane blocks & assignment applications for the | 1:50000 | CSIRO |
| Assign'ts HRIC Cane Blocks | Macknade Mill area. HRIC Cane blocks | 1:5000 | HRIC |
| | | | |
| HRIC Orthophotos | Orthophotos covering the Herbert River floodplain. | 2m pixel | HRIC |
| LIMD Come Disales | HMP Cane blocks | 5m pixel | IIMD vito |
| HMP Cane Blocks | HMP Cane blocks | 1:10000 | HMP via |
| I JII | I and are Harbart Diagrams at June 1 | 1.70000 | QDNR |
| Land Use | Land use - Herbert River catchment | 1:50000 | CSIRO |
| Mining Claims | Mining claims - Herbert River catchment | 1:50000 | QDME |
| Mining Leases | Mining leases - Herbert River catchment | 1:50000 | QDME |
| National Public & | National Public & Aboriginal Lands. AUSLIG's | 1:250000 | AUSLIG |
| Aboriginal Land | M10 dataset. | 1.50000 | ODMD |
| Unique Mapping | Soil and land suitability mapping (Wilson, 1989) - | 1:50000 | QDNR |
| Areas ~ lower | lower Herbert River catchment | | |
| Herbert | Soil and land quitability manning (ODND data) | 1.100000 | ODMD |
| Unique Mapping Areas ~ Townsville | Soil and land suitability mapping (QDNR data) - | 1:100000 | QDNR |
| | Townsville north mapsheet. | | |
| north | World Haritage Area houndaries Wet Tranies | 1:50000 | WTMA |
| World Heritage | World Heritage Area boundaries - Wet Tropics | 1.30000 | VV I IVIA |
| RAILWAYS | | | |
| AUSLIG Railways | Railways covering 1:250000 mapsheets of Atherton, | 1:250000 | AUSLIG |
| AUSLIG Ranways | Einasleigh, Ingham and Innisfail | 1.250000 | AUSLIG |
| Cane Railways | Cane railways - lower Herbert River catchment. | 1:5000 | HSC |
| HMP Railways | HMP Railways and tramways | 1:10000 | HMP via |
| Thir realiways | Thir ranways and trainways | 1.10000 | QDNR |
| | | | 421110 |
| REEF | | | |
| Foreshore (GBR) | Foreshore to the Great Barrier Reef. | 1:250000 | GBRMPA |
| GBRMPA | Great Barrier Reef Marine Park Auth. zones. | 1:250000 | GBRMPA |
| Islands (GBR) | Islands along coast to Great Barrier Reef. | 1:100000 | GBRMPA |
| Land Boundary | Land boundary to Great Barrier Reef. | 1:250000 | GBRMPA |
| (GBR) | • | | |
| Mangroves (GBR) | Mangroves along coast to Great Barrier Reef. | 1:250000 | GBRMPA |
| Reef (GBR) | Reef mapping within Great Barrier Reef. | 1:250000 | GBRMPA |
| Towns (GBR) | Towns along coast to Great Barrier Reef. | 1:250000 | GBRMPA |
| | - | | |
| ROADS | | | |
| AUSLIG Roads | Roads covering 1:250000 mapsheets of Atherton, | 1:250000 | AUSLIG |
| | Einasleigh, Ingham and Innisfail | | |
| COVERAGE | DESCRIPTION | SCALE | CUSTODIAN |
| THEME | | | |
| HMP Roads | HMP Roads | 1:10000 | HMP via |
| | | | QDNR |
| Roads | Roads - Cameron McNamara study area | 1:5000 | HSC |
| | | | |

| ĺ | | | |
|-------------------------------------|---|--------------------|-------------------|
| SOILS | | | |
| CSR Soils | CSR soil survey of the lower Herbert River and Stone River.(currently under revision, ensuring 1:5000 positional accuracy). | 1:5000 | CSR |
| CSR Soil Survey | CSR Soil survey points | 1:5000 | CSR |
| CSR Soil Survey Area | Boundary of areas mapped in SOIL5. | 1:5000 | CSR |
| QDNR Soils | Atherton, Babinda, Mossman and Tully areas soil and UMA data. (Source: QDNR) | 1:50000 | QDNR |
| QDNR Soil Survy Sites | QDNR (formally QDPI) soil sampling sites - lower Herbert | 1:50000 | QDNR |
| Ravenshoe Soils | QDNR (formly QDPI) soil survey of Ravenshoe | 1:100000 | QDNR |
| UMA Soils | 1:100000 map.(Grundy & Heiner, 1994) Soils from UMA50 - lower Herbert River catchment | 1:50000 | QDNR |
| TOPOGRAPHY | | | |
| AUSLIG Topography | Topography - spot heights covering 1:250000 mapsheets of Atherton, Einasleigh, Ingham and Innisfail | 1:250000 | AUSLIG |
| HMP Digital Elevation | HMP Digital Elevation Model (DEM) data. | 1:10000 | HMP via |
| HMP Topography | HMP Topography - contours & spot heights. | 1:10000 | QDNR HMP via |
| Ravenshoe DEM | DEM, Ravenshoe 1:100000 map. (Grundy & Heiner, 1994) | 1:100000 | QDNR QDNR |
| Topography | Topography - contours & spot heights for map sheets covering the Herbert River catchment and surrounds. | 1:50000 | WTMA |
| | | | |
| VEGETATION Fresh Wetlands | Fresh water wetlands extracted from VEG_LANDUSE. | 1:25000 | QDNR |
| Habitat Habitat Corridors | Habitat extracted from VEG_LANDUSE. Habitat corridors / linkages - Herbert River catchment. | 1:25000 1:25000 | QDNR QDNR |
| HMP Vegetation | HMP Vegetation (presence or absence only) | 1:10000 | HMP via QDNR |
| Pre-European Vegetation | Pre-European vegetation estimate for the lower Herbert River catchment. | 1:100000 | CSIRO |
| QDoE Glider Habitat | QDoE Mahogany Glider habitat (1996) | 1:50000 | QD ₀ E |
| QDoE Regional Ecosystem | QDoE Regional ecosystems mapped for Province 1, Herbert. | 1:50000 | QD ₀ E |
| Riparian Vegetation | Herbert. Herbert River main channel riparian vegetation. (Drummond & Associates, 1994) | 1:50000 | CSIRO |
| Savanna Grasslands | Savanna grasslands of northern Australia. | 1:2.5mill | CSIRO |
| Vegetation & Landuse | Vegetation & land use digitised from 1993 1:25000 colour aerial photographs. (Perry, 1993). | 1:25000 | QDNR |
| Webb & Tracey Vegetation | (Webb & Tracey, 1982) Vegetation classification | 1:50000 | WTMA |
| VEGETATION ~ | | | |
| RIPARIAN Blockages in | Blockages in the Herbert River and the Stone | 1:25000 | HRCCC |
| Waterways | River. Current to December 1996. | 1.20000 | |
| COVERAGE THEME | DESCRIPTION | SCALE | CUSTODIAN |
| Erosion along | Erosion points along the Herbert River and the | 1:25000 | HRCCC |
| Waterways Riparian Vegetation | Stone River. Current to December 1996. Riparian vegetation vigour along the Herbert River | 1:25000 | HRCCC |
| Vigour Riparian Widths | and the Stone River. Current to December 1996. Riparian widths recommended for the Herbert | 1:25000 | HRCCC |
| • | River and Stone River. | | |

| Trust Assets | Trust assets located along the Herbert River and the Stone River. Current to December 1996. | 1:25000 | HRCCC |
|----------------------|---|----------|-------|
| WET TROPICS | | | |
| Coast ~ Wet Tropics | Coastline, Wet Tropics Region, North Qld. | 1:250000 | WTMA |
| Roads ~ Wet Tropics | Major roads, Wet Tropics Region, North Qld. | 1:250000 | WTMA |
| Streams ~ Wet | Major streams, Wet Tropics Region, North Qld | 1:250000 | WTMA |
| Tropics | | | |
| Towns ~ Wet Tropics | Major towns, Wet Tropics Region, North Qld | 1:250000 | WTMA |
| Wet Tropics boundary | Wet Tropics Regions, North Queensland. | 1:250000 | WTMA |

Acronyms

ABS Australian Bureau of Statistics

AGSO Australian Geological Survey Organisation

AML Arc Macro Language ~ a programming language used in ArcInfo

ANZLIC Australia & New Zealand Land Information Council

Aerial Photograph Interpretation API

ArcInfo A GIS software package

ArcView A windows based version of ArcInfo, a GIS software package

ASL Above Sea Level

ATSIC Aboriginal & Torres Strait Islander Commission

AURISA Australian Urban & Regional Information Systems Association

AUSLIG Australian Survey & Land Information Group

(title changed to GeoScience Australia in 2002)

Bureau of Meteorology BoM

BSES Bureau of Sugar Experiment Stations

CSC Caboolture Shire Council CCC Caloundra City Council

CSIRO Commonwealth Scientific & Industrial Research Organisation

CSIRO CSIRO Tropical Agriculture Colonial Sugar Refineries CSR CoolSC Cooloola Shire Council **CZP** Coastal Zone Project (CSIRO)

DD **Decimal Degrees**

DCW Digital Chart of the World DEC **Digital Equipment Corporation** Digital Elevation Model DEM

DLPE Department of Lands, Planning & Environment (NT) Department of Minerals and Energy, Queensland **DME**

