Natural resource management in
the Burdekin Dry Tropics:
social and economic issues
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Natural resource management in the Burdekin Dry Tropics: social and economic issues

Report for the Burdekin Dry Tropics NRM Board

January 2003

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Executive Summary

The Burdekin Dry Tropics Natural Resources Management Board (BDTB) commissioned CSIRO to undertake this socio-economic scoping study of the Burdekin region. The study contributes to an understanding of the regional economy and community in relation to natural resource management (NRM). The report presents information to determine the capacity and willingness of the community in general, and landholders in particular, to participate in NRM. This provides a critical contribution to the process of prioritisation and target setting, which will guide public investment into NRM in the Burdekin. While the implementation of the National Action Plan for Salinity and Water Quality (NAPSWQ) provided the immediate impetus for the study, its scope is to advise NRM and planning in the Burdekin region in a broader sense.

The report describes the community and economy of the Burdekin Dry Tropics, with specific focus on issues pertinent to NRM. It considers individual, business and community indicators for the adoption of sustainable practices. It highlights social and economic consequences of changes to natural resource-based industries. It emphasises the role of landholder attitudes to natural resource management practices and the impediments to implementation. It widens the investigation of NRM practices from the property scale to provide a whole-of-catchment perspective, and suggests options for supporting implementation of NRM practices.

The report touches only superficially on issues that concern land management aspirations by Aboriginal traditional owners. Such issues deserve careful attention and their resolution is outside the scope of this study.

Key messages from the data

The Burdekin region

The document deals with three basic reference areas. It refers to the Burdekin River Catchment as the area from which water drains into the Great Barrier Reef Lagoon via the Burdekin River. The catchment is the investment area for the NAPSWQ.

Much of the data presented in the report is on the basis of the eight Local Government Areas, which in total, present a ‘best administrative fit’ of the Burdekin River catchment. This area is referred to in the report as the Burdekin Region.

The Burdekin Dry Tropics Region is the planning area for the NAPSWQ and includes Townsville/Thuringowa and Bowen in addition to the Burdekin River catchment. This is in recognition that people living within the catchment are embedded in social processes and economic flows, which concentrate towards urban centres outside the catchment area. Conversely, population growth and industrial development in those urban centres are reliant on the security of water supply from the Burdekin catchment. The report refers to the Burdekin Dry Tropics region as “The Burdekin”.

The Burdekin region
The Burdekin shows a high degree of incompatibility between hydrologically, ecologically and administratively defined boundaries. The Burdekin encompasses 10 local government areas but straddles three planning and development areas and multiple federal and state electorates. This poses difficulties for data manipulation but more significantly poses challenges for NRM bodies in defining and implementing policies.

The Burdekin region is a rural region with few population centres. Landuse is dominated by grazing. Grazing is complemented by dryland (and opportunistic irrigation) farming in the southern areas. There is irrigation farming (predominantly sugar cane) in the Lower Burdekin.

Landscape health across the region is generally good. However, some coastal areas and parts of the Belyando-Suttor catchments show signs of stress where modification of ecosystems and hydrological conditions have been extensive. Specific areas of concern in relation to erosion, salinity and water quality across the entire Burdekin River catchment were identified by Roth et al., (2003).

The regional community

The community of the Burdekin Dry Tropics region is predominantly urban. More than three quarters of the population reside in the major urban centre Townsville/Thuringowa but also Charters Towers, Bowen and Ayr/Home Hill.

Most shires within the Burdekin region are experiencing population decline – and substantial declines in the proportion of population aged less than 15 years. This may reflect a low ‘desire to remain’, indicating a weakening link between the community and the region.

Most rural shires within the catchment appear to be at a relative socio-economic disadvantage (compared to Queensland and Australia as a whole) – with some areas rating among the most disadvantaged communities in the country.

Agriculture and mining employ close to 50% of the workforce in Belyando, Dalrymple, Jericho and Nebo shires and a significant proportion in all other shires. The fact that so many people and families derive their livelihoods from “the land” provides a very strong tie between the natural resource base of the region and the community.

Unemployment in the Burdekin region is quite low, home ownership is relatively high and families are generally ‘intact’. Contrary to indications based on population decline this may indicate a strong ‘desire to remain’. It also indicates a capacity to invest into the region as large sums of money are not necessarily tied up in mortgage and/or rent payments. If the individuals who live and work in the area do have a strong ‘desire to remain’, then this may provide a very strong motivation for ensuring sustainable development.
The regional economy

The economy of the Burdekin Dry Tropics is heavily reliant upon natural resource-based industries, particularly agriculture.

Agriculture is the second most important industry in the North Queensland economy on the basis of contribution to the value of gross regional product. Most of the revenue generated remains in the regional economy.

Natural resource-based industries are subject to much volatility – through changes in economic variables (volatile prices and exchange rates), changes in nature (variable rainfall, natural disasters), and changes in government policy.

Natural resource-based industries are heavily linked into the regional economy. This means that changes in these industries affect other industries through ‘multiplier’ effects. Multipliers quantify (1) the strength of relationships between sectors of the economy based on supply, transport, processing and service relationships, and (2) the employment impact of industries, and economic impact of wages and profits.

Agriculture is by far the most important employer in the rural areas of the Burdekin region and is therefore even more important socially than economically.

The relatively high employment multipliers of agricultural sectors (particularly when compared to mining) mean that revenue changes in that sector have a large impact on other sectors of the economy. The more important is the agricultural sector, the larger will be that effect. Some shires within the Burdekin Dry Tropics have fairly diversified economies, and are therefore less susceptible to boom-bust cycles in response to boom-bust cycles within the agricultural sector. Others, specifically Nebo, Jericho and Belyando shires, are much less diverse and may therefore be considerably less ‘robust’.

Tourism in the Burdekin region is in a fledgling state. There is little supply and little demand and there are few attractions. However, there are niche opportunities for farm-based and other nature-based tourism activities. This provides an exciting challenge to NRM with issues ranging from access to natural resources to point-source pollution to diversification.

Mining is a small-scale, high-impact activity in the landscape in contrast to the other natural resource-based industries, whose impacts are much more extensive and diffuse. High priority management issues for this industry are associated with optimal exploitation rates of the non-renewable resource and operational optimisation, rather than NRM issues. Gross operation surplus from mining generally leaves the region.

Agriculture

Grazing is the predominant land use across the Burdekin Dry Tropics while dryland and irrigation cropping is restricted to relatively small areas. Yet crops contribute about twice as much value as livestock to gross regional product. This is due to a large variation in land productivity between different areas within the region, which ranges from $400 per hectare for the Burdekin and Mirani shires to as little as $10 per hectare for the Dalrymple and Jericho shires.
Land productivity is highly variable over time. All shires within the region experience large fluctuations between years, with the per-hectare value of agricultural production rising (and falling) as much as 30% from one year to the next.

Farm incomes and profits fluctuate widely between years in response to production and price fluctuations. Over the past 25 years, profit was negative, on average, in two out of every five years.

Total value of capital for farms has steadily increased and a trend of rising debt and falling equity is prevalent. While farm equity has remained generally high, farms may not be able to service debt during recurring low-income periods.

Large capital investment, specifically when coupled with debt financing, increases the pressure for intensification of production systems to maintain profitability and returns on investment.

Farm household income is derived from profit. This means that in may years farm families need to go into or increase debt simply to cover ongoing living expenses and stay in business. During such periods, landholders do not have the financial capacity to engage in significant investment, let alone NRM innovation – despite tax incentives and the prospect of generating returns on investment at some point in the future. The extreme variability in farm incomes makes the implementation of NRM policy all the more difficult.

Natural resource management: policy context, complexity, personal characteristics, perceptions, values, impediments to implementation of NRM and communication

There are a large number of plans, strategies and policies already implemented with the intention of (a) governing the interactions between individuals and businesses with the environment and natural resource base and (b) providing institutions for administering NRM related processes. The BDTB needs to be conscious of this context.

There is much overlap between institutions developed at various levels. There are policies that are ineffective through lack of monitoring, enforcement or incentives. There is overlap in scope. There are policies that have unintended consequences because their design ignores the complexity of natural, economic, social and individual factors in a diversity of land-use systems.

The degree of implementation of NRM practices across the Burdekin is varying. Adoption of rangeland and grazing management practices is generally high. Adoption of NRM practices into cropping systems is generally low. There is very little implementation of specific environmental activities targeted at biodiversity conservation.

Climate variability is the single most important constraint for landholders that keeps them from implementing more NRM practices. In combination with the other major constraints (lack of staff and time, investment and ongoing costs, and lack of government incentives), there is a clear indication that, while farmers are motivated, their financial situation constrains the degree to which they can change towards more sustainable production systems.
Landholders in the Burdekin see large scope for on-farm environmental and financial improvements from a range of NRM activities. Contrary to traditional economic-environmental trade-off theory, landholders expressed a large degree of congruence between both goals. This can be taken to indicate an appreciation of natural resource condition as basis for farm profitability. However, there is reason for caution as evidence suggests that landholders may self-justify financially profitable practices with environmental claims.

Landholders expressed a perception that most NRM activities could provide environmental benefits for the Burdekin catchment as a whole, if implementation was to be wide-spread. This is an indication of the need for (1) a strategy involving a suite of activities – which may vary across different sub-regions – to achieve benefits in multiple environmental domains, and (2) the need for concerted and collaborative effort in implementing chosen activities.

In terms of the BDTB communicating information and messages to its constituency, a large variety of newspapers need to be involved in the circulation of material to achieve coverage of the Burdekin catchment, ideally supported by broadcasts through the local ABC stations.

KEY CONCLUSIONS FOR NRM

NRM policy needs to start considering the socio-economic conditions that impede NRM implementation either through lack of capacity or willingness. These constraints need to be addressed in designing NRM policy and implementing priority actions.

Several important conclusions emerge from the data presented in this report. They show how the BDTB might broker and value-add to the complex web of environmental and NRM-related laws and policies. Some of the suggested actions lie outside the direct domain of the BDTB. Nevertheless, it has an important role to play in talking to relevant agencies, and advising on change.

Specifically, it needs to consider ways of:

- Managing the social and economic pressures and dependencies on the natural resource base. Actions may include:
  1. encouraging diversification of regional economies particularly into secondary and tertiary industries;
  2. conducting scientific research into ways of using natural resources more effectively and sustainably; and
  3. facilitating farm-level structural adjustment (be it enterprise diversification, expansion, changes to management, etc), while recognising and where possible mitigating the social, economic and environmental consequences.

- Maximising the benefits of policy implementation at a broad regional level while encouraging flexibility to allow tailoring to sub-regional and site-specific circumstances. Actions may include:
  1. refining ‘blanket-type approaches’ such as environmental regulation and tax incentives for NRM,
(2) developing a suite of supportive policies, by:

(a) drawing on the full suite of potential policy instruments available;
(b) taking into consideration the likely acceptability by the community and landholders;
(c) tailoring policy to biophysical and ecological conditions in certain areas; and
(d) co-ordinating public investment into NRM from programs such as the National Heritage Trust (NHT) and Bushcare in a strategic manner.

• Providing consistent policy signals over time. Given the boom-and-bust cycles in agriculture, caused predominantly by climatic and market volatility, long-term perspectives of policy are essential. For example, tax incentives are only effective in years where landholders generate sufficient profit. Short-term policies (such as one-off funding of individual and small-scale projects by NHT) run the risk of being ineffective because they cannot be strategically applied in a highly volatile environment.

• Integrating existing policies and co-ordinating actions across multiple NRM and environmental management issues, thereby offering complex solutions to complex problems, which typically span multiple dimensions and time scales. The current legislative and policy environment is characterised by a multiplicity of plans and policies, developed largely in isolation of each other. This leads to overlap, unintended side-effects, and even conflicting messages. It is a challenge to work within this framework to take advantage of synergies.

Ideas for improvement include:

(1) facilitating a whole-of-government approach, which could provide substantial benefits by making it easier for agencies to administer NRM, and for NRM bodies and businesses to understand and operate within; and
(2) establishing an overarching monitoring program that can provide the basis for an improved data and knowledge base to support decision making (e.g. higher resolution land and water audit data which is freely available and timely).

• Enhancing the understanding of NRM issues of landholders and the community at large through communication, consultation and education.

• Involving research to identify and answer priority questions and working with agencies to maximise implementation and monitor progress. Specifically there is a need for further research into the 'real' (as opposed to perceived) economic benefit of a range of different NRM practices, with a view towards using that information to prioritise policy.
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<tr>
<td>ABARE</td>
<td>Australian Bureau of Agricultural and Resource Economics</td>
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<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
</tr>
<tr>
<td>AFFA</td>
<td>Agriculture, Fisheries and Forestry Australia</td>
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<td>AIMS</td>
<td>Australian Institute of Marine Science</td>
</tr>
<tr>
<td>ANCID</td>
<td>Australian National Committee of the International Commission on Irrigation and Drainage</td>
</tr>
<tr>
<td>ARIA</td>
<td>Accessibility/Remoteness Index of Australia</td>
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<tr>
<td>ASCO</td>
<td>Australian Standard Classification of Occupation</td>
</tr>
<tr>
<td>ATSIC</td>
<td>Aboriginal and Torres Strait Islander Commission</td>
</tr>
<tr>
<td>AUSLIG</td>
<td>Australian Survey and Land Information Group</td>
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<tr>
<td>BDTP</td>
<td>Burdekin Dry Tropics Board</td>
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<td>BDTB</td>
<td>Burdekin Dry Tropics Region</td>
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<tr>
<td>BRS</td>
<td>Bureau of Rural Sciences</td>
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<td>BTR</td>
<td>Bureau of Tourism Research</td>
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<tr>
<td>CD</td>
<td>Collection district (for ABS census)</td>
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<td>CDEP</td>
<td>Community Development Employment Program</td>
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<tr>
<td>CIE</td>
<td>Centre for International Economics</td>
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<tr>
<td>COAG</td>
<td>Council of Australian Governments</td>
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<tr>
<td>CSIRO</td>
<td>Commonwealth Scientific and Industrial Research Organization</td>
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<tr>
<td>DNR</td>
<td>Department of Natural Resources (Queensland)</td>
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<tr>
<td>ECC</td>
<td>Estimated Carrying Capacity</td>
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<tr>
<td>FTE</td>
<td>Full-Time Equivalent</td>
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<tr>
<td>GBR</td>
<td>Great Barrier Reef</td>
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<td>GBRMPA</td>
<td>Great Barrier Reef Marine Park Authority</td>
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<td>GBR-WQP</td>
<td>Great Barrier Reef Water Quality Plan</td>
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<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>GRP</td>
<td>Gross Regional Product</td>
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<td>IBRA</td>
<td>Interim Biogeographic Regionalisation of Australia</td>
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<td>IRDB</td>
<td>Inter-Regional Database (ABS)</td>
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<tr>
<td>LGA</td>
<td>Local Government Area</td>
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<tr>
<td>LSU</td>
<td>Large Stock Unit</td>
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<tr>
<td>LWRRDC</td>
<td>Land and Water Resources Research and Development Corporation</td>
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<tr>
<td>NAP</td>
<td>National Action Plan</td>
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<tr>
<td>NAPSWQ</td>
<td>National Action Plan for Salinity and Water Quality</td>
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<tr>
<td>NHT2</td>
<td>National Heritage Trust phase 2</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>NLWRA</td>
<td>National Land and Water Resource Audit</td>
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<tr>
<td>NRM</td>
<td>Natural Resource Management</td>
</tr>
<tr>
<td>NR&amp;M</td>
<td>Department of Natural Resources and Mines (Queensland)</td>
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<tr>
<td>QPWS</td>
<td>Queensland Parks and Wildlife Service</td>
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<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
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<tr>
<td>SD</td>
<td>Statistical Division</td>
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<tr>
<td>SEIFA</td>
<td>Socio-Economic Indices for Areas</td>
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<td>SLA</td>
<td>Statistical Local Area</td>
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<td>SRMP</td>
<td>Sustainable Resource Management Practices</td>
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<td>SSD</td>
<td>Statistical Subdivision</td>
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<td>TQ</td>
<td>Tourism Queensland</td>
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1 Introduction

Section summary

The BDT NRM Board commissioned CSIRO to provide socio-economic information about the Burdekin region. The study contributes to the prioritisations and target setting process for public investment into NRM. While the implementation of the NAPSWQ provided the immediate impetus for the study, its scope is to advise NRM and planning in the Burdekin region in a generic sense.