DMR Department of Main Roads, Queensland

DSS **Decision Support System** EΑ Environment Australia

EPA Environment Protection Authority

ESRI Environmental Systems Research Institute Australia **FRDC** Fisheries Research & Development Corporation

GIS Geographic Information System

GBRMPA Great Barrier Reef Marine Park Authority Department of Health & Aged Care HAC

HMP Herbert Mapping Project

HRCCC Herbert River Catchment Coordinating Committee Herbert Resource Information Centre HRIC

HSC Hinchinbrook Shire Council

IBRA Interim Biogeographic Regionalisation of Australia

ICM Integrated Catchment Management

IMCRA Interim Marine & Coastal Regionalisation of Australia **REG** Integrated Resource Use & Management (CSIRO) Landsat MSS

Landsat (satellite) Multi-Spectral Scanner

LGA **Local Government Areas**

Look Up Table ~ Table of item value meanings stored in ArcInfo. LUT

LUWQ Land Use & Water Quality

LWRRDC Land & Water Resources Research & Development Corporation MSC Maroochydore Shire Council

MSM Moreton Sugar Mill

NRIC National Resource Information Centre

NSC Noosa Shire Council

QSC Queensland Sugar Corporation

QDoE Queensland Department of Environment (formerly Queensland Department of Environment & Heritage)

QDL Queensland Department of Lands

QDNR Queensland Department of Natural Resources

(formally Queensland Department of Lands and partially QDPI)

QDPI Queensland Department of Primary Industries

QDT Queensland Department of Transport

Qld Herb Queensland Herbarium, Department of Environment and Heritage

QLIS Queensland Land Information System

RMS Root Mean Square ~ error indicating digitising registration accuracy

SCAR Sugar Cane Assignment Register (QSC's database)

TIN Triangulated Irregular Network ~ a surface modeling package UMA Unique Mapping Area ~ relating to the mapping of soils, geology,

geomorphology and vegetation cover and associated classifications for agricultural land suitability and land limitations (eg: erodability)

UPS Uninterruptable Power Supply
UQ University of Queensland
USDMAU.S. Defence Mapping Agency
USGS U.S. Geological Survey

WALIS Western Australian Land Information System

WTMA Wet Tropics Management Authority

Appendix 2 – Resource book: The changing face of resource use planning: A resource for sugar industry stakeholders

Synopsis of the Resource Book

Introduction and Overview

This document is intended to promote improved resource use planning and sustainable development in sugar districts by synthesising current understanding and exploring new frontiers. We describe and evaluate on-the-ground approaches and experiences with natural resource management in relation to the emerging operating environment of the sugar industry, and those of its key stakeholders. Examining on-going and completed projects in integrated resource use planning illuminates the challenges and experiences of the sugar industry. Exploring these projects will, hopefully, extend their local impacts to industry-wide planning processes. These projects have been supported by CSIRO, the CRC for Sustainable Sugar Production, Land and Water Australia, and the Sugar Research and Development Corporation.

We discuss the changing national and global requirements for resource management, outlining how governments and industries, particularly the sugar industry, are responding. Three case study areas are used to explore how generic challenges to the industry effect different regions.

We use a specific conceptual framework to consider the current performance of the policies, regulations and planning processes governing the industry. We explore the links between planning systems and their outcomes, and how decision-making depends on individual capacity for *bona fide* participation and application. Using examples of the approaches and core technologies developed in the CRC's case study regions, we show how an evidence-based approach to resource use planning can enhance the process as well as the outcomes. The case studies also illustrate the critical, complementary requirements for effective stakeholder participation, which include suitable institutional arrangements, appropriate tools and information, and the capacity of stakeholders to effectively exploit both of these. From all of this, we identify emerging roles and responsibilities in resource use planning in the sugar industry, sector by sector, including priorities for future investment.

The document is organised into the following sections:

The Australian sugar industry in its economic, environmental and social contexts This section provides a brief introduction to the Australian sugar industry, including its location, economic value, operation, perceived environmental impact and community significance. Examination of historic events emphasises the industry's demonstrated ability to respond to changing conditions and remain viable. We then explore the particular challenges facing the industry today, and those anticipated in the future.

The sugar industry as regions

The sugar industry operations cover a large range of scales: production on individually-owned farms, processing through mill districts, regulation and marketing controlled by State, National and International agencies and interests. It is at the regional scale that planning processes and on-the-ground actions converge, so we examine the *Sunshine Coast*, *Herbert River* and *Mossman* regions that differ in spatial extent, social context and market share. The Sunshine Coast (Maroochy) is an established cane-growing region whose future expansion is restricted through its proximity to a growing urban area. Although the Herbert is one of the main cane growing areas in Australia, the industry is struggling with current market pressures. The Mossman region is intermediate between these two in spatial extent and sugar productivity. Using these regions as case studies, we can see that while the industry as a whole is facing challenges related to market forces and new expectations of environmental performance, the ways in which these are played out on the ground can vary dramatically from region to region. It follows then that responses to the challenges facing the whole industry will need to be tailored to regional needs, rather than applying a one-size-fits-all approach.

Resource use planning - everybody's business

This section describes the specific framework that we use to consider the current performance of planning systems in the sugar industry, and the opportunities to improve their effectiveness at regional scales. It proposes four key cornerstones for effective planning – responsive institutional arrangements, availability of appropriate information, tools to use that information, and the capacity of the participating stakeholders to meaningfully integrate these elements into the decision-making process.

Regulation of environmental impacts of the sugar industry – institutional arrangements Having examined the broader context of resource use planning, this section describes the past and present planning and policy frameworks that govern the sugar industry, particularly in Queensland. It considers the idea that since planning arrangements themselves may be key determinants of outcomes, reforming the planning process may be an important focus for improvement. The roles of information and participants in the process are considered in the following chapters.

Evidence-based approaches to decision-making

We explore ways to enable diverse groups of stakeholders to use evidence-based approaches to resource use planning, so that the reformed planning process leads to improved decision-making. We report on a range of resources that were designed to facilitate informed decision-making for the *Sunshine Coast, Herbert River* and *Mossman* regions. These resources include tools designed to acquire and sort information from various sources, and sophisticated analyses of this information, including modelling of land use suitability, rainfall distribution, transportation costs, and cost/benefit analysis of revegetation.

Implementation - roles, responsibilities, skills and infrastructure

For information and analyses to be incorporated into the decision-making process in a meaningful way, it is imperative that the participants have the capacity to exploit these services. This idea will be explored through reflection on our experiences in the *Sunshine Coast*, *Herbert River* and *Mossman* regions.

Having reviewed the need and options for improving the planning system and increasing the role of evidence-base into the planning process, this section will argue for participatory planning processes are actually participatory, i.e. that stakeholders have the capacity to participate and that this is important because it impacts the possibility of effective implementation! The section will therefore focus on capacity building and will provide narratives of capacity building activities in the three case studies and review their implications.

Evaluation and adaptation

Having examined three components of effective planning practice in the previous sections, we will examine how their integration and growth can produce organisational learning and continuous improvement. We contend that the responsiveness of the planning system to changing needs is a critical component of its long-term effectiveness. The planning system may include formal mechanisms designed to achieve this objective. Reflection on our experiences with the three case studies (including use of the formal evaluation processes) we be used to illustrate this contention. On the basis of this analysis and discussion, we will conclude with an outline of emerging roles and responsibilities in resource use planning in the sugar industry on a sector-by-sector basis, identifying priorities for future investment.

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Appendix 3- External evaluation report

Improved Integrated Resource Planning in the Australian Sugar Industry (Project Ref: CTA039)

External Evaluation Final Report

April 2002

Prepared by:

Mr Colin J. Macgregor

Macgregor Consulting Pty Ltd, Canberra

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Herbert area

Stakeholder understanding of current planning Stakeholder capacity to participate in planning

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Summary of findings from second workshops

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Workshop attendance

Changes over the course of the workshops Participant retention over the workshops

Conclusions

Appendix A: External review timeframe

Executive summary

| Purpose of the external review | Report on the merits of the project in terms of improving the relative capacity of the various stakeholders associated with the sugar industry, in the Herbert and Nambour areas, to negotiate and develop common strategic industry goals. |
|---|---|
| Methods adopted for external review | The review used both qualitative and quantitative methods. A questionnaire issued at the time of the 5 workshops gathered quantitative data on participant experience in planning, stakeholder relations, and attitudes to planning generally. Frequency distributions and cross-tabulation procedures were then used to explore the data. Post-workshop telephone surveys (qualitative data) with selected participants explored central issues of concern to the stakeholder groups and obtained feedback regarding the research team's organisational and facilitation skills. |
| Workshop participation varied considerably | The Nambour had 3 workshops in all and participation began with 12 participants in the first workshop, 21 in the second, and between 50 and 60 in the last. Stakeholder representation also increased in the latter workshops. The participation rate at Nambour alone suggests increasing interest in the project. In the Herbert, the second workshop did not take place and participation decreased from 21 participants in the first workshop to 11 in the third. Stakeholder representation was not as encouraging as Nambour, particularly in the third workshop, where the millers were not represented at all. |
| Participant retention was high in the Nambour and low in the Herbert. | The workshop questionnaires from the Herbert revealed that just 4 participants who attended the first workshop were also at the third. However, in the Nambour, retention was high. Seven participants who attended the first workshop were also at the second, 3 that attended the second were at the third and 2 participants were able to attend all three workshops. |
| The growers appeared to be the most familiar with planning processes, particularly in the Herbert. | The workshop questionnaires suggest that it was the growers that had the most experience in planning processes as well as in use of tools typically used in such processes (e.g. Geographic Information Systems, Cost- Benefit Analysis, Environmental and Social Impact Assessment, catchment management and Land Capability Assessment). Workshops were the preferred and most highly regarded method of negotiation over planning issues (compared to public meetings and questionnaires). There were little perceptible changes in responses to questions associated with these processes and tools over the course of the workshops. |
| The millers and growers of both catchments regard each other as 'difficult to work with'. | Perceptions about the level of ease in working with other stakeholders did not appear to change over the course of the workshops. By far, the stakeholders to have the greatest difficulty in working together are the growers and millers. There is apparently very little trust between the two groups and there is a perception that 'the other group is only concerned with their own agenda'. |
| Attitudes of participants and did not change over the course of the project. | A number of attitude questions in the workshop questionnaires explored attitudes to planning and negotiations. There was consistently good support for 'holistic and integrative approaches to planning' although responses to consultation were not so favourable with the growers and millers demonstrating only marginal commitment. Local government participants regarded consultation more highly. |

| Central issues between the growers and millers were extending the harvesting season and 24-hour harvesting. | Post-workshop telephone surveys revealed that both the main issues of contention between the millers and growers of both the Herbert and Nambour areas are the proposed changes in the manner in which the cane is harvested. The millers in both areas apparently regard these changes as essential for the milling side of the industry to remain viable. However, the growers are not convinced of the value of the implied changes on the farm. In the Nambour, another important issue is related to the efficiency of the transportation system, and the implied costs involved in up-grading the system – again, to make the milling side of the industry more viable. There have been some difficulties in negotiating over cost sharing on this issue. |
|--|---|
| Continued low sugar prices and low profit levels are major issues for the industry | The sugar industry in Australia has to be regarded as 'price takers' since it is subject to world prices. The price has been low for at least as long as the life of this project. This has brought a sense of urgency and intensity to the issues identified above. In the Herbert, the mill owner's response was to try and sell the mill at a time that was about halfway through the project. This impacted on the progress of the project and ultimately resulted in the second Herbert workshop being cancelled. Similarly, in the Nambour, the mill owners have also been threatening to close the mill. It is likely that these events have 'rail-roaded' this project to such a degree that determining the relative success of this project is difficult because one cannot separate this project from these events. Nevertheless, the two areas have responded to the threats on the industry differently. In the Herbert, it seems that interest in this project fell away, while in the Nambour the project was used by participants as a platform to strategically plan local industry responses. |
| Overall, comments from participants regarding the research team's management and facilitation of the project were favourable | The decision to abandon the second Herbert workshop in light of the proposed sale of the local mill appears to have negatively impacted on the success of the project in that area. Participants reported lack of continuity and general loss of touch during the period that led up to a delayed third workshop. This could also partially account for the apparent loss of interest in the project and the poor participant turn-out at the third workshop. Despite some major difficulties and conflicts between stakeholder groups at the first Nambour workshop, the research team was able to employ some excellent facilitations and salvage the event. The subsequent workshops were also well organised with stakeholder involvement increasing significantly. Again, comments from participants suggest the teams facilitation and presentation skills at the later workshops was well regarded. |
| The project has contributed positively to stakeholder relations in the Nambour. | It is the conclusion of this external review that the project has made a positive contribution to enhancing stakeholder relations in the Nambour. The industry clearly faces considerable challenges in this area in the future but this project has at least been able to assist industry stakeholders establish a working group to continue strategic planning for the industry's future. It is difficult to be conclusive about how well this project has enhanced relations between stakeholders in the Herbert. Based on the data obtained from this external review, it seems likely that little has been achieved. However, it is quite likely that the research team were in many helpless to avoid the project's perceived diminished relevance in the face of the proposed sale of the mill mid-way through the project. Unfortunately unforeseen but major externalities, which are well outside the sphere of influence of research teams, impact on research projects in |

| negative and unpredictable ways. |
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Introduction

Project CTA039 primary goal is to improve the capability of the sugar industry in the Herbert and Nambour areas of Queensland to undertake industry and land use planning. In order to achieve this goal four central aims have been developed:

- Enhance the sugar industry's rural land use planning capacity;
- Prepare for, and undertake negotiations with other stakeholders to establish and implement agreed catchment and regional priorities and rural resource management strategies;
- Identify and implement rural land use strategies and plans over which the industry has responsibility as well as strategies and plans that will require negotiated solutions with other stakeholders in sugar catchments; and,
- Develop and implement innovative ways to involve the industry and other catchment stakeholders in the process of planning to meet their catchment and regional land use planning responsibilities and objectives.

A series of workshops, anticipated to extend over a two and a half year period, were conducted where it was intended to meet the stated aims. It was expected that, as the project progresses, the number of represented stakeholder groups/participants would increase with each workshop. It has been determined that a critical component of this project relates to the evaluation of the project to meet the stated aims. This will be achieved by internal and external evaluations.

The evaluation process was being conducted by Colin J. Macgregor of Macgregor Consulting Pty Ltd, Canberra, who is essentially a social research scientist with around 10 years experience in community natural resource management and associated research.

Project timeframe

The research team's anticipated process involved a series of workshops coupled to a research and modeling process, which took place between the workshops. The anticipated timeline was expected to last from September 1999 with completion in July 2001 (see Figure 1, Appendix A). However, the actual timeframe for the project was extended which took completion to April 2002. Figure 2 (Appendix A) clarifies the details of the external evaluation process, which by necessity was determined by the scheduling of the workshop events.

It will be apparent from Figure 2 that the second Herbert workshop did not take place. The reason for this is related to CSR's proposed sale of the sugar mill in the Herbertin 2001. As it turned out the mill was not sold at that time and in fact it still remains the property of CSR to this day, but its prospective sale effectively 'rail-roaded' this particular project because negotiations between the various stakeholders made it impossible to progress this project in the Herbert during that period.

External reviewer's role

In order to clarify the purpose of the external evaluation an external evaluation aim has been developed, which in essence is to report on the merits of the project in terms of:

Improving the relative capacity of the various stakeholders associated with the sugar industry, in the Herbert and Nambour areas, to negotiate and develop common strategic industry goals.

Three objectives have been identified in order to meet this aim:

- 1) Identify benchmark knowledge, attitudes and experience with respect to strategic assessment of resource use options for all willing participants associated with the first benchmark workshops in the Nambour and Herbert areas;
- 2) Using the data collected from the first workshops as a baseline, monitor the progress of willing respondents against that data after subsequent suitable workshops to assess the efficacy of the participatory processes.
- 3) Monitor and record the views of the participants with respect to the performance of the research team after subsequent suitable workshops to determine their efficacy.

External review methods

The external evaluation process has employed both quantitative and qualitative research techniques to meet the three objectives. Objective (1) has been met by employing a 'benchmarking' questionnaire that explored a range of themes relevant to the sugar industry planning process. The benchmarking survey was integrated into the first two benchmarking workshops and as such, all participants completed it. The central themes explored in these questionnaires were:

- Respondent understanding of current planning legislation and process;
- Capacity to participate in planning;
- Relations with other stakeholders; and,
- Beliefs about planning and planning process.

A combination of both closed and open-ended questions elicited responses for the above areas. Closed questions offered respondents a choice of answers, which were then quantified and analysed directly. It should be noted that statistical techniques were not considered an appropriate method of analysis since respondents at the workshops could not be considered to be a representative sample of any population group even though each respondent was attending the workshop as a representative of one of the stakeholder groups. Also, with round 20 or less participants at the workshops, it was considered that inspection of frequencies and cross-tabulations would be the most appropriate method of exploring the data. With respect to the open-ended questions, these were analysed by identifying common themes within the answers from each stakeholder group.

The above criteria for questionnaire analysis were also considered suitable for subsequent questionnaires from further workshops.

It was also considered that a more qualitative assessment of the workshops using semi-structured telephone questionnaires would augment the data collected from the written questionnaires – particularly in relation to perceptions of progress. This also enabled respondents to expand upon any issues they believed important. Responses during the telephone interviews were initiated from prompts developed out of the following:

- The individually perceived central stakeholder contributions made to the workshops from the growers, the millers, council representatives, state government representatives and any other stakeholder groups;
- Expectations of the participants; and,
- Any other comments or criticisms of the research team or the workshops.

Data analysis and report writing associated with the completed quantitative questionnaires was completed following the workshops. Most of the telephone interviews were conducted immediately following the workshops.

It should be noted that the questionnaires used in workshops following the first benchmarking workshop, were reduced in size with more emphasis being placed on assessing attitudinal changes that may have occurred as a result of taking part in the workshops. However, the format of these follow-up questionnaires were very similar to the benchmarking questionnaire, which ensured 'time-series' analysis could be carried out across the workshops. The semi-structured telephone questionnaire essentially remained unchanged for all workshops.

Summary of findings from first workshops

Herbert area

The first Herbert benchmark workshop had 21 participants (10 Council representatives, 7 growers and 4 millers) and completed questionnaires came from Council representatives (N=4), Herbert growers (N=6) and Herbert millers (N=3). As described above there are four thematic areas that the questionnaire addressed. The main findings from the responses to these are now summarised in turn.