The report describes the community and economy of the Burdekin Dry Tropics, with specific focus on issues pertinent to NRM. It considers individual and community indicators of the likely adoption of sustainable practices; social and economic consequences of changes to natural resource-based industries, and landholder attitudes to resource management practices.

The purpose of this chapter is to provide background, context and direction.

First, it discusses the report in the context of the National Action Plan for Salinity and Water Quality (NAPSWQ, conveniently referred to as NAP) to highlight the primary purpose of the report, which is, to discuss socio-economic drivers and impediments to NRM change in the Burdekin. Next, it outlines the structure of the report. Finally, it introduces the theoretical framework for the report’s discussion; noting individual, community and business indicators of the likely adoption of sustainable resource management practices.

1.1 Background of this report and scope

Release of the National Action Plan for Salinity and Water Quality (NAPSWQ – short NAP; AFFA 2000) and the Great Barrier Reef Catchment Water Quality Action Plan (GBR-WQP; GBRMPA, 2001) has focused attention to water quality issues. It has also provided new resources through public investment. The NAPSWQ is the first strategy for comprehensively addressing problems of salinity and water quality at the national level, while the GBR-WQP reviewed historical and current conditions, and proposed quantitative targets for reductions in sediment and nutrient runoff. Together, these documents forecast major changes in future management of lands that control water quality in targeted catchments.

The NAPSWQ planning and implementation process is driven by interim regional natural resource management (NRM) bodies. The Burdekin Dry Tropics NRM Board (BDTB) is the regional body representative for the Burdekin catchment, which is part of the Burdekin-Fitzroy priority investment region of the NAP. The BDTB is responsible for producing and implementing a NRM plan that is endorsed at state and federal level.

Accreditation of the agreed NRM plan is a prerequisite for receiving funding from the NAPSWQ. To achieve accreditation, the plan must incorporate initial targets for salinity,
water quality, and in-stream and terrestrial biodiversity, consistent with the National Framework for NRM Standards and Targets.

The plan will also need to consider regional water quality needs (including wetlands, human and industry uses), costs and feasibility of the required management actions, and the requirements of downstream water users and environments.

The Great Barrier Reef Catchment Water Quality Action Plan was released in September 2001. It categorises the 26 GBR catchments according to the ecological risk they pose to the Reef and recommends minimum targets for pollutant loads. The Burdekin River catchment is rated a medium/high risk catchment due to its large size (130 thousand km²). Sediment and phosphorus exports are classified as high risk for the GBR with estimated current loads of 2.4 million tonnes/year of sediment and 2.4 thousand tonnes/year phosphorus. Nitrogen exports pose a medium risk with an estimated current load of 11.1 thousand tonnes/year. Proposed targets are load reductions of 50% for sediment and phosphorus and 33% for nitrogen by the year 2011.

These targets were developed by a scientific working group within GBRMPA independently of the NAPSWQ process and with little consultation of researchers outside GBRMPA. However, GBRMPA sees the NAPSWQ as the appropriate process for the federal and state governments to deliver water quality targets for GBR catchments. Development of realistic targets is viewed as a critical first phase in a staged approach to reverse trends in declining water quality and to eventually allow for the recovery of inshore reef ecosystems.

For the following reasons the Burdekin catchment provides the ideal pilot region for a strategic integrated research approach to support the regional implementation of the NAPSWQ. The Burdekin Dry Tropics Board is very active and, in other forms (such as the Dry Tropics Regional Strategy Group) has long-standing and well-established relations to the community as well as government and industry. The Group has established relations with researchers from all major research providers in North Queensland. The Burdekin is well researched in comparison to many other catchments. Specifically, AIMS has undertaken research in the adjoining Great Barrier Reef Lagoon and CSIRO has completed grazing management research in the upper parts of the catchment and is conducting ongoing work in the irrigation area. This research provides the foundation to deliver information into the NAP process in a timely manner.

The BDTB has recognised that it requires information from a variety of different disciplines when developing a NAP implementation and investment strategy for the catchment as well as supporting and guiding other investment strategies such as the impending National Heritage Trust phase 2 (NHT2). More specifically, the BDTB has recognised that it needs biophysical and environmental information as well as information on how the regional community relates to and uses its natural resources.

This report fills a very important gap in the understanding of the Burdekin region as very little is known about: the relationship of the region’s natural resources to its economy and its community. It provides the first comprehensive attempt to link social and economic considerations at the regional scale to natural resource management issues.
1.2 Structure of report

This report is the 2nd of two reports collating existing understanding of the Burdekin catchment and region. The 1st report, entitled ‘Burdekin Catchment Condition Study Phase 1’, by Roth et al., (2003), describes the factors and processes that define the biophysical dimension of natural resource management issues in the Burdekin catchment. That document also provides preliminary scoping of key drivers, focus areas for investment, success factors, future monitoring requirements and critical R&D knowledge gaps.

This report adds a socio-economic and institutional understanding to those issues. Its structure is shown in Figure 1.1. It focuses on people – on individuals, on communities, on their relationship with natural resources, and on factors likely to encourage or constrain them in the adoption of sustainable land practices.

Figure 1.1: Structure of report
The purpose of chapter 2 is to provide detailed background information pertinent to the analysis. After describing the geography of the region, it notes important distinctions between biophysical, administrative, electoral and ‘social’ boundaries. It thereby highlights inherent difficulties and complexities for processes that operate at a bioregional scale, which does not neatly coincide with social and economic ‘catchments’ across the landscape. Chapter 2 also provides background material to ‘landscape health’ within the region; information which is used within chapter 6 when interpreting the socio-economic data.

The purpose of chapter 3 is to describe the regional community. Some of the discussion aims to provide a generic overview of the district. The purpose of most of the discussion, however, is to consider ‘indicators’ of likely adoption of innovative NRM practices. Its primary aim, therefore, is to identify geographic regions within the Burdekin Dry Tropics which are most/least likely to have either the capacity or the motivation to adopt sustainable resource management practices.

Chapter 4 aims to determine which industries are most important to communities within the Burdekin Dry Tropics mainly in terms of the employment they generate. It also considers the ‘risk’ of such industries; noting factors which contribute to volatile incomes and employment in those sectors. Finally, it explores linkages within the economy, aiming to determine the susceptibility of non resource-based industries to the ‘boom-bust’ cycles in natural resource-based industries.

Chapter 5 examines natural-resourced based-industries in more detail. It focuses specifically on inter-regional differences (in, for example, land-use efficiency), on farm-business statistics (examining changes in profits, expenses, debt and equity over time), and on the tourism industry.

Chapter 6 discusses natural resource management in the context of the information presented in preceding chapters. This analysis is further supported by data obtained from various surveys of landholders. From a survey conducted of landholders in the Burdekin during 2002, it draws a comprehensive picture of impediments to and incentives for change to NRM in the current social, economic, institutional and policy environment.

Chapter 7 offers a series of conclusions from the material presented.
1.3 Key drivers of NRM: change and adoption

Processes such as the NAP, NHT and associated policies and programs are essentially investments by society to change aspects of the way in which people manage the land and water towards practices that support ecologically sustainable development.

The adoption or non-adoption by people, specifically landholders, of more environmentally benign land and water management practices is a multi-faceted issue and influenced by a number of factors (CIE et al., 2001). Among other things, profitability is crucial: landholders are more likely to adopt new NRM practices if the perceived profitability of the new practices exceeds the perceived profitability of the current system and other alternatives. This will necessarily depend upon a range of factors including biophysical conditions, costs of implementation, risk, and the time horizon for return (Shively, 1997).

In addition to characteristics of the NRM practice itself, the characteristics of land-users (eg. personality, education, degree of motivation) influence propensities to adopt sustainable resource management practices (SRMP) (Guerin, 2000). A number of empirical studies concur that a combination of motivation and capacity is required for people to adopt sustainable practices (Fenton et al., 2000; Frank, 1997; Lapar and Pandey, 1999; Mbaga-Semgalawe and Folmer, 2000; Baidu-Forson, 1999).

Frank (1997) concludes from three grazing management studies conducted between 1995 and 1997 that capacity, encapsulated predominantly in managerial skills and resources, is necessary for adoption of innovation. Motivation, most notably the profitability of a new practice, is the sufficient condition. “If [the owners/managers of North Queensland Beef properties] have a sufficient level of managerial skill and resources and they experience a declining return per production unit they adopt innovations which offer a means of arresting that decline”. Filho et al., (1999) also found that declining returns increased adoption rates.

It is no trivial task to assess the propensity of people to engage in change. A detailed analysis of the adoption of sustainable rangeland management practices elicited three sets of indicators that capture the complexity (BRS, 2001). Age, education and family situation influence individuals’ decisions. The number of persons working on a farm, income and profit are correlated adoption at a business level. At the community levels, indicators such as age-dependency ratio and unemployment are linked to adoption, while at the institutional levels the relative investment into NRM is of importance. Tables A1.1, A1.2 and A1.3 (in Appendix A) summarise individual and business-related, community characteristics, and institutional factors, respectively.

Many of these characteristics are socio-economic; some are business related. All highlight the importance of community characteristics when planning for NRM: Even the best made policies will go to waste if not suited to and adopted by the communities they target.
2 The Burdekin

Section summary

The Burdekin River drains water from 130 thousand square kilometres into the Great Barrier Reef lagoon. The Burdekin River Catchment area is predominantly located in the dry tropical climatic zone of North-East Queensland. However, environmental conditions, ecosystems and hydrology across the catchment vary significantly.

Much of the data presented in the report is on the basis of the eight local government areas, which in total, present a ‘best administrative fit’ of the Burdekin River catchment. This area is referred to in the report as the Burdekin Region.

The people living within the catchment are embedded in social processes and economic flows, which concentrate towards urban centres outside the catchment area. They are Townsville/Thuringowa in the north and Bowen, Emerald and Mackay in the south, with the former exerting the predominant influence across the catchment. Urban and industrial wealth and growth in these centres, specifically Townsville and Thuringowa, is fundamentally reliant on the security of water supply provided by the Burdekin catchment. Where appropriate, this report provides data for, and considers this wider area and its interdependencies. When reference is made to ‘The Burdekin’, it is meant in a broader than hydrological sense - encompassing the entire Burdekin Dry Tropics region, which includes Townsville/Thuringowa and Bowen.

The Burdekin Dry Tropics region shows a high degree of incompatibility between hydrologically, ecologically and administratively defined boundaries. It encompasses 10 local government areas but straddles three planning and development areas and multiple electorates. This poses difficulties for data manipulation but more significantly poses challenges for NRM bodies in defining and implementing policies.

The Burdekin region is a rural region with few population centres. Landuse is dominated by grazing. Grazing is complemented by dryland (and opportunistic irrigation) farming in the southern areas. There is irrigation farming (predominantly sugar cane) in the Lower Burdekin.

Landscape health across the region is generally good. However, some coastal areas and parts of the Belyando-Suttor catchments show signs of stress where modification of ecosystems and hydrological conditions have been extensive.

This section presents profiles of the region from various aspects and provides interpretation in relation to issues of natural resource management at the regional scale. The social and economic analysis of the Burdekin is challenging due to the complex and multiple interrelationships between bio-physical processes with economic and social processes and ways in which statistical data is collected and presented.
The problem of area incompatibility is common in catchment or bioregionally-based resource management and is a major issue for planning processes and research. The challenge is to interpret the available data in the context of the bio-physically defined area.

2.1 Geography

The Burdekin River drains water from approximately 130,000 km$^2$ of north-east Queensland into the Great Barrier Reef lagoon (Map 2.1 (note: maps are collated at the end of each section)). The vast majority of the catchment area lies in the dry tropical climate zone. The mouth of the river is located near Ayr. The geographical extent of the watershed extends from the ranges behind Ingham in the north, to Pentland in the west and to Alpha in the south.

Adjacent to the Burdekin river catchment on the coastal side are several small catchments. These areas, while hydrologically disconnected from the Burdekin River, have major urban centres located in them. Urban centres such as Townsville/Thuringowa in the north and Bowen, Emerald and Mackay in the south govern the social and economic processes and flows that the people who live within the boundaries of the Burdekin River catchment are embedded in.

2.2 Biophysical and institutional partitioning

2.2.1 Bioregions and sub-catchments

The catchment lies in the Dry Tropics and comprises a variety of ecosystems, from tropical rainforests on the northern edge to mangroves and wetlands at the Burdekin estuary. Most of the region is covered by savanna landscape (henceforth referred to as the Burdekin rangelands), including open woodland, Brigalow country and arid dry lands.

The Interim Biogeographic Regionalisation of Australia (IBRA) distinguishes 19 bioregions in Queensland (Thackway and Cresswell, 1995). Bioregions summarise broad landscape patterns of soil, geology, landform and vegetation (NLWRA, 2001). Three of those bioregions include parts of the Burdekin (Map 2.2). The northern part of the catchment is part of the Einasleigh Uplands, the south-western part is classified as Desert Uplands, and the south-eastern part lies in of the Brigalow Belt.

2.2.2 Administrative, statistical and electoral areas

Population and economic statistics are commonly presented for defined administrative and/or statistical areas such as local government areas. These boundaries rarely coincide with biophysical boundaries.