Understanding of current planning processes

A broad range of planning legislation and processes were presented to respondents for comment. Overall the growers were the one stakeholder group that demonstrated the greatest familiarity of all the other groups – even the Council representatives. Not surprisingly then that when respondents were asked about past experience, the growers were also the group that the most. As one might expect, the council representatives were the group with the least amount of past exposure to sugar industry planning and legislation with their experience mainly associated with town and regional planning processes.

Stakeholder capacity to participate in planning

Questions in this section asked for more detail about respondent's previous procedural involvement in planning and the types of planning tools they had been exposed to. Specifically, the question investigated past experience, perceived effectiveness and preferences with respect to such procedures and tools.

In terms of procedures, attention was drawn to workshops, public meetings and the use of questionnaires. Once again the growers were found to be the most experienced group in the Herbert with workshops – nearly half of them said they were very experienced. With respect to preference for workshops, there was little difference between the groups with most respondents showing favourable responses. All the Herbert groups reported a similar pattern of experience, preference and effectiveness with respect to public meetings, which basically did not score as well as workshops particularly with respect to preferences and perceived effectiveness.

There was little variation between Herbert stakeholder groups with respect to questionnaires although the growers may have marginally more experience. In terms of perceived effectiveness, it is notable that the Herbert groups evidently believe questionnaires to be more effective than the Nambour groups (see below).

Essentially, all the Herbert stakeholder groups were clearly more favorable of workshops than both public meetings and questionnaires. All the Herbert groups felt that workshops were the most effective process to use in planning.

When it came to planning process and tools, the Herbert groups again demonstrated considerable experience. With Geographic Information Systems (GIS) the Herbert groups were very supportive of it as a planning tool. All groups had little experience with Cost Benefit Analysis (CBA). The same was also true of Social Impact Assessment (SIA) and Environmental Impact Assessment (EIA). Notable here perhaps is that the growers of the

Herbert believed EIA to be more important than the millers. Catchment planning was also considered important and there was some notable experience with SWOT analysis (Strengths, Weaknesses, Opportunities and Threats), which probably reflects past experience in workshops. Most respondents from all Herbert groups had been exposed to land capability/suitability assessment and its value was acknowledged by all.

When it came to information types for planing, the Herbert council representatives acknowledged Australian Bureau of Statistics (ABS) data, cadastral information and other plans and strategies as being more important than the miller and grower groups. Given the nature of their responsibilities, this is perhaps not surprising. The importance of economic information was also acknowledged by all Herbert groups as was environmental information. However, it is local knowledge and skills that stands out as being considered the most important type of information – in fact, it was considered very important by most respondents and important by the remainder.

Nambour area

There were no Council representatives at the first Nambour workshop so just two stakeholder groups were present. Completed questionnaires were returned from 4 millers and 5 growers. As described above there are four thematic areas that the questionnaire addressed and these are summarised in turn.

Understanding of current planning processes

Again, it was the growers who demonstrated the greatest familiarity of planning processes in the Nambour catchments when compared to the millers.

Stakeholder capacity to participate in planning

As discussed above, attention was drawn to workshops, public meetings and questionnaires. On the whole, the Nambour growers felt workshops were not as effective as the Nambour millers and this is also particularly true when their comments are compared to the Herbert growers. With respect to preference for workshops, there was again little difference between the two Nambour groups with most respondents showing favour, as was the case in the Herbert. The two Nambour groups reported a similar pattern of experience, preference and effectiveness with respect to public meetings, which again did not score as well as workshops particularly with respect to preferences and perceived effectiveness. Once again, there was little variation between the two groups with respect to questionnaires although it seems that the Nambour growers had less experience than the Herbert growers. In terms of perceived effectiveness, the Nambour groups again evidently believe questionnaires to be less effective than the Herbert groups. But like the Herbert, the Nambour groups were more favorable to workshops than both public meetings and questionnaires. Important to note however is that the Nambour growers did not believe any of the three processes were particularly effective.

When it came to planning processes and tools, the Nambour groups again demonstrated less experience than the Herbert groups. With Geographic Information Systems (GIS) the Nambour groups were fairly supportive of it. The Nambour growres and millers had less experience with Cost Benefit Analysis (CBA) unlike the Herbert groups who appeared more exposed. The same was also true of Social Impact Assessment (SIA) and Environmental Impact Assessment (EIA). Again, the growers of Nambour believed EIA to be more important than the millers (like the Herbert growers) but catchment planning was not considered so important than in the Herbert. The two Nambour groups also demonstrated less exposure to SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) when compared to Herbert groups. Most respondents from the Nambour had some exposure to land capability/suitability assessment. As was the case in the Herbert, local knowledge and skills stood out as the most important type of information.

Stakeholder relations (Herbert & Nambour)

This area was examined by addressing four questions: (1) the level of understanding of other stakeholder's objectives; (2) the level of alignment between stakeholder group's objectives; (3) the level of ease between stakeholder groups in achieving consensus; and, (4) stakeholder group opinions of other stakeholder groups. Another stakeholder group, the state government, was also introduced in this question even though they were not actually represented at the workshops. This was done because it was considered that they have an important role in relations between the represented groups. Respondents were offered five options for their response: 5 = 'very high'; 4 = 'good'; 3 = 'moderate'; 2 = 'poor'; 1 = 'none'.

When asked about the level of understanding of other stakeholder's objectives a series of cross-tabulations generally revealed that most respondents believed they had a moderate understanding of the other groups. Perhaps the only exception to this trend was the level of understanding between local government and state government. All the industry groups felt that these two groups had either a good or very high level of understanding of each other's objectives. However, it is notable that the council representatives themselves did not share this view. They believed there was only a moderate level of understanding with state government.

The level of alignment between stakeholder group objectives revealed a more diverse result. It seems there is poor alignment between the local government and the Herbert growers. This is also very much the case for the millers and growers in both catchments. In fact, most of the Herbert growers believe there is no alignment at all with objectives between the millers and growers in the Herbert. The grower groups are also skeptical of state government objectives again considered to be poorly or just moderately aligned. Once again, the Nambour growers in particular believed that local government and state government objectives align well.

The level of ease between stakeholder groups in achieving consensus again supports a moderate pattern, i.e. most believed consensus was moderately easy to achieve. Exceptions could lie between the local government and the Herbert millers. Apparently these two groups have found it slightly easier to achieve consensus, which is interesting given the perceived poor alignment between these two. According to the industry groups, this is also again considered to be the case for local and state government but again, the Council representatives would dispute this claiming the reverse; that it is difficult for them to achieve consensus with state government. Once again, the main disparity lies between the millers and growers in both catchments. The growers in particular go as far as to say it is impossible to achieve consensus with the millers. The millers are perhaps not so pessimistic opting instead to acknowledge that consensus is difficult to achieve.

When asked to comment about group opinions of other stakeholders, most respondents opted for the moderate response, which is one of basic mutual respect but again this fell down rather badly when the industry groups commented on each other. For the most part, opinions were expressed as low to very low from both millers and growers.

Beliefs about planning and negotiating (Herbert & Nambour)

Five questions tapped into respondents beliefs about planning. (1) The importance of negotiation. (2) The perceived difficulty in working with other industry stakeholders. (3) The degree to which other industry stakeholders were considered reasonable to negotiate with. (4) The importance of consultation before plan finalisation. (5) The importance of holistic and integrative planning. These questions were presented in the form of statements to which the respondents could express an attitude according to a five-point Likert scale. Options were 'strongly agree'; 'agree'; 'neither agree or disagree'; 'disagree'; 'strongly disagree'.

With respect to question (1), the importance of negotiation, nearly all respondents from all the groups either agreed or strongly agreed that it was important. With question (2), the distribution of answers was much more varied. The Herbert council representatives

largely neither agreed or disagreed but both the grower groups either agreed or strongly agreed that it was difficult to work with other industry groups. As was found above, the miller groups were not so pessimistic; the Nambour millers generally neither agreed nor disagreed but the majority of Herbert millers actually disagreed clearly contradiction to the Herbert growers. As might be expected, a similar pattern of answers was also found with question (3). All industry groups from both catchments generally disagreed with the statement that other stakeholders were reasonable to negotiate with. With question (4) only the Herbert council representatives were supportive of consultation overall. All industry groups from both catchments neither agreed nor disagreed with the statement that it is important to consult. However, the responses for question (5) were generally more positive. All the groups basically either agreed or strongly agreed that planning should be holistic and integrative, which of course slightly contradicts the attitudes expressed towards consultation. Apparently the industry groups in principle support a philosophical position of holistic and integrative planning but it seems they would prefer not to consult in order to achieve it.

First post-workshop telephone survey

Herbert area

In all, 17 out of the 21 people that attended the first workshop in the Herbert were successfully contacted for a telephone interview. The common thread from all the groups in the Herbert was of continued profitability. The growers are also concerned about drainage issues and the idea of 24-hour harvesting, which is being promoted by the millers. The Herbert council's main concern was over infrastructure and they are trying to encourage diversification into other industries. In terms of expectations, there is good support for improved relations between the groups and improved planning generally. The support for improved relations also revealed itself in the general comments, which again emphasised that the workshop was a good start and it should be encouraged to continue. It was generally considered that the research team had a facilitative role, which it was believed they fulfilled in a professional and effective manner.

Nambour area

In the Nambour catchment 11 out of 12 people that attended the first workshop were successfully contacted for a telephone interview. Like the Herbert groups the millers and growers of the Nambour seem keen to improve relations and they are both concerned about long-term viability. The two areas of contention between the two groups centre on the push from the millers for a longer growing season and the mill's operations and profitability. In fact, mill accountability is a particularly difficult issue in the Nambour and it apparently was at the heart of a dispute within the workshop that nearly led to some participants walking out of the meeting. As it turned out, the research team was able to 'cool things down' and avoid such a breakdown. In the end, all participants seemed supportive of the process and believed it was a good first step despite the difficulties, which apparently have a long history. Both the millers and the growers believed the research team handled the workshop well.

Summary of May 2000 telephone survey and progress report (Herbert & Nambour)

A total of 11 key informants were suggested for contact during May 2000 (4 growers and 2 millers in Nambour, 2 growers, 2 millers and 1 council representative in the Herbert) to determine their views on the project so far. Telephone contact was made with at least one representative from all groups except from the Herbert Millers.

One very general question was forwarded to the informants for them to comment on, i.e. thinking over the past six months of the project, would you like to make any comment about the general direction and progress of the project?

Two Nambour growers were contacted. One said he was fairly happy so far with the project and what was planned. The other expressed concern about the miller's attitude towards revealing information regarding costs and the profitability of the milling process. He suggested that this issue might need arbitration. The one miller contacted from the Nambour believed the project was heading in the right direction and was progressing as well as could be expected. That miller also commented that the lower sugar price might be helping to encourage the millers and growers to work more with each other. He also complemented the research team on how well they were managing the project to date.

In the Herbert, the Council representative was of the opinion that the millers and growers were now already working on parts of the project but he said other council business had not allowed him to maintain good contact with the project. Good progress was confirmed by one of the two growers who also said that some of the resolutions from the workshops were now in action. The other grower was not so positive commenting that he had some reservations about the process, which he believed, may be being driven by the millers.

What was clear from the external evaluation as at May 2000 was that the format and methods identified for this project were appropriate. Early results clearly indicated that the workshop approach is well supported by all groups and participants. It was noted that an obvious indicator of progress would be if the Nambour attendees become as supportive of workshops by the end of the project as the Herbert attendees were at the time. There was little doubt that this was a particularly valid project and, in fact, was one that perhaps should have been identified long before the project inception. As one of the Herbert Council representatives put it, 'it should have happened 20 years ago'.

At this stage in the project the two workshops were reasonably well attended. It was also thought at this point that it was important to recognise that taking part in workshops such as these extends well beyond the 'normal' daily activities of the participants. With respect to the evaluation, perhaps the most obvious quantitative measure of a 'successful' project is an increase in the number of people who attend the workshops. The workshops would certainly have been better represented if there was also attendees from state government e.g. Queensland Department of Primary Industries (QDPI) and/or the Queensland Department of Natural Resources (QDNR) in both catchments, and, local government in the Nambour.

It was also noted that if the number of participants diminished in future workshops, it could be indicative that the project may not achieving all that it had set out to. Nevertheless, it was apparent that the external review at this stage had established some good baseline data.

The importance of telephone interviews was stressed at this point because the problems that had occurred at the Nambour workshop (where a number of the participants were almost ready to leave following a dispute) were not evident in the questionnaires. The event was obviously important to note but it was only revealed during the telephone discussions when respondents were able to express more about their emotions and feelings associated with their attendance.

Summary of findings from second workshops

Herbert area

The second workshop intended for the Herbert catchment did not occur. This reviewer understands that the workshop was not conducted because CSR (the mill owners) put the mill up for sale at the time when this workshop was planned. The proposed sale set off a

chain of events in the Herbert that effectively over ran this project. In the end, the research team decided that there would be little point in attempting to conduct the workshop because it would be extremely difficult to engage the sugar industry community in any meaningful strategic planning processes at the time.

Nambour area

The second workshop in Nambour was conducted at the end of 2000 and the external review was reported in December of that year. In all, 21 questionnaires from the workshop were returned. Four main stakeholder groups were represented in the questionnaires however two of the 21 respondents failed to identify themselves or the groups they represented. Rather than discard these data, a fifth group of 'unidentified respondents' was created. The final five groups were:

- 1. Growers
- 2. Millers
- 3. Local Government
- 4. Community / Research and Extension
- 5. Unidentified respondents

It was found that the sugar industry act and the Integrated Planning Act (IPA) were the two most cited legislative processes although the Environmental Protection Act (EPA) was also well cited. Most millers and local government cited IPA and the EPA but the growers cited the sugar industry act more frequently. Overall the considered most important planning process for the future of the industry was consultation and participation. However, the two most central and influential groups (millers and growers) did not identify this process and in fact these groups did not concur on any identified process. The most commonly identified experiences in planning were council planning processes and cane supply and processing agreements. While there were some common experiences within the groups there was again little consensus between the millers and growers.

The level of experience between the three negotiating processes (workshops, public meetings and questionnaires) was fairly similar between groups. Overall workshops were evidently the most preferred way to negotiate with other stakeholders. They were also marginally considered to be the most effective process.

The most commonly used tool for planning (particularly with the growers and millers) was land capability assessment – it was also identified as the most important. The use of GIS was also well acknowledged although not considered to be quite as important. EIA, SIA and CBA were also well acknowledged and of these three, CBA was considered most important. ICM and SWOT analysis were poorly acknowledged, particularly by the growers. Local skills were identified as the most important source of data for planning – it was also thought to be the most important. Land tenure information was also well used, which was followed by other plans and environmental information.

The only group to be identified more than once as 'poorly represented' was the indigenous people group (identified by 3 of the 21 respondents).

Overall local government was considered to have a poor understanding of millers, growers and state government. Growers poorly understood millers and neither understood nor not understood local and state governments. State government neither understood nor not understood the millers and local government but were thought to have had a high level of understanding with the growers. Millers neither understood nor not understood local or state government and were split between neither understanding or not and poor understanding of growers.

Local government regarded the community, research and extension groups the easiest to work with. 'Readiness to consult' and 'accessibility' were the main reasons for this. State government seemed to slightly prefer working with the millers and local government but

the only identifiable reason for this was 'consultation'. Millers also appeared to work best with the community, research and extension group although there was no definable reason for this. Importantly the millers clearly did not like working with the growers who were considered too 'self-centred'. Growers also tended to favour the community, research and extension group to work with but again no sufficient reason was offered. Least in favour of the growers were the millers who were also thought 'too self-centred'.

The most commonly recognised form of communication between the groups were meetings – particularly with millers and growers. However, the catchment coordinating committee was also identified – particularly by the community, research and extension group.

All groups were fairly unanimous in acknowledging the importance of the sugar industry to the local community.

The majority of respondents from all the groups, except the millers, 'strongly agreed' that it was important to spend time negotiating with other stakeholders. The millers 'agreed' with the statement. Most respondents from the groups, except the growers, 'nether agreed nor disagreed' with the statement 'I find other stakeholders in the industry difficult to work with'. Most growers 'strongly agreed' with this statement. The majority of respondents from all the groups 'agreed' with the statement '...we always consult with others in the region...'. The majority of the growers, local government and the unidentified group 'strongly agreed' with 'the value of holistic, integrative and inclusive planning'. However, the millers and community, research and extension groups were not quite so enthusiastic when they 'agreed'.

The belief statement about the value of time and effort in negotiation received a rather mixed response between groups and even within groups. While most respondents were generally in favour of spending such time, some of the growers 'strongly agreed' while others 'neither agreed nor disagreed'. The millers tended to 'agree' while the community, research and extension group was split between 'agreeing' and 'strongly agreeing'. Local government 'strongly agreed'.

Second post workshop telephone survey (Nambour only)

Of the 16 participants at the workshop who were contacted for a telephone survey, 11 had also taken part in Nambour's first workshop.

The main issue of contention in the second Nambour workshop was the proposed expansion and extended harvesting season that the millers had proposed. The growers anticipated additional costs on their part, which was one of the reasons for the contention. The millers were fairly adamant that if expansion did not occur then the mill might have to close. The council's main concerns were associated with the potential environmental impacts associated with proposed increases in the use of road transport to move cane to the mill. Apart from that, most respondents felt the council representatives were basically supportive of the proposed expansion. Community representatives were also mainly concerned about potential environmental impacts however, for the most part, they seemed supportive of industry needs.

Most respondents thought the research team had done a very good job in facilitating the workshop. The only consistent criticism was over the venue where some respondents reported that it was difficult to hear. A couple of respondents also felt the workshop should be broadened out to include more people from the community and perhaps also state government. All respondents agreed that they wanted to continue their involvement in the project and the workshops.

Summary of findings from the third workshops

Herbert area

The questionnaire used to assess workshop perceptions had been slightly modified from that used following the first benchmarking workshop. In essence it was shortened to minimise completion time.

This reviewer received 10 questionnaires in all. It is believed there were a total of 11 participants at the workshop, which is not encouraging when compared to the first workshop, and particularly because it seems there was no miller representation.

The participants had all gained broad experience in planning processes. There was also evidence of good exposure to a variety of planning tools and procedures. EIA and CBA were considered the most important while SIA was not regarded particularly highly.

Perceptions of the stakeholder group's understanding of each other showed considerable variation depending upon whether the response was from within or outside the groups in question. The general tendency was for observers of other groups to rate understanding between them higher but comments from within these groups were not so encouraging. In short, perceptions about between group relations from within the concerned groups were not as high as they were from external observers.