The issue of mismatching biophysical and social area definitions is further complicated by the difference in data collection boundaries of different agencies. For example, much of Queensland’s tourism data is collected by ‘tourism regions’, which do not always coincide
with the Statistical Divisions of the ABS (Tourism Queensland, 2002a). Employment data is often collected and reported for ‘employment regions’.

Political decision making processes at state and federal levels further complicate the issue as state and federal electorates show little consistency between political levels or with statistical and administrative area boundaries. People living in the Burdekin Dry Tropics region may be assigned to any one of 4 federal electorates (see Map 2.3).

The problem of area incompatibility is common in catchment or bioregionally-based resource management and is a major issue for planning processes and research based on natural boundaries and communities within them. The challenge is to interpret the available data in the context of the bio-physically defined area and to incorporate boundary crossing interactions.

This report illustrates social and economic aspects of the Burdekin by displaying statistical data at most appropriate geographical resolution. Most of the socio-economic reporting is based on data collected by the Australian Bureau of Statistics (ABS). ABS data are predominantly available for Statistical Divisions (SD’s), Statistical Subdivisions (SSD’s) and Statistical Local Areas (SLA’s). For some data, the spatial resolution can be increased to the smallest statistical areas of Collection Districts (CD’s). Figure 2.1 illustrates how the various scales or reference areas relate to each other.

Collection districts (CDs) are the smallest units for which ABS releases census-based statistical information and form the basic building block for statistics and the aggregation of statistics to larger areas. In urban areas, there are about 225 dwellings in each CD but in rural areas the number of dwellings declines as population densities decrease. CDs are
defined and current only for each census, therefore posing difficulties for comparisons between census years at that level. Map 2.4 shows CD boundaries of the Burdekin including population counts for 1996.

Statistical Local Areas consist of one or more CDs. They can be based on Local Government Areas (LGAs), or parts thereof, or any unincorporated area. Statistical Subdivisions consist of one or more SLAs and are used as an intermediate level, general purpose and regional-type geographic unit.

Statistical Divisions (SDs) consist of one or more SSDs. They do not cross State or Territory boundaries and are the largest statistical area building blocks. They are used as large, general-purpose regional type geographic areas. They represent relatively homogeneous regions characterised by identifiable social and economic links between the inhabitants and between the economic units within the region, under the unifying influence of one or more major towns or cities.

For the 1996 Census of Population and Housing, there were approximately 33,000 CDs throughout Australia (ABS online http://www.abs.gov.au).

Wherever possible, data contained in this report is presented spatially, at the highest level of resolution available. Areas surrounding the Burdekin are also mapped, reasoning that: (a) such an approach gives the information some regional context; and (b) the economies and communities are – of necessity – interdependent, and to ignore communities on the ‘other side’ is to ignore much important socio-economic information.

Various parts of the Burdekin lie within three Statistical Divisions: the Northern, Mackay and Fitzroy SDs. State development processes operate at the SD level. This means that different areas within the Burdekin are subject to different development strategies.

Some 16 shires fall to some degree within the boundaries of the Burdekin River catchment (Map 2.5). Only one shire, the City of Charters Towers, is entirely located within the catchment boundaries. Dalrymple is almost entirely within the catchment and is the shire with the largest area of land within the catchment, comprising more than 42% of the total catchment area. Together, three other shires, namely Belyando, Bowen and Jericho have more than 50% of land area within the catchment. Six LGAs have a majority of area within the watershed. The remainder of LGAs has small fringe areas within the catchment. Map 2.5 shows the details.

2.3 **Landuse and tenure**

More than 99% of the land in the Burdekin Dry Tropics is classified as rural. The predominant use of land in this area is extensive cattle grazing (Map 2.6), although irrigation and broad acre agriculture occur in small areas throughout the Burdekin. The primary land use in the lower Burdekin, adjacent to the Great Barrier Reef lagoon, is irrigated sugarcane. Mining of gold, copper and coal are sporadic in their geographical extent but play a major role in the region’s economy.

There is a clear pattern of tenure types across the catchment (Map 2.7). Most of the land in the upper catchment of the Burdekin is leasehold; the coastal areas are predominantly freehold. On the catchment edges, there are small areas set aside for conservation. There is
also an area for defence (south-west of Townsville), and two Aboriginal reserves in the north-west.

These tenure and land use data refer to the use, and conditions of use, of current land holders. They do not describe other uses of land, water and biodiversity resources. Section 3.6 of this report elaborates on some issues of multiple resource use. This report does not attempt to deal with the complex issue of land rights and land ownership.

### 2.4 Landscape Health

Ideally, NRM policies should target areas in which it is physically, socially and economically possible to achieve significant rewards. Much of this report seeks to identify regions within the Burdekin which are most likely to adopt SRMP (i.e. having the capacity and the motivation to do so). Yet that is only part of the story. It serves little purpose to identify a region which has the socio-economic characteristics associated with high adoption rates, if it is biophysically impossible to introduce such practices. It is, therefore, important to consider Landscape Health. Landscape Health was assessed across Australia as one of many topics addressed by the National Land and Water Resources Audit (http://audit.ea.gov.au/ANRA/vegetation/docs/landscape_health/Landscape_Health_Contents.html). This section of the report briefly reviews the findings of that project for the Burdekin. Section 6 re-visits that information; collating it and interpreting it with the socio-economic analysis of chapters 3-5.

#### 2.4.1 Landscape health as a concept

Landscape health is a concept that provides systemic investigation of the implications of human interactions with the natural resource base and environment. The assessment is based on implications within and between landscapes and incorporates biophysical, ecological and land-use aspects.

Salinity and water quality are important determinants of landscape health. They are the focus issues of Phase 1 of the Burdekin catchment condition study (Roth et al., 2002) and the target management areas for the NAPSWQ. However, the concept of landscape health spans further to also include other NRM issues such as plant and animal pests, clearing of native vegetation and biodiversity, specifically threatened species and ecosystems. While the focus of the BDTB under NAPSWQ is to address salinity and water quality issues through a range of measures including on-ground works, further data acquisition and capacity building, the concept of landscape health provides a useful framework to approach catchment NRM issues in a more holistic way.

From a biophysical perspective, landscapes are defined as areas of relative homogeneity of landforms, soils, geology and hydrogeology. By definition, a landscape can contain several catchments or alternatively may be part of a single catchment (National Land and Water Resource Audit 2001).

The national land and water resource audit (NLWRA) assesses landscape health on the basis of the interim bio-geographic regionalisation for Australia (Thackway and Cresswell, 1995). The boundaries of these bio-regions often differ from catchment boundaries (eg Tait
et al., 2000). The Burdekin Dry Tropics region significantly intersects four bioregions (Map 2.2).

Each bioregion is further divided into subregions. Landscape health is assessed at the scale of these subregions.

The health of subregions is assessed on a range of indicators. These indicators are:

- Native vegetation and land use
- Soil and hydrology
- Weeds and feral animals
- Threatened species and ecosystems

The following sub-sections describe conditions of each indicator of landscape health across the Burdekin Dry Tropics region in some detail, providing an aggregate assessment of level of landscape stress. The information is obtained from the NLWRA report on landscape health (National Land and Water Resource Audit 2001).

In the interpretation of the data it is important to consider that the NLWRA Landscape Health study was conducted to provide a national assessment of the state of the environment in relation to NRM and trends. The resolution of the data is therefore relatively coarse, thus limiting its usefulness for detailed regional management. While relatively small regional hotspots may not show up, this data can identify important large-scale issues and trends.

2.4.2 Native vegetation and land use

Land use impacts on the extent and condition of the native vegetation. Four criteria define the condition of the landscape based on native vegetation and land use:

1. Extent of native vegetation cover
2. Native vegetation connectivity and fragmentation
3. Protection of native vegetation indicated by (a) bioregions protected in reserves and (b) native vegetation outside reserves; and
4. Condition of native vegetation indicated by (a) grazing pressure and (b) vegetation in land use with conservative practices (conservation land use)

Most of the Burdekin bioregions have over 50% of native vegetation cover. Only in the Belyando-Sutter (Map 2.8) native vegetation has been cleared to a larger extent.

Significant fragmentation of native vegetation occurs in Belyando-Sutter (Map 2.9). Fragmentation and clearing of native vegetation have a profound impact on the biota as loss of more than 70% of native vegetation is correlated with a rapid loss of wildlife species (CSIRO in National Land and Water Resource Audit 2001).

The vast majority of native vegetation remains outside designated conservation areas (Map 2.10), and is grazed. Grazing impacts on vegetation by changing species composition and reducing plant biomass.
2.4.3 Soil and hydrology

Salinisation is one of the most pressing issues impacting on soil and hydrology in Australia. Clearing and irrigation are linked to salinisation (Commonwealth of Australia, 2002). The risk that an area could be affected by dryland salinity serves as a landscape health indicator. Subregions with a high dryland salinity hazard in the Burdekin catchment are below 1% except for the southern part of the Upper Burdekin and adjoining part of the Belyando-Sutton (1-5% risk).

Hydrological changes may arise from soil degradation (erosion), clearing, damming, canalising and contouring. The NLWRA used a combination of expert assessment, land use and native vegetation data to determine the degree of hydrological changes. In the Burdekin area, minor to moderate changes are common, except for the coastal areas, the Belyando-Sutton, and the Bowen-Broken, where moderate to major changes to flow regimes are apparent (Map 2.11).

Due to the coarseness of the dataset employed for the NLWRA Landscape Health project and the methodology employed, it is essential to supplement these findings with the more detailed, high-resolution data provided in Roth et al., (2002:p25ff). The data presented in that report identify sections of the Burdekin River and its tributaries with water quality problems (maps 5 and 6). Source areas of sediments are pin-pointed in detail as areas with high hill-slope and gully erosion (maps 8 and 9). The current extent of dryland salinity hazard is shown (map 7) and localised hotspots identified. This data provides a much more detailed picture of the area than the Landscape Health approach can provide.

2.4.4 Weeds and feral animals

The NLWRA provides distributions for a range of weeds and feral animals. However, some data are restricted due to lack of detailed distributional information. The NLWRA report investigated weed species of national significance and also included some other introduced plants identified by the states and territories as a threat to biodiversity. Infestations of significant weed species occur throughout the Burdekin area. Distribution of these species range from localised to widespread. These significant weed species are:

- Alligator Weed (*Alternanthera philoxeroides*)
- Hymenachne (*Hymenachne amplexicaulis*)
- Para grass (*Brachiaria mutica*)
- Pond Apple (*Annona glabra*)
- Buffel grass (*Cenchrus ciliaris*), a pasture grass spreading rapidly into natural ecosystems.
- Parkinsonia (*Parkinsonia aculeata*)
- Prickly Acacia (*Acacia nilotica ssp. indica*)
- Rubber Vine (*Cryptostegia grandiflora*)
- Lantana (*Lantana camara*)
- Parthenium Weed (*Parthenium hysterophorus*)

Foxes (*Vulpes vulpes*), Rabbits (*Oryctolagus cuniculus*), Cats (*Felus catus*), Pigs (*Sus scrofa*) and Cane Toads (*Bufo marinus*) occur throughout the Burdekin area. The
Environmental Protection and Biodiversity Conservation Act 1999 lists all these species except the Cane Toad as key threatening processes impacting on matters of national significance. Threat abatement plans for the first three of these species exist (Environment Australia 1999a,b,c) and a plan for feral pigs is in preparation. Foxes occur occasionally and localised within the whole Burdekin catchment. Rabbits are common and widespread except in the coastal areas. Feral Pigs and Cats are common and widespread in the Burdekin area and Cane Toads are abundant throughout.

2.4.5 Threatened species and ecosystems

"Ecosystems at risk in the intensive use zone“ and “threatened species” are two criteria for assessing landscape health from a conservation point of view. Ecosystems are considered “at risk” when they are reduced to less than 70% of their initial extent or covering an area of less than 100,000 hectares or moderately degraded over most of their area. Loss of important landscape elements is also considered in the risk assessment.

There is a large degree of variation across the Burdekin region in terms of what proportion of ecosystems is at risk (Map 2.12). There is a risk hotspot in the landscape around Alpha (in the Belyando-Suttor) where more than 90% of ecosystems are considered “at risk”. Other areas with high risk ratings include parts of the Upper Burdekin and the Belyando-Suttor.

The “number of threatened species as listed in the EPBC Act 1999” which occur within a bioregion is an indicator of the degree to which a region contains habitats, fauna and flora of national significance. Differences between regions, particularly regions with low numbers, may also indicate the current state of knowledge (or lack thereof) regarding survey intensity. For example excursions into remote areas may not have taken place recently, so no data records exist. To this avail the use of data for mapping of threatened plants, terrestrial and pelagic/marine vertebrates is limited as it may not reflect distributions, threats or importance of a region for the conservation of a species. Consequently this indicator is not presented here.

2.4.6 Trends in vegetation clearing and dryland salinity

Trends in vegetation clearing are a way of assessing future issues in native vegetation loss. In Queensland extensive clearing of native woody vegetation occurred between 1995-1997 and 1997-1999. For the Burdekin Dry Tropics Region, clearing rates for 1997-1999 were highest in the Belyando-Suttor with more than 20000ha per year. Most of the Upper Burdekin had a low clearing rate ( < 1000 ha per year cleared). Annual clearing rates for the Lower Burdekin and the Bowen-Broken did not exceed 5000ha.

The annual clearing rate during the period 1995-1997 and 1997-1999 increased in the western part of the Belyando-Suttor, the southern part of the Upper Burdekin, the Townsville area and parts of the Bowen-Broken. Constant or decreasing clearing rates occurred for the remainder of the area (Map 2.13).

Future trends for dryland salinity identify the Upper Burdekin as having a high risk with 1-5% of its subregions expecting dryland salinity in 2050.
2.4.7 Landscape stress

Landscape stress is a cumulative and integrative measure describing the landscape health based on the different criteria discussed in the NRWLA report. It provides a broad overview of the stress levels experienced in a sub-catchment and may prove useful in determining action priorities.

Stress level in the Belyando-Suttor is low, in the Upper Burdekin medium. Most of the Burdekin Dry Tropics Region shows low levels of stress. Exceptions are the lower parts of the Belyando-Suttor and the coastal areas around Townsville (Map 2.14).

The study by Roth et al., (2003) provides a means for refining these findings in the areas of water quality and salinity. That study, as elaborated in Section 2.4.3 identifies hotspots of dryland salinity as well as erosion and subsequent water quality problems in-stream for the Burdekin Rivers and its tributaries.

2.4.8 Summary assessment of landscape health in the Burdekin

Landscape health in the Burdekin Catchment is described through a range of criteria each of which is represented by indicators. Landscape health is assessed on the basis of subregions from the bio-regionalisation of Australia. The borders of these provinces do not align exactly with the Burdekin catchments and sub-catchment boundaries, so visual interpolation is required.

Landscape stress is a systematic measure integrating landscape health criteria. This measure provides a broad overview of the stress levels experienced in a sub-catchment. It is very useful in recognising large-scale processes but restricted by the resolution of data and methodology in picking up localised hot-spots. Its power in describing the implications of broad-scale environmental processes resulting from human activity may prove useful in determining action priorities.

Based on the assessment of landscape health criteria, the following landscape health issues are eminent for the Burdekin Dry Tropics Regions:

- Relatively high level of landscape stress occur in parts of the Belyando-Suttor and the coastal areas around Townsville (Map 2.14).
- Native vegetation extent in the Belyando-Suttor reaches lower level of ecosystem requirements (30%, Map 2.8).
- Fragmentation of native vegetation occurs mainly in the Belyando-Suttor.
- Low subregion representation in conservation areas (<2%) for the Belyando-Suttor, the Upper Burdekin and the Bowen-Broken.
- Fragmentation of native vegetation in the Lower Burdekin, Bowen-Broken and coastal parts along Townsville (Map 2.9).
- Up to 90% of the native vegetation in the Burdekin Dry Tropics regions is not represented in conservation areas (Map 2.10).
- Trends in the annual clearing rate are very high in parts of the Belyando-Suttor, Upper Burdekin and the Townsville area (Map 2.13).
• Significant weed species and feral animals occur throughout the region.

• A high proportion of ecosystems are at risk in parts of the Upper Burdekin and the Belyando-Suttor (Map 2.12).

• Threatened species (as listed in the EPBC Act 1999) occur throughout the area.

• Groundwater hydrology and surface water flow regimes and quality have been affected in several ways. Hydrological changes are presumed to occur in the Belyando-Suttor, the Bowen-Broken and some coastal parts along Townsville (Map 2.11), coinciding with areas of high clearing. River flow has been significantly affected by the several impoundments, notably the Burdekin Falls Dam. Impacts of land use on soil erosion, in-stream water quality and salinity are highest are shown by Roth et al., (2003) to coincide with these areas but hotspots exist in other areas of the catchment.

• Future dryland salinity risk is highest in the Upper Burdekin with 1-5% of its subregions expecting salinity in 2050. Data provided by NR&M and reported in Roth et al., (2003) shows a high dryland salinity hazard in parts of the Belyando Suttor in addition to irrigation induced salinity in the Lower Burdekin and more sporadic outbreaks in the Upper Burdekin.
2.5 Maps for Section 2

Map 2.1: The Burdekin: Burdekin River catchment and Burdekin Dry Tropics region.
(Source: map compiled by CSIRO with gauging station information from NRM)
Map 2.2: Bioregions of the Burdekin Dry Tropics region.

(Source: Map compiled by CSIRO based on QLDEPA, 2000).
Map 2.3: Federal electoral areas of the Burdekin Dry Tropics regions.

(Source: Map compiled by CSIRO from the AEC data 1996).
Map 2.4: Collection districts and population of the Burdekin Dry Tropics region.

(Source: Map compiled by CSIRO from ABS, 1996a).
Map 2.5: Local Government Areas of the Burdekin Dry Tropics region.
(Source: Map compiled by CSIRO from ABS, 1996a).
Map 2.6: Land uses of the Burdekin Dry Tropics region.

(Source: Map compiled by CSIRO from Bureau of Rural Sciences 1999 and QLDEPA, 2001).
Map 2.7: Land tenure across the Burdekin Dry Tropics region.

(Source: Map compiled by CSIRO from Bureau of Rural Sciences, 1999 and EQLDEPA, 2001).
Map 2.8: Extent of native vegetation cover.

(Source: Map compiled by CSIRO with data from the Commonwealth of Australia, 2001 and QLDEPA, 2000)
Map 2.9: Extent of native vegetation connectivity.

(Source: Map compiled by CSIRO with data from the Commonwealth of Australia, 2001 and QLDEPA, 2000)
Map 2.10: Extent of native vegetation outside conservation reserves in the intensive use zone.

(Source: Map compiled by CSIRO with data from the Commonwealth of Australia, 2001 and QLDEPA, 2000)
Map 2.11: Changes to hydrological conditions.

(Source: Map compiled by CSIRO with data from the Commonwealth of Australia, 2001 and QLDEPA, 2000)
Map 2.12: Proportion of ecosystems at risk.
(Source: Map compiled by CSIRO with data from the Commonwealth of Australia, 2001 and QLDEPA, 2000)

(Source: Map compiled by CSIRO with data from the Commonwealth of Australia, 2001 and QLDEPA, 2000)
Map 2.14: Landscape stress in the Burdekin Dry Tropics region.
(Source: Map compiled by CSIRO with data from the Commonwealth of Australia, 2001 and QLDEPA, 2000)
3 The Regional Community

Section summary

The chapter characterises communities within the Burdekin Dry Tropics. It shows changes in population and demographics, regional diversification, housing tenure, family structure and the socio-economic status of individuals within the communities. These are key variables for considering the adoption of SRMP at a whole-of community scale.

The community of the Burdekin Dry Tropics region is predominantly urban. More than three quarters of the population reside in the major urban centre Townsville/Thuringowa but also Charters Towers, Bowen and Ayr/Home Hill.

Most shires within the catchment are experiencing population decline, and most notably decline in the proportion of population aged less than 15 years. This may reflect a low ‘desire to remain’, indicating a weakening link of the community with the region.

Most rural shires within the catchment appear to be at a relative socio-economic disadvantage compared to Queensland and Australia as a whole, with some areas rating among the most disadvantaged communities in the country. This is evidenced in the ABS calculated socio-economic ‘indices of areas’ and in the relatively low proportions of individuals working in white-collar jobs, by the relatively low proportion of individuals who have continued past year 11 in education, and by the relatively high proportion of individuals earning less than $300 per week.

Agriculture and mining employ close to 50% of the workforce in Belyando, Dalrymple, Jericho and Nebo shires and a significant proportion in all other shires. This provides a very strong tie between the natural resource base of the region and the community.

Unemployment in the Burdekin region is quite low, home ownership is relatively high and families are generally ‘intact’ families. Contrary to indications regarding population decline, this may indicate a strong ‘desire to remain’. It also indicates capacity for investment into the region as large sums of money are not necessarily tied up in mortgage and/or rent payments. If the individuals who live and work in the area do have a strong ‘desire to remain’, then this may provide a very strong motivation for ensuring sustainable development.

The purpose of this chapter is to describe the regional community. Some of the discussion aims to provide a generic overview of the district. The purpose of most of the discussion, however, is to consider what the social profile tells us about the relationship of the people living in the region with their natural resources and environment.

This chapter investigates population statistics and trends, indigenous population, social fabric in relation to families, employment and occupation, and socio-economic indicators that combine multiple aspects of social and economic data into assessments of relative advantage or disadvantage.
3.1 Population statistics and trends

As discussed in section 1.3, individuals and communities need both the motivation and the capacity to adopt sustainable land management practices. Among other things, a “desire to remain” [on the property], may increase the propensity of landholders to adopt SRMP; they have a higher motivation than landholders who have little desire to remain. The same applies for the general public. If a high proportion of individuals within an area have little desire to remain, then one would expect to see declining populations. Hence, it is useful to consider changes in population when considering the propensity of communities to adopt SRMP.

In 2001, the Burdekin region (comprising the 8 ‘best fit’ shires) had a population of 56,193 and the adjacent areas of Townsville/Thuringowa had a combined population of more than 130,000 (Table 3.1). In total there are approximately 200,000 people residing in the Burdekin Dry Tropics region.

Table 3.1: Population and population change in the Burdekin

<table>
<thead>
<tr>
<th>Region</th>
<th>Usual Residential Population (URP)</th>
<th>1996 (persons)</th>
<th>2001 (persons)</th>
<th>1996 - 2001 change (persons)</th>
<th>Average annual rate of change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burdekin Region</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belyando</td>
<td></td>
<td>9,861</td>
<td>8,252</td>
<td>-1,609</td>
<td>-3.3</td>
</tr>
<tr>
<td>Bowen</td>
<td></td>
<td>12,261</td>
<td>11,569</td>
<td>-692</td>
<td>-1.1</td>
</tr>
<tr>
<td>Burdekin</td>
<td></td>
<td>17,979</td>
<td>17,345</td>
<td>-634</td>
<td>-0.7</td>
</tr>
<tr>
<td>Charters Towers</td>
<td></td>
<td>8,261</td>
<td>7,933</td>
<td>-328</td>
<td>-0.8</td>
</tr>
<tr>
<td>Dalrymple</td>
<td></td>
<td>3,232</td>
<td>3,315</td>
<td>83</td>
<td>0.5</td>
</tr>
<tr>
<td>Jericho</td>
<td></td>
<td>899</td>
<td>920</td>
<td>21</td>
<td>0.5</td>
</tr>
<tr>
<td>Mirani</td>
<td></td>
<td>4,709</td>
<td>4,881</td>
<td>172</td>
<td>0.7</td>
</tr>
<tr>
<td>Nebo</td>
<td></td>
<td>2,009</td>
<td>1,978</td>
<td>-31</td>
<td>-0.3</td>
</tr>
<tr>
<td>Total 8 LGA's</td>
<td></td>
<td>59,211</td>
<td>56,193</td>
<td>-3,018</td>
<td>-1.0</td>
</tr>
<tr>
<td>Townsville/Thuringowa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Townsville City Part A (SSD)</td>
<td></td>
<td>83,968</td>
<td>89,154</td>
<td>5,186</td>
<td>1.2</td>
</tr>
<tr>
<td>Townsville Part B</td>
<td></td>
<td>2,747</td>
<td>3,219</td>
<td>472</td>
<td>3.4</td>
</tr>
<tr>
<td>Thuringowa City Part A (SSD)</td>
<td></td>
<td>37,792</td>
<td>43,849</td>
<td>6,150</td>
<td>1.4</td>
</tr>
<tr>
<td>Thuringowa Part B</td>
<td></td>
<td>7,618</td>
<td>9,150</td>
<td>1532</td>
<td>4.0</td>
</tr>
<tr>
<td>Queensland</td>
<td></td>
<td>3,220,839</td>
<td>3,491,381</td>
<td>270,542</td>
<td>1.7</td>
</tr>
<tr>
<td>Australia</td>
<td></td>
<td>17,752,829</td>
<td>18,769,249</td>
<td>1,016,420</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Of the Burdekin region population, almost one in three (31%) live in the Burdekin Shire and 21% live in Bowen Shire. About 15% reside in Belyando Shire and 14% in the City of Charters Towers. The other three shires, i.e. Mirani, Nebo and Jericho, account for 9%, 4% and 2% of the region’s usual resident population respectively. These shires are sparsely populated, with the exception of the City of Charters Towers. Average population density is 35 persons for every 100 square kilometres. Comparative values for Queensland and Australia are 202 and 244 persons per 100 square kilometres. Map 3.1 shows the population density at CD level for the Burdekin.
In some shires - specifically, Belyando, Bowen, Burdekin, and Nebo - the majority of the population lives outside the catchment (Map 2.4). If one includes only those CD’s which fall within the catchment, the population density is less than that reported here. Lavery (2000) estimates that only 50,000 people lived within the catchment in 1991.

Over the past five years, the population in the Burdekin region has declined by about 3000 persons, equivalent to a rate of about one per cent per year (Table 3.1). Population decrease was fastest in Belyando (-3.3% p.a.), while Mirani recorded the highest population increase (+0.7% p.a.). The population in the urban centers Townsville and Thuringowa increased at an average rate of 1.3% p.a. The overall trend of population decline in the Burdekin area is consistent with that identified by McKenzie (1994) and matches that of many other regional areas.

Like Queensland and Australia as a whole, the median age in all shires within the Burdekin Dry Tropics region has increased steadily over the last five years (Table 3.2). This is indicative of an aging population. In 1991, median age within the Burdekin region was at or below the Australia median of 32 years, with the exception of Bowen, which had a median age of 33 years. By 2001, Bowen, Burdekin and Dalrymple shires had median ages which were greater than the Australian median.

Table 3.2: Age structure of the Burdekin population, 1991, 1996 and 2001
(Source: ABS, 2001)

<table>
<thead>
<tr>
<th>Region</th>
<th>Median age</th>
<th>Dependency ratio</th>
<th>Proportion of population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1991 (%)</td>
<td>1996 (%)</td>
<td>2001 (%)</td>
</tr>
<tr>
<td>Burdekin Region</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belyando</td>
<td>27</td>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>Bowen</td>
<td>33</td>
<td>36</td>
<td>40</td>
</tr>
<tr>
<td>Burdekin</td>
<td>32</td>
<td>34</td>
<td>36</td>
</tr>
<tr>
<td>Charters Towers</td>
<td>29</td>
<td>31</td>
<td>32</td>
</tr>
<tr>
<td>Dalrymple</td>
<td>30</td>
<td>33</td>
<td>36</td>
</tr>
<tr>
<td>Jericho</td>
<td>31</td>
<td>32</td>
<td>33</td>
</tr>
<tr>
<td>Mirani</td>
<td>30</td>
<td>33</td>
<td>34</td>
</tr>
<tr>
<td>Nebo</td>
<td>28</td>
<td>31</td>
<td>33</td>
</tr>
<tr>
<td>Townsville/Thuringowa</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Townsville City Part A (SSD)</td>
<td>na</td>
<td>32</td>
<td>33</td>
</tr>
<tr>
<td>Townsville Part B</td>
<td>33</td>
<td>35</td>
<td>38</td>
</tr>
<tr>
<td>Thuringowa City Part A (SSD)</td>
<td>27</td>
<td>30</td>
<td>36</td>
</tr>
<tr>
<td>Thuringowa Part B</td>
<td>32</td>
<td>35</td>
<td>37</td>
</tr>
<tr>
<td>Queensland</td>
<td>32</td>
<td>33</td>
<td>35</td>
</tr>
<tr>
<td>Australia</td>
<td>32</td>
<td>34</td>
<td>35</td>
</tr>
</tbody>
</table>
The proportion of population at working age is measured as dependency ratio. Persons aged less than 15 years and more than 65 years are deemed ‘dependent’. With the exception of Bowen and Townsville City (Part A), the proportion of the population aged less than 15 years was higher in the Burdekin Dry Tropics than for Australia as a whole, and the proportion of the population aged more than 65 (except Bowen, Burdekin and Charters Towers) was lower. The relatively high dependency rates in most shires are reflecting a high proportion of people aged less than 15, rather than high proportions of those aged more than 65; the important exceptions here are the shires of Bowen, Burdekin and Charters Towers. Nebo, Belyando, Townsville City (Part A) and Thuringowa (Part B) all had low dependency rates, for the most part due to the relatively few people aged more than 65 years.