Again, in terms of working relations between groups, it seemed that relations were for the most part easy or difficult depending on whether the work was taking place within or between groups. Evidently, there was still some lack of trust and there was a perception that other groups were only concerned with their own agendas.

There was considerable variance in the perceived frequency of meetings between groups. This could suggest that meetings should be more formalised with information about their time, date and place etc being more thoroughly disseminated within and between the groups.

Sugar industry stakeholder groups appeared to believe the industry was more important to the community than the community believed. However, there were some good suggestions about how to improve the industry's image in the community – mainly by addressing the environmental concerns the community evidently had.

Local government seemed more comfortable and supportive of wider consultation and holistic planning processes than the growers did.

Overall, it was clear following this last workshop that there was still much to be done in improving the relations between the stakeholder groups associated with the sugar industry in the Herbert area. Although not mentioned by any of the respondents from these questionnaires, continuing low profits across the industry were apparently eroding relations between the groups.

Nambour area

As mentioned above, the questionnaire used to assess the third workshop in the Nambour had been slightly modified from that used in the previous two workshops.

This reviewer received only 5 questionnaires in all but it is known from the post-telephone survey (see below) that this is not an accurate reflection of the total number of attendees at the workshop, which had been suggested may be as many as 50. It must be noted that the poor return rate is almost certainly a result of the manner in which the questionnaire was administered at the workshop. The obvious implication of the poor return rate is in the capacity of the responses to represent the workshop and the stakeholders who attended, which is clearly diminished.

Workshops were the most preferred method of planning participation and it was also the type that most respondents had experienced. Land capability and CBA were the planning

tools respondents had most experience with – they were also highly regarded. The least experience with planning tools was found with GIS and SIA but these were still rated highly in terms of importance.

All responses suggest that all the relevant stakeholder groups were represented at the workshop even though the poor return rate of questionnaires meant that the perceptions of all these groups could not be reviewed here.

There was some division between the growers in terms of how well local government understood the millers, the growers and state government. However, with just three individual views being expressed, caution must be advised in assuming there is any division in these views across the grower community. However, there was consensus among the respondents that there was a poor level of understanding between the growers and millers. The millers also appeared to believe growers understood state government better than the growers themselves believed. There was also consensus among the respondents that state government did not understand the growers; likewise, the millers do not understand local government.

In terms of working relations between groups, there was not enough evidence in the data to make any definitive statements except perhaps to confirm that growers find other growers easier to work with. Likewise, millers find millers easy to work with.

Only one respondent (a grower) seemed certain about regular formal meetings with other stakeholder groups. Again, it cannot be assumed that none of the other stakeholder group representatives who did not submit a questionnaire, are unaware of regular meetings.

The perceived importance of the sugar industry in the community was not as high as was found in the Herbert. However, like the Herbert, the general consensus is that the industry does not have a very high profile in the community.

There was good support from the growers and millers for holistic planning, however, growers and millers seem divided on the level of consultation that should take place.

Unfortunately when only 5 completed questionnaires were returned from the workshop it was difficult to gain any in-depth insights into the workshop. As alluded to, 5 respondents cannot in any way be considered representative of their respective stakeholder groups, or even representative of those who attended the workshop. However, if estimates of attendance were accurate, then an attendance of 50 is significantly more than previous events. This in itself must be regarded as encouraging.

Third post-workshop telephone survey

Herbert area

In all 7 informants were interviewed in this process – 4 were growers and the remaining three were local government representatives. All informants interviewed had attended the first workshop associated with this project and so were in a position to comment on any changing stakeholder concerns.

The main concerns of the growers were the price of sugar, recent poor weather which had seriously impacted on sugar yields in the area, and the proposed extended harvesting season proposed by the millers. Drainage issues, which were a major concern of the growers at the first workshop, were not so much of an issue at the time of this workshop. Instead, continuing poor weather and diminishing sugar prices were regarded more important. These were seen as exacerbating grower problems and impacting on the whole industry. However, other comments seemed to suggest that the growers have been making some important efforts in addressing environmental concerns.

As mentioned above, there were no millers this third Herbert workshop. The reasons for their absence were not evident from the interviews, however, comments from the growers and local government attendees suggest the main concern of the millers is the profitability of the mill. This has not changed since the first workshop. However, the recent poor yields had apparently forced the millers to think more about grower problems and it seemed they were now making some efforts to help growers tackle technical problems. As was the case at the first workshop, the millers apparently still believe that some of the answers to their problems are in extending the harvesting season.

The local government was mainly concerned with community-wide issues. However, they acknowledged that poor performance in the sugar industry must inevitably impact on the wider community. For example, it was noted that low farmer incomes meant the council cannot raise rates in line with inflation, which impacts on the council's capacity to attend to council maintenance (roads etc). The council was also concerned about the level of dependence on the sugar industry in the area and it would like to see some diversification. Tourism in particular was mentioned. Comments from the council representatives suggest that their concerns had not changed much since the first workshop.

Wider community stakeholders were also not present at this workshop although there was someone from Worknorth. Apparently, he made some comments regarding employment in the area.

General perceptions about the performance of the research team on the day were positive. Only one comment was slightly negative in which it was implied that the 'pitch' of the presentations might have been aimed a little high – 'a bit academic' was one comment. There was also some concern about the figures presented by the research team in terms of their accuracy and with the project coming to an end, there was a feeling of 'where to now?'

There was some concern that the workshop hadn't achieved all that it set out to although this criticism may not be entirely justified. There was an implication that the informants were confused about what will happen with the industry rather than answering the question, which was about this one workshop. In other words, it seemed that the informants were unable to separate the objectives of the workshop from the plight of the industry overall. For the most part comments about the presentation of the figures were positive.

In terms of relations between stakeholders most comments were not favourable. Most comments suggested that the workshop had done little to improve relations between the growers and the millers in particular.

As noted above, there was a sense that the project had come to an end with no sense of where things were to progress. There was also some concern about research feedback. Basically, it was suggested that there is much research of this kind done with the industry but little of the findings are fed back to participants.

Nambour area

Unfortunately of the 6 informants interviewed (1 grower, 2 millers and 3 state government representatives) only 2 were involved in the project before this workshop. This obviously impaired data collection regarding changing stakeholder views. Despite this, the messages about the central issues and how these have altered over the past year or so were still fairly evident.

The main concerns of the growers were the long-term viability of the industry in light of the possibility of the mill's closure. More specifically, the central issues were low sugar prices and the possible \$1.00 per ton levy being proposed by the millers to help pay for

transportation of cane. The main change since the preceding project workshop was the survival of the industry – closure of the mill was not thought by the growers to be a genuine possibility a year ago. A change in the leadership of the growers (Chairperson) seemed to be generally regarded positively by the other stakeholders.

As mentioned above, the millers were keen to up-grade the cane transport system and they were proposing to levy the growers to help make this possible. They were still also keen to see the harvesting season extended. Ultimately, it was the financial viability of the mill that they believed was at stake. In terms of changes, it seemed that most informants believed that both the growers and millers were more cooperative than they were at the time of the last workshop, mainly because they were all united in an effort to save the local sugar industry.

The local government's main concerns were the possible social and environmental impacts associated with the implied changes in the transportation of cane, particularly in light of the fact that much of the proposed changes involved increasing road transportation. The requirements of the Integrated Planning Act were central to their concerns.

The environmental lobby was also concerned with environmental issues associated with the industry (as they were a year ago) but most informants thought that they were generally supportive of the industry.

The workshop was regarded by most as very well organised and run. The level of attendance at the workshop also testified to the research team's success in promoting the event and the level of interest in the community. For the most part there were no specific concerns about the research team; the only negative comment was in relation to the clarity of the workshop's objectives.

Most informants believed the workshop had helped improve relations between stakeholders and the establishment of a working group to progress the activities and relations between the stakeholders of the industry was also regarded very positively by all that mentioned it. It was also seen as a necessary outcome of the workshop.

Summary of review process (all questionnaires & telephone surveys)

Workshop attendance

One of the most obvious and significant indicators of the relative success of a project of this nature is workshop attendance. With a project that extends over a period of three years it is reasonable to expect considerable variation in attendance. This has certainly been the case with this project.

The first workshop in the Herbert was attended by a total of 21 participants (10 council representatives, 7 growers and 4 millers). This suggests there was good interest in the project early on, particularly by the local governments associated with the area. The proposed sale of the mill occurred at the anticipated time of the Herbert's second workshop. This was an unfortunate circumstance that ultimately led to the cancellation of the second workshop. The third workshop was attended by a total of 11 participants (6 growers, 4 council representative and 1 other interested community person). The reduced attendance would at first glance suggest there was diminished interest in the project. This may be true however it must also be noted that the proposed sale of the mill, which took place in the middle of the project's intended schedule, almost certainly had a negative impact on interest in the project. In short, one cannot separate the 'rail-roading' effect that the proposed sale had. What is perhaps of more concern however is the complete lack of attendance of millers at the third workshop. Unfortunately, there were no comments from those that did attend as to why the millers had decided not to attend. One can only assume they did not regard the workshop important enough to make time available for attendance.