Figure 3.1 shows that between 1986 and 1996 Australia as a whole experienced a decline in the proportion of population aged less than 15, and an increase in the proportion aged more than 65. Most shires within the Burdekin Dry Tropics experienced similar demographic changes, with one – notable – exception: between 1986 and 1996, Charters Towers experienced a decline in the proportion of population aged more than 65 and a small rise in the proportion aged less than 15. Nebo, Belyando, Burdekin, Thuringowa City (Part A), Bowen and Townsville (Part B) had relatively large declines in the proportion of population aged less than 15 years (-7.6, -4.7, -4.2, -4.2, -3.8 and –3.5 percentage points respectively). Dalrymple, Bowen, Mirani and Burdekin all experienced relatively large increases in the proportion of population aged more than 65.

Much of the decline in population across shires in the Burdekin Dry Tropics since 1986 is due to declines in the number of young people. To the extent that declining youth populations reflect lower ‘desires to remain’, the recent demographic changes within the
Burdekin Dry Tropics region may reflect low, or declining, propensities to adopt innovative NRM changes (BRS, 2001).

3.2 Indigenous Population

Expeditions of European explorers such as Kennedy, Leichhardt or Dalrymple first entered the Burdekin area in the mid 1800’s. The Kennedy District, as the Burdekin and the Herbert River (adjacent to the North) catchments were called then, was opened up for settlers in the 1860s and within few years almost the whole area was settled. The Aboriginal tribes that had lived in the area for an unknown time were confronted with radical change. As the area was taken over by settlers they could not continue their traditional way of life. Confrontations, disease and the relocation policy of the Queensland government all contributed to a rapid decline in the indigenous population (Brayshaw, 1990).

Before providing data, it is important to stress that care must be taken when interpreting data on the Indigenous population. The ABS, for example, reports ‘average household income’, for both indigenous and non-indigenous groups. When doing so, they define households as a group of two or more related or unrelated people who usually reside in the same dwelling, who regard themselves as a household, and who make common provision for food and other essentials for living. As noted by Daly et al., (2002) this definition makes little sense in the context of a highly mobile population – a characteristic of many Indigenous peoples. Material is presented on the basis of ABS data, reasoning that some data is better than no data.

On the 2001 census night, there were a total of 2,778 Aboriginal and/or Torres Strait Islander persons counted within the Burdekin area (Table 3.3). Assuming that most if not all of them usually lived within the catchment, Aboriginal and/or Torres Strait Islander persons make up about one in twenty (5%) of the Burdekin catchment’s population. This is significantly higher than the Queensland and Australian proportions which stood at 3.2% and 2.2% respectively as at 2001. The City of Charters Towers (9%) and the Bowen shire (6.5%) had the highest proportions of Aboriginal and/or Torres Strait Islander persons living within their boundaries. Only 2.4% of the Belyando Shire’s total population were of Aboriginal and/or Torres Strait Islander descent.

Slightly more than 80% of the Burdekin catchment’s total number of Aboriginal and/or Torres Strait Islander persons were living in three of the eight local government areas within the catchment in 2001. While the Burdekin shire had 28.9% and the Bowen shire had 26.8%, the City of Charters Towers contained 25.6% of the catchment’s total indigenous population.

Westbury (2002) reports that the Indigenous share of the total outback population grew from 13 per cent in 1981 to 18 percent in 1996. In the Burdekin region, Charters Towers had the highest share of indigenous persons (9 percent of the population), but many other LGA’s (eg. Belyando, Dalrymple, Mirani and Nebo) had levels comparable to the Queensland average. However, in marked contrast to the average annual 1% decrease in the catchment’s general population between 1996 and 2001, the catchment’s Indigenous population increased on average by 2.9% each year during this time. Other than the Belyando shire (which had an average 2.2% annual decline), all local government areas
within the catchment experienced an Indigenous population growth between the two census counts. The Mirani shire (12.1%) and the Dalrymple shire (7.6%) had the two highest average annual growth rates over the five years.

Table 3.3:  Aboriginal population in the Burdekin for 2001  
(Source: ABS, 2001)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Burdekin Region</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belyando</td>
<td>198</td>
<td>2.4</td>
<td>7.1</td>
<td>-24</td>
<td>-2.2</td>
</tr>
<tr>
<td>Bowen</td>
<td>748</td>
<td>6.5</td>
<td>26.8</td>
<td>53</td>
<td>1.5</td>
</tr>
<tr>
<td>Burdekin</td>
<td>805</td>
<td>4.6</td>
<td>28.9</td>
<td>166</td>
<td>5.2</td>
</tr>
<tr>
<td>Charters Towers</td>
<td>715</td>
<td>9.0</td>
<td>25.6</td>
<td>71</td>
<td>2.2</td>
</tr>
<tr>
<td>Dalrymple</td>
<td>109</td>
<td>3.3</td>
<td>3.9</td>
<td>30</td>
<td>7.6</td>
</tr>
<tr>
<td>Jericho</td>
<td>37</td>
<td>4.0</td>
<td>1.3</td>
<td>9</td>
<td>6.4</td>
</tr>
<tr>
<td>Mirani</td>
<td>125</td>
<td>2.6</td>
<td>4.5</td>
<td>47</td>
<td>12.1</td>
</tr>
<tr>
<td>Nebo</td>
<td>51</td>
<td>2.6</td>
<td>1.8</td>
<td>2</td>
<td>0.8</td>
</tr>
<tr>
<td>Total 8 LGA's</td>
<td>2,788</td>
<td>5.0</td>
<td>100.0</td>
<td>354</td>
<td>2.9</td>
</tr>
<tr>
<td>Townsville/Thuringowa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Townsville City Part A</td>
<td>4,483</td>
<td>5.0</td>
<td>na</td>
<td>744</td>
<td>3.3</td>
</tr>
<tr>
<td>Townsville Part B</td>
<td>75</td>
<td>2.3</td>
<td>na</td>
<td>36</td>
<td>18.5</td>
</tr>
<tr>
<td>Thuringowa City Part A</td>
<td>2,658</td>
<td>6.1</td>
<td>na</td>
<td>633</td>
<td>4.8</td>
</tr>
<tr>
<td>Thuringowa Part B</td>
<td>193</td>
<td>2.1</td>
<td>na</td>
<td>76</td>
<td>13.0</td>
</tr>
<tr>
<td>Queensland</td>
<td>112,772</td>
<td>3.2</td>
<td>na</td>
<td>17,254</td>
<td>3.6</td>
</tr>
<tr>
<td>Australia</td>
<td>410,003</td>
<td>2.2</td>
<td>na</td>
<td>57,033</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Since 1977, Indigenous communities have been able to (voluntarily) participate in the Commonwealth Development Employment Projects (CDEP) scheme. Interested individuals transfer from social security to the receipt of equivalent levels of income – in exchange for undertaking work coordinated by local CDEP organizations (Smith, 2001). In many remote communities, a major employer of Indigenous people is CDEP, yet this was not so in the Burdekin Region at the time of the 2001 census (Table 3.4). Nevertheless, unemployment rates among the Indigenous peoples of the Burdekin are considerably higher than that of the population as a whole. Labour force participation rates are also generally lower than the Queensland 1996 rate of 62.2% (OESR, 2002). This may reflect large numbers of ‘discouraged’ workers – a phenomenon particularly prevalent among Indigenous communities (Taylor and Hunter, 2001).
Table 3.4:  Labour force statistics for Indigenous persons in the Burdekin region  
(Source: ABS 2002, data for 2001)

<table>
<thead>
<tr>
<th></th>
<th>Number employed in CDEP (persons)</th>
<th>Number otherwise employed (persons)</th>
<th>Labour force participation rate (%)</th>
<th>Unemployment rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burdekin Region</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belyando</td>
<td>0</td>
<td>67</td>
<td>67.3</td>
<td>11.8</td>
</tr>
<tr>
<td>Bowen</td>
<td>9</td>
<td>245</td>
<td>61.2</td>
<td>10.6</td>
</tr>
<tr>
<td>Burdekin</td>
<td>12</td>
<td>164</td>
<td>53.7</td>
<td>27.9</td>
</tr>
<tr>
<td>Charters Towers</td>
<td>0</td>
<td>98</td>
<td>43.9</td>
<td>44.3</td>
</tr>
<tr>
<td>Dalrymple</td>
<td>0</td>
<td>25</td>
<td>49.1</td>
<td>10.7</td>
</tr>
<tr>
<td>Jericho</td>
<td>0</td>
<td>12</td>
<td>44.4</td>
<td>0.0</td>
</tr>
<tr>
<td>Mirani</td>
<td>0</td>
<td>24</td>
<td>54.1</td>
<td>27.3</td>
</tr>
<tr>
<td>Nebo</td>
<td>0</td>
<td>12</td>
<td>62.5</td>
<td>20.0</td>
</tr>
<tr>
<td>Total 8 LGAs</td>
<td>21</td>
<td>647</td>
<td>54.2</td>
<td>23.0</td>
</tr>
<tr>
<td>Townsville/Thuringowa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Townsville City Part A</td>
<td>10</td>
<td>978</td>
<td>46.0</td>
<td>26.0</td>
</tr>
<tr>
<td>Townsville Part B</td>
<td>4</td>
<td>999</td>
<td>46.1</td>
<td>26.1</td>
</tr>
<tr>
<td>Thuringowa City Part A</td>
<td>9</td>
<td>485</td>
<td>48.4</td>
<td>26.5</td>
</tr>
<tr>
<td>Thuringowa Part B</td>
<td>0</td>
<td>42</td>
<td>57.1</td>
<td>25.0</td>
</tr>
<tr>
<td>Queensland</td>
<td>4923</td>
<td>24368</td>
<td>54.2</td>
<td>20.0</td>
</tr>
<tr>
<td>Australia</td>
<td>17805</td>
<td>82588</td>
<td>50.4</td>
<td>20.0</td>
</tr>
</tbody>
</table>

With the exception of Jericho, the proportion of Indigenous workers employed in natural resource-based industries was lower than that of the entire workforce. Shergold (2001) notes that there are very few Indigenous people employed in the private sector – most are on CDEP or have ‘government’ jobs. In the Burdekin, this is evident in Charters Towers, Jericho and Mirani, where the proportion of Indigenous workers employed in Government Administration and Defence, Education, or Health and Community Services is considerably higher than that of the population as a whole (Table 3.5).

Most relevant to NRM policy is the fact that there are relatively few Indigenous people in the area, and fewer still (in percentage terms) working in industries which are directly dependent upon natural resources. This is not to say that the association between Indigenous peoples and ‘country’ in the Burdekin is weak. Rather, it highlights the fact that the association is other than through farming and grazing. Further, if the demographic patterns – of rising numbers of Indigenous and falling numbers of non-indigenous persons – continues, then many of the shires within the Burdekin will soon find that a significant proportion of their population is Indigenous.
Table 3.5 Comparison of Indigenous and total workforce in the Burdekin in terms of employing industries
(Source: ABS 2002, Indigenous Employment Profiles; data for 2001)

<table>
<thead>
<tr>
<th></th>
<th>Indigenous workforce (%)</th>
<th>Total workforce (%)</th>
<th>Indigenous workforce (%)</th>
<th>Total workforce (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burdekin Region</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belyando</td>
<td>34.2</td>
<td>48.3</td>
<td>12.0</td>
<td>12.3</td>
</tr>
<tr>
<td>Bowen</td>
<td>29.2</td>
<td>32.3</td>
<td>19.1</td>
<td>16.0</td>
</tr>
<tr>
<td>Burdekin</td>
<td>11.9</td>
<td>26.3</td>
<td>19.3</td>
<td>16.0</td>
</tr>
<tr>
<td>Charters Towers</td>
<td>8.5</td>
<td>18.9</td>
<td>40.0</td>
<td>30.2</td>
</tr>
<tr>
<td>Dalrymple</td>
<td>39.3</td>
<td>48.9</td>
<td>14.3</td>
<td>13.9</td>
</tr>
<tr>
<td>Jericho</td>
<td>50.0</td>
<td>47.1</td>
<td>40.0</td>
<td>16.1</td>
</tr>
<tr>
<td>Mirani</td>
<td>0.0</td>
<td>35.0</td>
<td>47.1</td>
<td>15.2</td>
</tr>
<tr>
<td>Nebo</td>
<td>46.7</td>
<td>50.0</td>
<td>0.0</td>
<td>7.0</td>
</tr>
<tr>
<td>Townsville/Thuringowa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Townsville City Part A</td>
<td>1.3</td>
<td>1.8</td>
<td>42.4</td>
<td>32.2</td>
</tr>
<tr>
<td>Townsville Part B</td>
<td>1.3</td>
<td>9.9</td>
<td>42.7</td>
<td>31.8</td>
</tr>
<tr>
<td>Thuringowa City Part A</td>
<td>1.3</td>
<td>1.7</td>
<td>43.3</td>
<td>58.0</td>
</tr>
<tr>
<td>Thuringowa Part B</td>
<td>na</td>
<td>6.6</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Queensland</td>
<td>5.1</td>
<td>6.8</td>
<td>43.1</td>
<td>22.0</td>
</tr>
<tr>
<td>Australia</td>
<td>4.5</td>
<td>5.4</td>
<td>39.7</td>
<td>21.3</td>
</tr>
</tbody>
</table>

The indigenous community may have a very strong motivation for ensuring sustainable land management practices, but almost certainly lack the capacity – they have, for example, few ‘ownership rights’ of the region’s natural resources and little financial capacity.

3.3 Remoteness

There is increasing recognition by government that people living in rural and remote areas face difficulties in accessing services that most Australians take for granted. The concept of remoteness was developed to provide a measure of not only the geographical distance of people and communities from metropolitan centres, but also their difficulty in accessing services to meet their needs (Public Health Information Development Unit, 1999). The indicator for remoteness is termed Accessibility/Remoteness Index of Australia (ARIA).

ARIA measures access in terms of remoteness along a road network to service centres of various sizes. Index values for individual localities range from 0 (high accessibility) to 12 (high remoteness). For mapping applications, ARIA values have been grouped into five categories: very accessible, accessible, moderately accessible, remote, very remote.
Map 2.1 shows the ARIA values for LGAs in the Burdekin Dry Tropics region. The vast majority of the region is rated 'remote' with Jericho shire in the very south-west rated as 'very remote'. Most of the coastal area is rated 'moderately accessible' while the urban areas of Townsville/Thuringowa have an 'accessible' rating.

Remoteness is also a useful concept in the NRM context in that it provides a way of anticipating potential issues associated with long distances from administrative centres in terms of the implementation, administration and monitoring of change and associated cost.

### 3.4 Housing Tenure

To the extent that individuals with a strong ‘desire to remain’ within a region are more likely to purchase their own homes than those who do not plan to stay, housing tenure may be an indicator of motivation to adopt sustainable resource management practices. Further, those living in ‘fully owned’ homes may not need to meet rent or mortgage payments and may, therefore, have more ‘capacity’ to finance NRM changes than their rent and mortgage paying counterparts.

In contrast to both Queensland (39%) and Australia (42%), more than 50% of private dwellings were fully owned in Burdekin, Dalrymple, Jericho, and Mirani (Figure 3.2). This may be interpreted as meaning that a high proportion of individuals within these shires have a long-term commitment to the area. In contrast, almost 65% and 45% of private dwellings in Nebo and Belyando were rented in 1996. This almost certainly reflects the transitory nature of communities that are largely reliant upon mining (more will be said of this in subsequent sections).

![Figure 3.2: Proportion of private dwellings fully owned and rented](source: ABS, 2001, data for 1996)
3.5 Family type

The discussion of section 1.3 noted that family structure may be an important indicator of motivation to adopt SRMP; families with dependent children may have a stronger ‘desire to remain’ in a community than those without.

Across the Burdekin, with exception of Townsville city part A and Bowen, two-parent families with dependent children constitute a larger proportion of households than Queensland as a whole (Figure 3.3). The proportion of households classified as single-parent families within the Burdekin is generally lower than in Queensland and Australia – particularly in Nebo, Jericho, Belyando and Dalrymple. An urban/rural divide is also apparent; single-parent families are more prevalent in the Charters Towers, Bowen and Townsville/Thuringowa.

Families within the Burdekin catchment are more likely to be ‘intact’ and have more dependent children than the ‘average’ Australian family. If this is indicative of a higher ‘desire to remain’, then it may also indicate a relatively high motivation to adopt SRMP.

![Figure 3.3: Proportion of households classified as ‘two-parent family with dependent children’ and ‘single-parent family’](source: ABS, 2001, data for 1996)
3.6 Multiple uses of natural resources

For communities which are heavily dependent upon natural resources for their livelihoods, conservation of resources may be synonymous with conservation of lifestyle. Such communities may therefore be more apt to consider innovative NRM practices, particularly if the alternative is to relocate to urban areas and seeking employment in new industries. It is therefore important to examine the link between a community and its natural resources.

Natural resources include landscape or ‘country’, vegetation and biodiversity, soils, water and minerals. Minerals are distinct from the others in that they are classified as a non-renewable resource. Table 3.6 provides a generic overview of natural resources in the Burdekin and their uses through various user groups. It differentiates extensive uses from more point-scale uses.

Table 3.6: Natural resources of the Burdekin and their primary uses
(user groups in alphabetical order; $^E$ indicates extensive uses as opposed to point-scale uses)

<table>
<thead>
<tr>
<th>Users of Resources</th>
<th>Natural resources</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Landscape or ‘Country’</td>
</tr>
<tr>
<td>Farmers enterprise</td>
<td>Enterprise location</td>
</tr>
<tr>
<td>Fishers</td>
<td>Agriculture</td>
</tr>
<tr>
<td>Fishers</td>
<td>Life support for and source of fish $^E$</td>
</tr>
<tr>
<td>Fishers</td>
<td>Growth medium, Enterprise location $^E$</td>
</tr>
<tr>
<td>Graziers</td>
<td>Cattle grazing $^E$</td>
</tr>
<tr>
<td>Indigenous Persons</td>
<td>Living, Cultural uses $^E$, Recreation</td>
</tr>
<tr>
<td>Indigenous Persons</td>
<td>Subsistence hunting and gathering $^E$, Cultural uses</td>
</tr>
<tr>
<td>Mining and exploration companies</td>
<td>Enterprise location</td>
</tr>
<tr>
<td>Non-use interests</td>
<td>Conservation $^E$, Conservation $^E$, Management</td>
</tr>
<tr>
<td>Residents (non-indigenous)</td>
<td>Recreation</td>
</tr>
<tr>
<td>residents population</td>
<td>Support for natural processes $^E$</td>
</tr>
<tr>
<td>Tourism operators</td>
<td>Tourist attraction $^E$</td>
</tr>
<tr>
<td>Tourism operators</td>
<td>Human consumption, Scenic value</td>
</tr>
<tr>
<td>Tourists</td>
<td>Viewing, Experience</td>
</tr>
<tr>
<td>Tourists</td>
<td>Human consumption, Recreation</td>
</tr>
</tbody>
</table>

Table 3.6 provides a generic overview of natural resources in the Burdekin and their uses through various user groups. It differentiates extensive uses from more point-scale uses.
The user groups depicted in Table 3.6 should not be considered mutually exclusive. Specifically, the people working in commercial industries are also residents (indigenous or other). Commercial uses can be complementary, for example, pastoralists can also be tourist operators. Persons living in rural areas tend to be more directly embedded in the landscape through employment, recreational and cultural activities.

3.7 Employment

For many rural areas, specifically those outside commuting distance from large urban centres, natural resource-based industries are the backbone of their economies and principal source of employment and income for communities. The Burdekin Dry Tropics is no different. In Queensland (during 1996), 6.8% of the workforce were employed in Agriculture, Forestry, and Fishing and Mining (Table 3.5). This contrasts markedly with the proportion of workforce employed in natural-resource based sectors in shires within the Burdekin Dry Tropics (Figure 3.4). Additional information on employment is provided in sections 4.2 and 5 of this report.

Table 3.7: Regional diversity and proportion of workforce employed in natural resource-based industries
(Source ABS, 2001, data for year 1996)

<table>
<thead>
<tr>
<th>Region</th>
<th>Proportion of workforce employed in natural-resource based industries (mining and agriculture) (%)</th>
<th>Regional Diversity: number of different industries employing 80% of workforce</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burdekin Region</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belyando (S)</td>
<td>48.3</td>
<td>7</td>
</tr>
<tr>
<td>Bowen (S)</td>
<td>32.3</td>
<td>10</td>
</tr>
<tr>
<td>Burdekin (S)</td>
<td>26.3</td>
<td>9</td>
</tr>
<tr>
<td>Charters Towers (C)</td>
<td>18.9</td>
<td>10</td>
</tr>
<tr>
<td>Dalrymple (S)</td>
<td>48.9</td>
<td>8</td>
</tr>
<tr>
<td>Jericho (S)</td>
<td>47.1</td>
<td>6</td>
</tr>
<tr>
<td>Mirani (S)</td>
<td>35.0</td>
<td>8</td>
</tr>
<tr>
<td>Nebo (S)</td>
<td>50.0</td>
<td>6</td>
</tr>
<tr>
<td>Townsville/Thuringowa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Townsville City Part A (SSD)</td>
<td>1.8</td>
<td>10</td>
</tr>
<tr>
<td>Townsville (C) - Pt B</td>
<td>9.9</td>
<td>10</td>
</tr>
<tr>
<td>Thuringowa City Part A (SSD)</td>
<td>1.7</td>
<td>10</td>
</tr>
<tr>
<td>Thuringowa (C) - Pt B</td>
<td>6.6</td>
<td>10</td>
</tr>
<tr>
<td>Queensland</td>
<td>6.8</td>
<td>11</td>
</tr>
<tr>
<td>Australia</td>
<td>5.4</td>
<td>11</td>
</tr>
</tbody>
</table>
Nebo, Belyando and Charters Towers are heavily dependent on mining with 38%, 38% and 17%, respectively, of the workforce employed in that industry. The Jericho, Dalrymple, Mirani, and Burdekin shires are all heavily dependent upon agriculture, that sector employing 47%, 46%, 33% and 26% of the workforce, respectively. The rural parts of Townsville (Part B) had a relatively large proportion of its workforce employed in the agricultural sector. In contrast, the urban parts of Townsville/Thuringowa are much less dependent upon natural resources – their most significant industries being retail, government, health and community services.

The diversity of the regional economy can be measured in terms of distribution of employment across industries. A regional diversity measure is the number of industries (with the largest employment shares) which employ more than 80% of the workforce. Table 3.7 shows values for the LGAs in the Burdekin Dry Tropics. All shires within the catchment are less diversified than the Queensland economy as a whole. Jericho and Nebo shires are the least diversified with just 6 industries employing. The ‘urban’ areas of Bowen, Charters Towers and Townsville/Thuringowa are the most diversified with 10 different industries generating most of the employment.

The adjacent SSD’s of Townsville/Thuringowa had only a small percentage of the workforce employed in rural sectors – their most significant industries being retail, government, health and community services, and manufacturing. It is also worth noting the correlation between regional diversification and reliance on natural resource-based industries; the least diversified shires are also – generally – those which rely most heavily upon natural resource based industries.
The data clearly shows that the rural shires within the Burdekin region are heavily dependent upon natural resources, and may therefore have a strong incentive to ensure that they are used sustainably.

3.8 Socio-economic variables and indices

As noted earlier, those most likely to adopt sustainable resource management practices are those who have both the capacity and the motivation to do so. Socio-economic status is, therefore, likely to be a strong indicator of propensity to adopt SRMP: those who are highly educated, working in ‘white-collar’ jobs and/or well paid may have more ‘capacity’ than their ‘blue-collar’ counterparts.

3.8.1 Education

The Burdekin’s educational attainment levels are significantly below those of Queensland and Australia as a whole (Table 3.8).

Table 3.8: Proportion of population who left school at age 15 or less (or did not go to school) and proportion of population with degree or higher
(Source ABS, 2000b and Glover and Tennant, 1999 - data for year 1996:)

<table>
<thead>
<tr>
<th>Region</th>
<th>Proportion of population who left school at age 15 or less, or who did not go to school (%)</th>
<th>Proportion of population with university degree or higher (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burdekin Region</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belyando</td>
<td>33.3</td>
<td>4.1</td>
</tr>
<tr>
<td>Bowen</td>
<td>38.9</td>
<td>3.5</td>
</tr>
<tr>
<td>Burdekin</td>
<td>37.9</td>
<td>3.5</td>
</tr>
<tr>
<td>Charters Towers</td>
<td>32.7</td>
<td>5.2</td>
</tr>
<tr>
<td>Dalrymple</td>
<td>37.1</td>
<td>3.1</td>
</tr>
<tr>
<td>Jericho</td>
<td>42.9</td>
<td>2.7</td>
</tr>
<tr>
<td>Mirani</td>
<td>38.9</td>
<td>2.6</td>
</tr>
<tr>
<td>Nebo</td>
<td>35.9</td>
<td>4.2</td>
</tr>
<tr>
<td>Townsville/Thuringowa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Townsville City Part A (SSD)</td>
<td>27.8</td>
<td>8.4</td>
</tr>
<tr>
<td>Townsville Part B</td>
<td>31.8</td>
<td>5.2</td>
</tr>
<tr>
<td>Thuringowa City Part A (SSD)</td>
<td>27.1</td>
<td>4.2</td>
</tr>
<tr>
<td>Thuringowa Part B</td>
<td>35.3</td>
<td>3.9</td>
</tr>
<tr>
<td>Queensland</td>
<td>30.6</td>
<td>6.6</td>
</tr>
<tr>
<td>Australia</td>
<td>26.7</td>
<td>8.1</td>
</tr>
</tbody>
</table>
While 50% of Queensland’s and 54% of Australia’s over 15 year-olds (excluding those still at school) had completed Year 11 or higher at secondary school, only just over one in three (37%) of the Burdekin catchment’s over 15 year olds had done so. The shires of Mirani (33%), Jericho (33%) and Bowen (34%) had the lowest proportions of over 15 year-old residents who had finished Year 11 or higher at secondary school. The Belyando shire had the highest educational attainment rates with about 42% of its over 15 year-old residents having a Year 11 certificate or a higher qualification. The proportion of individuals with Year 11 or above in the adjacent SSDs of Townsville/Thuringowa were more closely aligned with the Australian figures although still somewhat lower than average. All areas – except Townsville city (Part A) have a smaller percentage of the population with degrees or higher than the national average.

### 3.8.2 Occupation and Unemployment

Table 3.9 provides a snapshot of occupations within the Burdekin Dry Tropics, showing both the unemployment rate and the percentage of workforce in ‘white collar’ jobs.

<table>
<thead>
<tr>
<th>Region</th>
<th>Unemployment rate (%)</th>
<th>Percentage of population working as professionals, associate professionals or managers and administrators (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burdekin Region</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belyando(S)</td>
<td>5.0</td>
<td>23.8</td>
</tr>
<tr>
<td>Bowen(S)</td>
<td>9.4</td>
<td>25.2</td>
</tr>
<tr>
<td>Burdekin(S)</td>
<td>5.3</td>
<td>34.0</td>
</tr>
<tr>
<td>Charters Towers(C)</td>
<td>9.2</td>
<td>32.8</td>
</tr>
<tr>
<td>Dalrymple (S)</td>
<td>7.9</td>
<td>36.7</td>
</tr>
<tr>
<td>Jericho (S)</td>
<td>2.8</td>
<td>51.3</td>
</tr>
<tr>
<td>Mirani(S)</td>
<td>6.1</td>
<td>39.0</td>
</tr>
<tr>
<td>Nebo(S)</td>
<td>3.1</td>
<td>25.5</td>
</tr>
<tr>
<td>Townsville/Thuringowa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Townsville City Part A (SSD)</td>
<td>9.8</td>
<td>36.3</td>
</tr>
<tr>
<td>Townsville Part B</td>
<td>7.3</td>
<td>33.0</td>
</tr>
<tr>
<td>Thuringowa City Part A (SSD)</td>
<td>8.5</td>
<td>27.6</td>
</tr>
<tr>
<td>Thuringowa Part B</td>
<td>10.4</td>
<td>29.2</td>
</tr>
<tr>
<td>Queensland</td>
<td>9.7</td>
<td>35.4</td>
</tr>
<tr>
<td>Australia</td>
<td>9.2</td>
<td>37.7</td>
</tr>
</tbody>
</table>
Charters Towers and Bowen both had unemployment rates at or above the national average; other shires fared better with unemployment rates as low as 3.1% and 5% in Nebo and Belyando. Dalrymple, Jericho and Mirani shires all had a relatively high proportion of their population employed in ‘white collar’ jobs, although other shires (Bowen and Charters Towers in particular) were more ‘blue-collar’ oriented than Queensland and Australia on the whole.

### 3.8.3 Welfare dependency

For people not employed in the workforce, welfare is often the only source of income. Welfare payments take many forms, for example in the form of unemployment benefits, aged pension and veteran pensions, to name just a few schemes. This section explores welfare dependency in the Burdekin, focussing on the predominant forms of welfare payments.

Table 3.10 provides an overview of the degree of welfare dependency in the Burdekin. In 1996, 15.1% of the population of the Burdekin region were receiving the aged, disability or sole parent pension or unemployment benefits – lower than the Townsville/Thuringowa (16.8%) and Queensland (19.2%) proportions. Dalrymple, Bowen and Charters Towers had averages which were higher than Queensland with 21%, 20.9 and 19.4%, respectively, of the population receiving some type of government pension. In Mirani, Nebo and Belyando, only a small percent of the population were dependant on pensions.