Attendance figures from the Nambour area suggest the project had a very different impact. Attendance at the first workshop was 12 (6 growers, 4 millers and 2 unknown). Notably, there were no council representatives at this first workshop. At the second workshop, attendance had gone up to 21 (9 growers, 4 millers, 2 local government representatives, 4 community research and extension and 2 that were unidentified). By the third workshop attendance had risen to around 50 or 60 although the exact details of stakeholder representation were not made available to this reviewer. Nevertheless. comments from those interviewed suggest there was also very good stakeholder representation. Interview data suggest the project had created an increasing level of interest in planning the future of the sugar industry in the area. There is just one word of caution however; the level of interest may also, in part at least, be the result of decreasing sugar prices, which brought the viability of the entire industry in the area under increasing scrutiny. The millers in particular now regard their enterprise as so unviable that they propose closing the mill. With no alternate mill in the area, this proposal threatens the whole local industry. Inevitably, such a proposal will generate an enormous level of interest from the whole community.

Changes over the course of the workshops

The growers appeared to be significantly more familiar with sugar industry planning processes than other stakeholder groups. This was particularly the case in the Herbert where the growers seemed relatively very experienced. Workshops were the planning process most experienced and favoured by all groups in both catchments. It was also generally considered to be the most effective method of planning although it was marginally not as well regarded in the Nambour area than in the Herbert.

The Herbert's stakeholders overall had more experience than the Nambour groups with planning tools (GIS, CBA, EIA, SIA, land capability) although it was the Herbert growers who again demonstrated some considerable experience, particularly with GIS. This may partially be a result of the influence of the Herbert River Information Resorce Centre located in the area. Land capability was regarded very highly in both catchments, again particularly by the growers, but it was local knowledge and skills that the industry stakeholder groups in both catchments felt was most important.

When asked about the level of understanding of other stakeholders, most of the growers and millers stated they had very little or no understanding of each other in both catchments. However, the millers seemed slightly less pessimistic although they clearly still saw difficulties. The growers of both catchments also believed that local and state governments had a good understanding of each other but responses from the local government representatives themselves showed this was not the case.

With respect to attitudes about planning, most informants from both catchments were for the most part favourable about negotiating and that planning should be holistic and integrative. The process of negotiation was apparently not regarded as an easy process and this may have affected their responses to consultation, which produced a mixed response. The growers and millers of the catchments were clearly less favourable to consultation than local government (this could only be confirmed in the Herbert).

The telephone surveys that followed the workshops revealed that the main concern of all stakeholder groups in both catchments was continued industry viability. The millers from both areas expressed their wish to see longer growing and harvesting seasons (24 hour harvesting), which the growers clearly had concerns over. The millers of the catchments regarded adoption of their proposals as necessary for the milling side of the industry to remain viable. Growers in the Herbert were also concerned over drainage issues while the council representatives were concerned with infrastructure. The council also supported diversification.

A major issue of contention in the Nambour was the management and financial details of the milling operation, which according to the growers, was not nearly transparent enough. The question caused considerable dispute at the first meeting that almost resulted in some of the participants walking out. As it turned out, the facilitation team was able to settle things down and the meeting finished on a relatively positive note with all agreeing that it was an important start. In fact, most comments about the research team's performance at both the first workshops were positive. Comments were along the lines of 'professional and facilitative'.

It was clear by May 2000 that the format and methods identified for this project were appropriate. However, the attendance at the first Nambour meeting implied that greater attendance was needed for things to progress. It was also noted that the workshops would be better represented if there were also some attendance from state government.

As mentioned above, the proposed second workshop in the Herbert did not take place but the Nambour's second workshop was held in November 2000. Once again, it was workshops that the participants had most experience with compared to public meetings and questionnaires. The level of experience between the groups was fairly similar and again workshops were the most preferred planning process and also thought the most effective. In terms of planning tools, the pattern of experience found at the first workshop was again expressed here. Land capability was regarded very important, as was the use of GIS and CBA however it was again local skills and knowledge that was considered most important.

Responses from participants at the second workshop regarding understanding between groups suggest little if any change in the level of understanding. There was however a slightly more positive response from the millers where some reported 'understanding' the growers. This was marginally a greater degree of understanding than the millers had of the growers since the first workshop. Despite this, the level of understanding reported by most participants at this stage of the project was still only moderate at best.

For the most part, attitudes towards planning had also changed little. As was the case following the first workshop, most participants acknowledge the importance of holistic and integrative planning and negotiation. However, it seems there was a shift in views regarding consulting with stakeholders. In the first workshop responses to consultation were mixed with many growers and millers reporting that they were not particularly supportive. Results from the second workshop however suggest that all were fairly favourable and it seems conceivable that the process of consultation that had taken place as a result of this project may have had a positive influence on grower and miller attitudes to consultation.

The second post-workshop telephone survey revealed that the central issue of concern was still over the miller's proposed extension of the harvesting season. Again, the millers regard this as necessary for the viability of their operations. Also on the agenda at this time was proposed changes to the transport system for transporting cane to the mill. The council had some concerns about potential impacts.

Once again the respondents at the second Nambour workshop were satisfied with the performance of the research team. However, what was not apparent following the first workshop was some criticism of the second workshop's venue, which may have been changed since the first. Some reported difficulties in hearing the presenters. Despite a greater attendance at the second workshop compared to the first, some informants still thought there should be better participation. In particular, state government was singled out as potentially making a useful addition to the list of participants.

The timing of the third workshops was not as planned. These were originally intended to take place in the middle of 2001 (see Figure 1, Appendix A), however, it was not until March or April of 2002 that the workshops actually took place (Figure 2). Whether or not the delay in the progress of the project affected the participation of the third workshop in the Herbert is difficult to assess but it is conceivable that some of the participants may

have lost interest over the two years and four months between workshops, particularly given the highly dynamic nature of changes in the industry over that period (e.g. the proposed sale of the mill). What was clear is that the stakeholders in the Herbert have been involved in many planning forum, which are associated with different planning processes, and comments received during the telephone interviews suggest that some found it hard to make linkages between the workshops associated with this project.

For the most part, the level of experience, preferences and perceived effectiveness between workshops, public meeting and the use of questionnaires remained unchanged. Both the growers and the council representatives have considerable experience with all of these. Workshops still remain the preferred method of planning. As was also the case at the first workshop, most had experience with the various tools associated with land planning although EIA and CBA were considered more important here. It must be noted here however that the range of respondents had changed significantly since the first workshop so direct comparison is difficult.

Since there were no millers at this Herbert workshop it is also difficult to make direct comparisons between workshops on the level of understanding between groups. It was apparent however that relations between millers and growers was still difficult because there is a perception that each group is only concerned with their own agenda.

The post-telephone survey of the third Herbert workshop revealed some shifts in the emphasis of issues. Continuing low sugar prices and three years of poor weather had placed greater emphasis on the viability of the industry in the area. Drainage issues were no longer so high on the grower's agenda. Importantly, the miller's position had also changed slightly; they seemed more receptive to the grower's concerns and problems, so much so in fact that they were apparently placing technical staff in the field to help growers deal with problems. What hadn't changed since the project began is the miller's desire to introduce 24 hour harvesting, which the growers still seem reluctant to adopt. While the millers apparent increase in support for the growers problems must be regarded as positive, it is not possible to say whether this has come about because of improved relations as a result of this project, or if it is the result of desperation on the millers part given the state of play in the industry overall. Comments would suggest it is more likely to be the latter.

Once again, comments regarding the performance of the research team at the workshop were for the most part positive. The only concern expressed about the project was in relation to how things were to progress now that the project was completed.

The third Nambour workshop was apparently very well attended but as mentioned above only 5 completed questionnaires were returned from the third workshop. This makes comparisons between results from this and previous workshops all but impossible in any meaningful way. All that can be said from the questionnaires with any measure of confidence is that there was still a poor level of understanding between millers and growers – this has not changed across all workshops.

It was unfortunate that of the 6 informants interviewed following the third Nambour workshop, just 2 had been involved previously. It turned out that 3 who were interviewed were from state government agencies. This immediately testifies to the fact that the research team were able to address one of the concerns from the first two workshops i.e. that state government should be involved. Nevertheless, it is difficult to comment on changed perceptions of issues when so few previous attendees were present.

Like the Herbert area, the low sugar prices had brought a sense of urgency and even despair in the responses of those interviewed in the Nambour. What was clear from the interviews was that the Nambour miller's concerns about the viability of the milling processing were far more severe. Closure of the mill seemed a much more realistic proposition than it had been at previous workshops, so much so that the growers were

making serious efforts to negotiate over costings associated with the transportation of cane to the mill. While they were not in favour of paying the \$1.00 per ton levy suggested by the millers, they seemed almost resigned to the fact that it was probably necessary if they wanted to retain a sugar industry around Nambour.

The proposed changes to the transportation system that had been on the agenda at the previous workshops were still there but again the emphasis had shifted and it seemed that the millers were now looking to the growers to fund all the necessary changes – something the growers could not support. The overall impression from this reviewer's perspective is that the millers seem reluctant to negotiate on the costs of up-grading the transportation system and if they felt there was no way to avoid major investment here then they would probably prefer to close the mill and be rid of a major headache.

In light of the above it is difficult to be positive about the workshop. One brighter note was the establishment of a working group which was charged at the workshop with the task of exploring the viability of the industry in the area.

Importantly for this review was the fact that most interviewed felt that the research team had done a good job in organising and facilitating the workshop. As mentioned above, the level of attendance testifies to the research team's management of the workshop and it's capacity to address previous concerns about representation.