Table 3.10: Proportion of population receiving different kinds of welfare payments
(Source: Glover et al., 1999, data for 1996)

<table>
<thead>
<tr>
<th>Region</th>
<th>Aged pension (%)</th>
<th>Disability support pension (%)</th>
<th>Sole parent pension (%)</th>
<th>Unemployment benefits (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belyando</td>
<td>2.4</td>
<td>0.7</td>
<td>0.9</td>
<td>1.8</td>
<td>5.9</td>
</tr>
<tr>
<td>Bowen</td>
<td>9.1</td>
<td>3.6</td>
<td>1.7</td>
<td>6.6</td>
<td>20.9</td>
</tr>
<tr>
<td>Burdekin</td>
<td>9.6</td>
<td>2.7</td>
<td>1.2</td>
<td>3.9</td>
<td>17.3</td>
</tr>
<tr>
<td>Charters Towers</td>
<td>10.4</td>
<td>3.8</td>
<td>1.8</td>
<td>3.4</td>
<td>19.4</td>
</tr>
<tr>
<td>Dalrymple</td>
<td>9.1</td>
<td>4.2</td>
<td>1.9</td>
<td>6.5</td>
<td>21.6</td>
</tr>
<tr>
<td>Jericho</td>
<td>7.8</td>
<td>2.2</td>
<td>0.8</td>
<td>2.3</td>
<td>13.0</td>
</tr>
<tr>
<td>Mirani</td>
<td>2.2</td>
<td>0.7</td>
<td>0.3</td>
<td>0.8</td>
<td>3.9</td>
</tr>
<tr>
<td>Nebo</td>
<td>1.4</td>
<td>0.8</td>
<td>0.4</td>
<td>0.7</td>
<td>3.4</td>
</tr>
<tr>
<td>TOTAL 8 LGAs</td>
<td>7.4</td>
<td>2.6</td>
<td>1.3</td>
<td>3.8</td>
<td>15.1</td>
</tr>
<tr>
<td>Townsville/Thuringowa</td>
<td>7.0</td>
<td>2.8</td>
<td>2.1</td>
<td>4.8</td>
<td>16.8</td>
</tr>
<tr>
<td>Queensland</td>
<td>8.9</td>
<td>3.3</td>
<td>1.9</td>
<td>5.1</td>
<td>19.2</td>
</tr>
</tbody>
</table>
3.8.4 Income

In 1996, 10.8% of Australians and 9.1% of Queenslanders over the age of 15 years old had a weekly individual income greater than $800. In Nebo and Belyando 38.4% and 32% of individuals were in that income bracket (Figure 3.5). Again, the influence of mining in the region is apparent. Most other shires had income distributions which did not differ markedly from that of Queensland and Australia as a whole – although there were generally a higher percentage of individuals earning less than $300 per week – close to 60% of those aged 15 years or more in Charters Towers and Jericho.

![Figure 3.5: Individual weekly income distribution](Source: ABS 2001, data for 1996)

3.8.5 Socio-economic indices from the ABS

To gain a better understanding of communities, the ABS has developed a series of indices that summarise different aspects of the socio-economic conditions of communities. The Socio-Economic Indices for Areas (SEIFA) provide lifestyle groupings of Australia’s communities (ABS: 1996).

The SEIFA measure different aspects of the socio-economic conditions of the populations of geographic areas relate to socio-economic aspects of geographic areas. Each index
Social and Economic Issues of NRM in the Burdekin Dry Tropics Region

summarises a different mix of census variables for a specified area. The indices are calculated to show the relativity of areas to the Australian average for particular sets of variables.

The indices have been obtained by summarising the information from a variety of social and economic variables contained in the census, each index using a different set of underlying variables. The indices area:

- **Index of Relative Socio-Economic Advantage**
  
  There are two expressions of the index for urban and rural areas. The urban index covers areas in urban centres with a population of 1000 and over, and the rural index covers the remaining areas of Australia. The urban/rural split is considered necessary because major structural differences were found in the relationships between socio-economic variables related to advantage for the urban and rural areas. The variables underlying both are associated with socio-economic wellbeing (e.g., high income, tertiary education, and skilled occupations).

- **Index of Relative Socio-Economic Disadvantage**;
  
  This index summarises the information available from variables related to education, occupation, income, family structure, race, ethnicity and housing. It reflects the extent of disadvantage represented by, for example, high unemployment. It is important to note that the scores for this index are counterintuitive as high index values represent low disadvantage.

- **Index of Economic Resources**;
  
  This index reflects the profile of the economic resources of families within the areas. The Census variables that are summarised by this index reflect the income and expenditure of families, such as income and rent and home ownership. Additionally, variables that reflect non-income assets, such as dwelling size and number of cars, are also included. The income variables are specified by family structure, since this affects disposable income.

- **Index of Education and Occupation**;
  
  The Index of Education and Occupation is designed to reflect the educational and occupational structure of communities. The education variables in this index show either the level of qualification achieved or whether further education is being undertaken. The occupation variables classify the workforce into the Australian Standard Classification of Occupation (ASCO) major groups and the unemployed. This index does not include any income variables.

The methodological assessment and full list of variables that make up these indices is provided in Appendix 2.

The SEIFA are available for a wide range of geographic areas from small areas, such as collection district (an area made up of approximately 200 households), postal areas, local government areas and statistical local areas, to large areas, such as statistical subdivisions.

Other indices, or ways of looking at composite variables, are being developed in an attempt to move away from Census based (and therefore CD defined) statistics and community
definition. Some of these, for example Town Resource Cluster analysis, seek to include issues such as resource dependence, and rely on primary and specific data gathering, as well as more participatory approaches (Fenton and Coakes, 1999). Until more detailed information is available, the SEIFA allows comparison across the nation consistently.

Map 3.3 shows the rural index of relative socio-economic advantage at CD level for areas in and around the Burdekin catchment. A high score on the Index indicates that an area has attributes such as a relatively large proportion of households with high incomes or a trained workforce. Conversely, a lower score on the index indicates that an area has a smaller proportion of households with these advantageous attributes. The reference year is 1996 as SEIFA indices for the census 2001 are not due to be released before July 2003. Dark areas indicate that the CD is performing ‘well’ when compared to other Australian CDs. Lighter areas indicate that region is doing poorly – the lighter the shade, the lower the CD’s ranking relative to all Australian CD’s.

Two points stand out. First, there are few areas within the Burdekin which are in the ‘upper half’ of Australian CD’s. Second, there is considerable variation across the catchment.

Map 3.4 shows the index of relative socio-economic disadvantage. To maintain consistency with the indices, the higher an area’s index value for the Index of Relative Disadvantage, the less disadvantaged that area is compared with other areas. For example, an area that has an Index of Relative Disadvantage value of 1200 is less disadvantaged than an area with an index value of 900. In most cases, an area that has a high score on the Index of Relative Socio-Economic Advantage will also have a high score on the Index of Relative Socio-Economic Disadvantage (i.e., high values of these indices always represent the more advantaged conditions).

High scores on the Index of Relative Disadvantage occur when the area has few families of low income and few people with little training and in unskilled occupations. Low scores on the index occur when the area has many low-income families and people with little training and in unskilled occupations. Most CD’s within the region are in the lower 50% of Australian LGAs although areas to the North and North-East of Charters Towers, and to the South of Collinsville are in the upper 50%.

Map 3.5 shows the index of education and occupation for shires within the Burdekin. An area with a high score on this index would have a high concentration of persons with higher education or undergoing further education, with people being employed in the higher skilled occupations, rather than being labourers or unemployed. A low score indicates an area with concentrations of either persons with low educational attainment or unskilled or unemployed people. As might have been expected from earlier discussion all CD’s are within the lower 50% of Australia’s CDs – many within the lower 10%.

Map 3.6 shows the index of economic resources for CDs within the Burdekin. A higher score on the Index of Economic Resources indicates that the area has a higher proportion of families on high income, a lower proportion of low-income families, more households purchasing or owning dwellings and living in large houses. A low score indicates the area has relatively large proportions of households on low incomes and living in small dwellings. In contrast to earlier indices; several areas rank within the upper 50% of all Australian CD’s on this measure – a few (south of Townsville and south-west of Ayr) are
even in the top 25%. This may reflect earlier observations regarding the high percentage of individuals within the area who own their homes.

Information from all socio-economic indices (calculated at the shire level – as opposed to the CD level presented in the maps) has been summarised in Table 3.11. The table shows how shires within the Burdekin catchment ‘rank’ within the national data set. LGA values for these indices are provided in Appendix 3A.

Table 3.11: Summary of relative SEIFA rankings for Shires within the Burdekin Catchment in national comparison
(Source: ABS: 1996a, data for year 1996)

<table>
<thead>
<tr>
<th>Burdekin Region</th>
<th>Rural Relative Socio-economic Advantage</th>
<th>Urban Relative Socio-economic Advantage</th>
<th>Socio-Economic Disadvantage</th>
<th>Economic Resources</th>
<th>Education and Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belyando (S)</td>
<td>Lower 10%</td>
<td>Upper 50%</td>
<td>Upper 50%</td>
<td>Upper 25%</td>
<td>Lower 25%</td>
</tr>
<tr>
<td>Bowen (S)</td>
<td>Lower 10%</td>
<td>Lower 10%</td>
<td>Lower 10%</td>
<td>Lower 25%</td>
<td>Lower 10%</td>
</tr>
<tr>
<td>Burdekin (S)</td>
<td>Lower 25%</td>
<td>Lower 50%</td>
<td>Upper 50%</td>
<td>Upper 50%</td>
<td>Lower 25%</td>
</tr>
<tr>
<td>Charters Towers (C)</td>
<td>Lower 50%</td>
<td>Lower 50%</td>
<td>Lower 50%</td>
<td>Lower 50%</td>
<td>Upper 50%</td>
</tr>
<tr>
<td>Dalrymple (S)</td>
<td>Lower 10%</td>
<td>Lower 25%</td>
<td>Lower 50%</td>
<td>Lower 10%</td>
<td></td>
</tr>
<tr>
<td>Jericho (S)</td>
<td>Lower 10%</td>
<td>Lower 25%</td>
<td>Lower 50%</td>
<td>Lower 10%</td>
<td></td>
</tr>
<tr>
<td>Mirani (S)</td>
<td>Lower 50%</td>
<td>Lower 50%</td>
<td>Upper 50%</td>
<td>Lower 10%</td>
<td></td>
</tr>
<tr>
<td>Nebo (S)</td>
<td>Lower 10%</td>
<td>Lower 10%</td>
<td>Lower 50%</td>
<td>Lower 25%</td>
<td>Lower 10%</td>
</tr>
</tbody>
</table>

Notably, all shires considered here, rank in the lower 50% on measures of relative socio-economic advantage. Given the high level of dependency of income from agriculture, the conclusion is valid that the low rating may be in part a result of the extremely poor price for beef during 1995/96, the reference year for the economic data captured in the 1996 census. As shown in Figure 4.2, the 1996 beef price index was only 40% of the 1993 beef price index. That index has since recovered – at least partially – it is now close to 80% of the 1993 level. Had the data for the socio-economic indices been collected in 1993, the story may have appeared less grim.

Most shires also rank poorly on ‘Education and Occupation’ (with the exception of Charters Towers); and on Urban Relative Socio-Economic Advantage (with the exception of Belyando).

Bowen, Dalrymple, Jericho and Nebo ranked below average on all measures. Bowen fares particularly poorly – ranking in the bottom 10% on four of the five indices and the bottom 25% on the other. Arguably, Belyando is the most socio-economically advantaged shire, ranking in the upper 50% on two of the five measures and in the upper 25% on one.
3.9 Maps for Section 3.

Map 3.1: Population density across the Burdekin Dry Tropics region.

(Source: Map compiled by CSIRO from ABS, 1996a).
Map 3.2: Remoteness of the Burdekin Dry Tropics region.

(Source: Map compiled by CSIRO and data from NLWRA and BRS, 2001)
Map 3.3: Rural index of relative socio-economic advantage 1996

(Source: Map compiled by CSIRO from ABS, 1996a).
Map 3.4: Index of relative socio-economic disadvantage 1996

(Source: Map compiled by CSIRO from ABS, 1996a).
Social and Economic Issues of NRM in the Burdekin Dry Tropics Region

Map 3.5: Index of education and occupation 1996

(Source: Map compiled by CSIRO from ABS, 1996a).
Map 3.6: Index of economic resources 1996
(Source: Map compiled by CSIRO from ABS, 1996a).
4 The Regional Economy

Section summary

The economy of the Burdekin Dry Tropics is heavily reliant upon natural resource-based industries, particularly agriculture. Agriculture is the second most important industry in the North Queensland economy on the basis of value contribution to gross regional product.

Natural resource-based industries are subject to much volatility, which is brought about through changes in economic variables (volatile prices and exchange rates), changes in nature (variable rainfall, natural disasters), and changes in government policy.

Natural resource-based industries are heavily linked into the regional economy. This means that changes in these industries affect other industries through the multiplier process. When farm incomes rise or fall by 30%, gross regional products may rise or fall by more than the equivalent value. The economy-wide impact of a change in one sector of an economy will equal the initial impact times a multiplier. The larger the initial impact and/or the larger the multiplier, the more other sectors of the economy will be affected by changes in that industry.

Agriculture is by far the most important employer in the rural areas of the Burdekin region and is therefore even more important socially than economically.

The relatively high employment multipliers of agricultural sectors (particularly when compared to mining) mean that revenue changes in that sector can have a large impact on other sectors of the economy. The more important is the agricultural sector, the larger will be that effect. Some shires within the Burdekin Dry Tropics have fairly diversified economies and are therefore less susceptible to boom-bust cycles within the agricultural sector. Others, eg Nebo, Jericho and Belyando, are much less diverse, and may therefore be considerably less ‘robust’.

This section provides an overview of the regional economy and explores the contribution, which natural resource-based industries provide. It examines, at an aggregate scale, the value of goods and services produced by industries to the regional economy (which defines the contribution to state and national accounts), and the employment that industries generate throughout the region. It is through employment of members of the regional community that industries most directly contribute to a region and the social welfare of a community.

The ‘North Queensland’ economic region, which covers the Northern Statistical Division, provides the closest alignment of a regional economy with the Burdekin Dry Tropics region.

The Department of State Development, on its website (http://www.sd.qld.gov.au/dsdweb/htdocs/global/content.cfm?ID=48), describes the ‘North Queensland’ economic region with the following attributes:

• a diverse economic base,
an established and expanding downstream minerals processing sector,
a well-developed and diverse manufacturing sector that includes a broad range of companies providing infrastructure support to the mining industry,
a large port facility capable of handling Panamex-sized vessels, including bulk handling capabilities for live cattle, sugar and mineral ores,
nearest major seaport to the Carpentaria Minerals Province and the agricultural producers of western Queensland,
a growing tourism sector with strong links to established tourism markets (eg. Cairns),
an international airport with well-established road and rail linkages,
an established university offering diverse education options,
a world-class marine research facility with strong links to other local education and research institutions,
rapid access to the Great Barrier Reef Marine Park offering a wealth of biotechnology opportunities; and
Queensland's major regional centre for State and Federal government administration.