Participant retention at the workshops

It was considered that some insight into participant retention over the course of the project might also offer some insight into the perceived value of the project. As mentioned above, in the Herbert the number of participants at the workshop dropped from 21 at the first workshop to 11 at the third. Of the participants who attended the first workshop, the questionnaires revealed that 4 respondents were also at the third – 2 growers and 2 local government representatives. Although there were negligible changes in these participants views regarding their understanding of the other stakeholder groups or their attitudes to planning, the telephone interviews revealed positive comments regarding the performance of the research team at both workshops.

In Nambour, the three workshops demonstrated an increasing number of participants (12 at the first, 21 at the second and round 50 or 60 at the third). Closer examination of the individual participant's questionnaires revealed an excellent retention record. A total of 8 participants were involved in 2 workshops and another 2 had participated in all 3 workshops. In fact, 7 participants who were at the first workshop were also at the second. The details of stakeholder attendance continuity is as follows:

3 growers attended the first and second workshops Another 2 growers attended the second and third workshops

2 millers also attended the first and second workshops

1 miller attended all three workshops

1 local government representative also attended all three workshops

1 community extension person attended the second and third workshops

Again, the workshop questionnaires of these participants were inconclusive regarding any positive change in between group understanding or attitudes towards planning, negotiation or consultation but their responses to questions concerning the performance of the research team during the telephone interviews were all positive. In fact, most of the comments suggest that the team was considered highly professional in their approach to organisation and facilitation.

Conclusions

It is important to recognise the industry context in which this project has been conducted. Like much of Australian agriculture, the sugar industry has been affected by a 'cost-price

squeeze' that has a long history. This project began in 1999 when sugar prices had fallen to a level lower than for some time. They have remained low for the life of the project. Costs associated with production and transportation have also been rising consistently. This economic environment implies that all stakeholders associated with the industry, particularly the growers and millers, have been under extreme pressure to find increasingly higher levels of efficiency and economies of scale. A central issue to have emerged from both catchments is that the millers do not believe the present harvesting system will allow them to make the necessary changes in their operations to allow their side of the industry to remain profitable. As far as they are concerned only with the introduction of a longer harvesting season and 24 hour harvesting will they have the opportunity to remain profitable. There are clearly also inefficiencies in the manner in which cane is transported to the mills (particularly in the Nambour area) and again, unless changes are made then the viability of the milling side of operations will be questionable. For the growers, these proposals imply significant changes in the manner in which cane is produced and it is clear that there are also cultural/life-style implications, which the growers seem reluctant to alter. Notably, the Herbert area has also experienced poor yields in recent years – the result of poor weather.

The community and sugar industry responses to the project and the workshops have been quite different in the two catchmant areas.

In the Herbert, community participation seemed to be quite positive at the early stages of the project but towards the end, the level of interest had fallen away. This appears to be particularly true of the miller stakeholders who could did not even show enough interest to take part in the last third workshop.

The influence of the prospective sale of the mill in the Herbert half way through the project undoubtedly impacted on the level of interest in the project. Recognising this at the time, the research team decided to abandon the idea of holding a second workshop, which was scheduled about mid-way through the project. In retrospect one could perhaps question if this was the right decision. Perhaps if the second workshop had occurred then it is possible that the initial inertia and interest in the project apparent early on might have been sustained for the life of the project. However, since this reviewer is unaware of all external influences acting upon the industry at that time, it would be inappropriate to criticise the team's decision. However, perhaps adding to the lost level of interest was the delay in running the last workshop. The last workshop was originally planned for the middle of 2001 but it did not take place until March 2002. This meant there were two years and four months between workshops – a very long time in increasingly dynamic times. Comments from some of the participants suggest that they had some difficulty in making links between the first and third workshops and the project as a whole. In short, perceived lack of continuity would certainly not have helped ensure interest. It must also be noted that these two workshops took place within an industry that is involved in a number of similar processes and it was also clear that participants had trouble distinguishing this project's workshops from the myriad of other workshops that have also taken place in the area over the past three years.

In the Nambour area, an entirely different story emerged compared to the Herbert. The first meeting started off with an attendance far less than that of the Herbert – one that was poorly representative of the sugar industry. Relations at this first meeting were evidently also highly strained. Nevertheless, the research team was able to demonstrate excellent facilitation and conflict resolution skills in bringing the meeting back on track and returning it to a point so that it ended on a fairly positive note with all agreeing to persevere with the process. The second meeting, which was held pretty much as planned on schedule, had a wider and larger participation than the first and relations, while still not mutually satisfying, were nevertheless engaging. The last meeting, which like the Herbert's third workshop was delayed, had an extremely high attendance. This meeting also finished on what must be regarded as a very positive note with the establishment of a working group charged to continue the process of negotiation in the absence of the project

and the research team' support. It is the view of this reviewer that, in the Nambour area certainly, the research team can take full credit for progressing what were apparently quite destructive relations early on and ultimately turning them into something far more constructive.

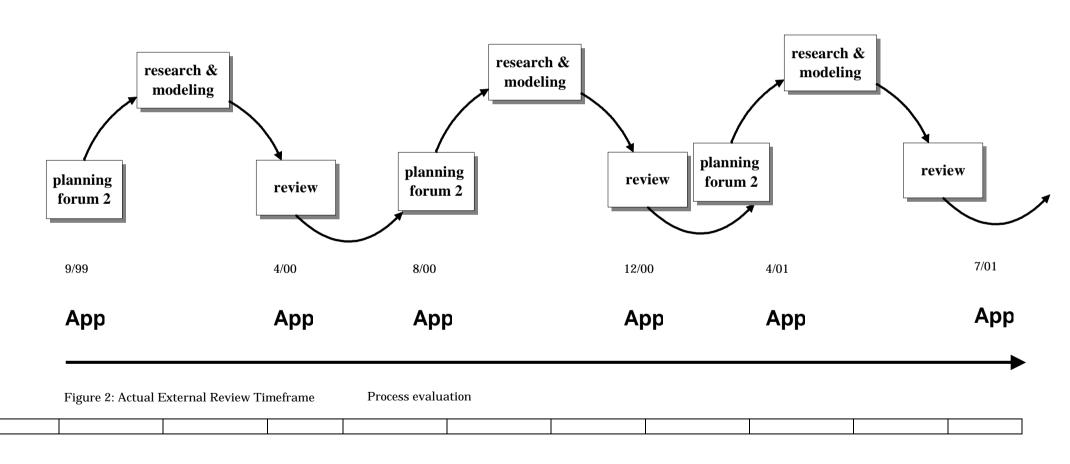
Responses to questions contained in the workshop questionnaires regarding participation in planning, relationships and working with other stakeholders, and beliefs about planning and planning processes revealed little discernable changes over the course of the workshops in both catchments. Differences between the various stakeholder groups in terms of their responses to these questions were also not significantly different except perhaps with once exception; the growers of the Herbert did appear to have a greater level of experience in planning processes and in the various tools associated with planning processes. As mentioned above, the sugar industry in the Herbert area has been researched in many contexts in the past and it is quite likely that this has drawn in many of the grower participants hence exposing them to similar processes.

Despite the above, it was clear from the telephone surveys that there were notable changes taking place between stakeholder groups over the period of the project. Put simply, these changes can be summarised as being positive in the Nambour but negative in the Herbert. What is not clear is whether these changes have occurred as a result of this project or whether they came about as a result of responses to changes taking place in the industry overall. It seems most likely that the changes in relations are the result of industry changes. However, it is interesting to observe how these pressures and threats appeared to have come between the Herbert stakeholders while in the Nambour, the reverse has happened and there has been some 'coming together' to tackle the problems head-on.

As far as the research team is concerned, they have evidently been forced to adopt and adaptive management process in response to the changing circumstances, particularly in the Herbert. This reviewer cannot be clear as to whether the decision to cancel the second workshop in the Herbert was in the best interests of the project. However, it almost certainly left some of the participants with a feeling of being out of touch with the project in the 2 years between the first and third workshops. In the Nambour, most comments regarding the research team were positive, except for some minor details, and the participation levels for the workshops are testimony to their success. In both catchments, the research team's facilitative skills were well acknowledged.

Appendix A: External review timeframe

Figure 1: Strategic Planning for the Sugar Industry Anticipated External Review Timeframe



A = Meeting process & outcome (how the meeting went)

D CL : LL L

| | Benchmark workshop questionnaire | Post- benchmark Workshop telephone survey | Progress report | Pre-2 nd Workshop telephone survey | 2 nd Workshop questionnaire | Post-2nd Workshop telephone survey | Pre-3rd Workshop telephone survey | 3 rd Workshop questionnaire | Post-3rd Workshop telephone survey | Final report |
|------------------|---|---|--|---|---|---|---|--|--|---|
| Herbert Area | Conducted: December 1999 Reported: December 1999 | Conducted: December 1999 Reported; December 1999 | External reviewer's progress report, prepared: May 2000 | Conducted: November 2000; Reported: November 2000 | No workshop conducted | N/A | Following outcomes of pre-2 nd workshop telephone survey it was decided these would not take place | Conducted: March 2002; Reported: April 2002 | Conducted: April 2002; Reported: April 2002 | External reviewer's final report, prepared: April 2002 |
| Nambou r Area | Conducted: December 1999 Reported: December 1999 | Conducted: December and January 1999/2000 Reported: February 2000 | | Conducted: November 2000; Reported: November 2000 | Conducted: December 2000; Reported: January 2001 | Conducted: December and January 2000/2001; Reported: January 2001 | | Conducted: March 2002; Reported: April 2002 | Conducted: April 2002; Reported: April 2002 | |