This description does not mention the strength of the agricultural sector other than being part of a diversified economy and generating export revenue from shipping produce out of the Townsville port. Yet Agriculture (in its ABS definition including fisheries and forestry) is the 2nd most important contributor to the gross regional product of the region, behind Manufacturing and before the Dwelling Investment, Retail Trade, Construction and Mining industries, based on data for 2001/02. In most shires within the Burdekin, it is THE most important employer. Mining is the most important employer in three other shires. This importance could be seen as reliance and would therefore indicate a high exposure of the region to risks that could affect primary industries. It is, therefore, essential to consider agriculture, and other important industries within the region, with particular focus on the 'risks' faced by these sectors, and the 'exposure' of the rest of the community (through economic linkages) to those risks.

4.1 Value of goods and services produced

The importance of an industry is most commonly measured in terms of the monetary value that its output adds to gross domestic product (GDP) or gross regional product (GRP). GRP is a measure of the combined market value of currently produced finished goods and the value of services rendered. GRP represents the aggregate income to the owners of the factors of production, that is the sum of wages, salaries, profits, interest, dividends, rent, and so on. GRP is usually measured at market prices. If measured at factor income, the estimate is less because indirect taxes are not included. A detailed definition of economic measures is provided in Appendix 3.

Table 4.1 summarises the contribution of industries to gross regional product of the Northern Statistical Division, which provides the closest possible match with the Burdekin region. The regional economy is characterised by a strong Manufacturing industry. It contributes 13.0% to the regional economy as compared to 10.4% for Queensland (ABS, 2002 for year 2000/01). Agriculture (including Forestry, Fisheries and Hunting) is also comparatively more important to the region than to the State with 8.4% as compared to
4.8%. Mining contributes 6.8% regionally as compared to 6.1% across the State. Accommodation, Cafes and Restaurants contributes 3.3% regionally as compared to 7.0% for Queensland. This would seem to indicate that the tourism industry in the region is comparatively little developed. Government Administration and Defence is 4.9% regionally, 3.8% at the State level.

Table 4.1:  Gross regional product at factor cost for the Northern Statistical Division, 2001-02
(Source: AEC Economics 2002)

<table>
<thead>
<tr>
<th>Industry</th>
<th>Value ($m)</th>
<th>Proportion (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>778</td>
<td>13.0</td>
</tr>
<tr>
<td>Agriculture</td>
<td>503</td>
<td>8.4</td>
</tr>
<tr>
<td>Dwelling Investment</td>
<td>466</td>
<td>7.8</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>441</td>
<td>7.3</td>
</tr>
<tr>
<td>Construction</td>
<td>414</td>
<td>6.9</td>
</tr>
<tr>
<td>Mining</td>
<td>409</td>
<td>6.8</td>
</tr>
<tr>
<td>Health &amp; Community Services</td>
<td>375</td>
<td>6.3</td>
</tr>
<tr>
<td>Property &amp; Business</td>
<td>352</td>
<td>5.9</td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>346</td>
<td>5.8</td>
</tr>
<tr>
<td>Transport &amp; Storage</td>
<td>294</td>
<td>4.9</td>
</tr>
<tr>
<td>Education</td>
<td>294</td>
<td>4.9</td>
</tr>
<tr>
<td>Government, Administration &amp; Defence</td>
<td>291</td>
<td>4.9</td>
</tr>
<tr>
<td>Electricity, Gas &amp; Water</td>
<td>201</td>
<td>3.4</td>
</tr>
<tr>
<td>Accommodation, Cafes and Restaurants</td>
<td>196</td>
<td>3.3</td>
</tr>
<tr>
<td>Communications</td>
<td>156</td>
<td>2.6</td>
</tr>
<tr>
<td>Personal &amp; Other Services</td>
<td>140</td>
<td>2.3</td>
</tr>
<tr>
<td>Cultural and Recreation</td>
<td>120</td>
<td>2.0</td>
</tr>
<tr>
<td>General Government</td>
<td>117</td>
<td>1.9</td>
</tr>
<tr>
<td>Finance &amp; Insurance</td>
<td>107</td>
<td>1.8</td>
</tr>
<tr>
<td>Total</td>
<td>5,998</td>
<td>100.0</td>
</tr>
</tbody>
</table>

These numbers reveal three limitations of economic data regularly collected by the ABS for regional-scale applications in a natural-resource management context. The usefulness of the data is limited for regional-scale application because:

- The resolution of published data is usually limited to the state/territory or at best economic region or SD level. Such data is difficult to interpret in the context of the Burdekin Dry Tropics, as the region straddles parts of three different SDs.
- The industry entitled Agriculture is an aggregate of agricultural, pastoral, forestry and fisheries sectors. Hence it is difficult to examine just one of these sectors in isolation.
- The contribution of ‘tourism’ cannot be derived easily from this data as tourism encompasses multiple industries including Accommodation, Restaurants and Cafes, Transport, Retail Trade and Cultural Services, amongst others.
Data can be acquired at the LGA level. Similarly, one can disaggregate *Agriculture*, or use special algorithms to ‘build/aggregate’ a *Tourism* specific sector, but such requests must often be directed to specialised consulting firms and can therefore be costly.

The Productivity Commission (2002) presents estimates of gross value of production for different agricultural industries and other natural-resource based industries. Projections are also provided for the year 2020. According to those numbers, all agricultural industries will grow slightly but tourism will be the real growth industry over the next two decades.

4.2 Employment

While the importance of industries is generally measured in terms of their share of GRP, they contribute most directly to a region and the social welfare of a community through the employment of members of the community.

In Queensland, about 5% of workforce were employed in the *Agriculture* industry during 1996. That percentage was exceeded by all rural shires within the Burdekin region (Table 4.2). The most agriculture-dependent workforce is in Jericho shire with 46.5% of all workers employed in that sector. Next most agriculture-dependent were the shires of Dalrymple, Mirani, Burdekin and Bowen with percentages of 35, 34.4, 25.6 and 25.4, respectively.

Employment across various agricultural industries is presented in the report by the Productivity Commission (2002: p.101), identifying horticulture and sugar as each having more than twice the number of persons employed than beef.

*Mining* is also more important at the regional scale in comparison to the State average, which recorded 1.6% of workforce employed in this industry in 1996. The contribution to employment in the Burdekin region is focussed in certain areas. Belyando and Nebo shires had 42.6% and 41.8 % of the workforce (respectively) employed in the mining industry. In contrast, there is virtually no employment in *Mining* in Burdekin, Jericho and Mirani shires.

Employment in tourism is difficult to estimate, as tourism involves, in part, several industries. Many of those working in tourism are employed in *Accommodation, Cafes and Restaurants* or in *Retail and Wholesale Trade* (OESR, 2002). Employment in those industries is therefore an indicator of the relative importance of tourism to a region. The percentage of workforce employed in *Accommodation, Cafes and Restaurants* is less than the Queensland average of 5.5% for all shires except Nebo, which is slightly higher. Employment in that industry is lowest for Burdekin shire with 2.9% and Dalrymple and Jericho shires, both at 3.4%. The most likely reason for this is that there is relatively less tourism activity in the Burdekin region than in Queensland as a whole. However, the relatively low figures for tourism-related employment may also be because formal measures of tourism do not reflect the type of tourism taking place within the region.

Over time, individual industries adapt to individual circumstances, collectively altering the structure of the regional economy. Economic measures such as employment therefore reflect changes in economic structure over time. Figure 4.1 provides a glimpse of the dynamic aspects of industries in the spatial context by examining employment over a 10-year period.
### Table 4.2: Percentage of workforce employed in industries in the LGAs of the Burdekin Region
(Source: OESR, 2002; data for year 1996)

<table>
<thead>
<tr>
<th>Industry</th>
<th>Belyando (S)</th>
<th>Bowen (S)</th>
<th>Burdekin (S)</th>
<th>Charters Towers (C)</th>
<th>Dalrymple (S)</th>
<th>Jericho (S)</th>
<th>Mirani (S)</th>
<th>Nebo (S)</th>
<th>Queensland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>10.2</td>
<td>25.4</td>
<td>25.6</td>
<td>3.1</td>
<td>35.0</td>
<td>46.5</td>
<td>34.4</td>
<td>14.3</td>
<td>5.1</td>
</tr>
<tr>
<td>Forestry Fishing and Hunting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mining</td>
<td>41.8</td>
<td>4.6</td>
<td>0.4</td>
<td>17.6</td>
<td>13.5</td>
<td>0</td>
<td>1.3</td>
<td>42.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>2.1</td>
<td>9.7</td>
<td>14.6</td>
<td>3.8</td>
<td>3.9</td>
<td>1.5</td>
<td>14.9</td>
<td>1.8</td>
<td>10.5</td>
</tr>
<tr>
<td>Electricity Gas and Water</td>
<td>0.3</td>
<td>0.8</td>
<td>0.9</td>
<td>1.2</td>
<td>0.6</td>
<td>0</td>
<td>0.9</td>
<td>0.3</td>
<td>0.7</td>
</tr>
<tr>
<td>Construction</td>
<td>4.8</td>
<td>4.4</td>
<td>5.1</td>
<td>5.1</td>
<td>3.6</td>
<td>6.4</td>
<td>4.9</td>
<td>7.2</td>
<td></td>
</tr>
<tr>
<td>Wholesale Trade</td>
<td>1.9</td>
<td>5.0</td>
<td>4.8</td>
<td>2.6</td>
<td>2.2</td>
<td>5.0</td>
<td>2.9</td>
<td>0.3</td>
<td>5.6</td>
</tr>
<tr>
<td>Retail Trade</td>
<td>8.8</td>
<td>12.3</td>
<td>12.8</td>
<td>13.6</td>
<td>7.8</td>
<td>5.2</td>
<td>6.7</td>
<td>3.5</td>
<td>14.2</td>
</tr>
<tr>
<td>Accommodation and Cafes and Restaurants</td>
<td>4.7</td>
<td>4.6</td>
<td>2.9</td>
<td>5.0</td>
<td>3.4</td>
<td>3.4</td>
<td>4.2</td>
<td>6.4</td>
<td>5.5</td>
</tr>
<tr>
<td>Transport and Storage</td>
<td>3.2</td>
<td>5.9</td>
<td>3.3</td>
<td>4.8</td>
<td>3.4</td>
<td>9.9</td>
<td>4.3</td>
<td>7.4</td>
<td>4.9</td>
</tr>
<tr>
<td>Communication Services</td>
<td>0.7</td>
<td>0.6</td>
<td>0.5</td>
<td>0.7</td>
<td>0.2</td>
<td>0.6</td>
<td>0.9</td>
<td>0.3</td>
<td>1.7</td>
</tr>
<tr>
<td>Finance and Insurance</td>
<td>1.0</td>
<td>1.4</td>
<td>1.8</td>
<td>1.9</td>
<td>0.4</td>
<td>0.0</td>
<td>0.7</td>
<td>1.2</td>
<td>2.9</td>
</tr>
<tr>
<td>Property and Business Services</td>
<td>2.7</td>
<td>3.7</td>
<td>4.9</td>
<td>4.2</td>
<td>2.7</td>
<td>0.6</td>
<td>2.9</td>
<td>2.3</td>
<td>9.3</td>
</tr>
<tr>
<td>Government Administration and Defence</td>
<td>2.5</td>
<td>2.8</td>
<td>3.3</td>
<td>5.3</td>
<td>3.2</td>
<td>7.1</td>
<td>3.4</td>
<td>3.3</td>
<td>5.1</td>
</tr>
<tr>
<td>Education</td>
<td>5.6</td>
<td>5.9</td>
<td>6.0</td>
<td>12.2</td>
<td>5.5</td>
<td>6.3</td>
<td>6.1</td>
<td>5.6</td>
<td>7.2</td>
</tr>
<tr>
<td>Health and Community Services</td>
<td>4.3</td>
<td>6.2</td>
<td>5.7</td>
<td>11.6</td>
<td>5.7</td>
<td>5.0</td>
<td>4.4</td>
<td>2.2</td>
<td>9.3</td>
</tr>
<tr>
<td>Cultural and Recreational Services</td>
<td>0.5</td>
<td>0.7</td>
<td>0.8</td>
<td>1.3</td>
<td>0.4</td>
<td>0.0</td>
<td>0.9</td>
<td>0.8</td>
<td>2.3</td>
</tr>
<tr>
<td>Personal and Other Services</td>
<td>2.0</td>
<td>2.0</td>
<td>2.2</td>
<td>3.2</td>
<td>1.6</td>
<td>1.5</td>
<td>1.4</td>
<td>0.8</td>
<td>3.6</td>
</tr>
<tr>
<td><strong>Total employment</strong></td>
<td><strong>5079</strong></td>
<td><strong>5399</strong></td>
<td><strong>8613</strong></td>
<td><strong>3176</strong></td>
<td><strong>1509</strong></td>
<td><strong>477</strong></td>
<td><strong>2117</strong></td>
<td><strong>1088</strong></td>
<td><strong>1,404,062</strong></td>
</tr>
</tbody>
</table>

Between 1986 and 1996 the proportion of total workforce employed in natural resource-based industries has remained relatively constant, but there have been some interesting spatial and inter-industry variations. For example, in Belyando shire the proportion of total workforce employed in both *Mining* and *Agriculture* fell from about 65% to under 50%
during that period. In Bowen shire, aggregate employment in those industries remained stable; with a decline in Mining employment being offset by a rise of employment in Agriculture. In Charters Towers, Mining has re-emerged as a major employer. Over that decade, no significant trends are apparent in Accommodation, Café and Restaurants anywhere in the Burdekin region. It remains a minor industry.


**4.3 Risks to agriculture and other industries**

Sudden decline in industries can arise from a series of shocks, ranging from natural events to economic, political and social factors. Roberts (2000) provides a detailed regional risk analysis as part of a general assessment of the future competitiveness of the economy of Far North Queensland. While conducted for a region adjoining the study area to the north, the key messages are equally applicable to the Burdekin Dry Tropics region.

Roberts (2000) provides an estimation of risk possibilities for a series of 30 risk factors. Table 4.3 shows a selection of those risk factors, the estimated probability of occurrence and their ranking out of 30 factors. The three highest ranking factors are economic, natural and policy changes, and the probability of such a change occurring in a 10-year period is rated higher than 80%.

Most risk factors are external to the region, meaning they are outside the control of regional authorities and people. Major sectors of the regional economy show a high level of susceptibility to various external risks.
Table 4.3: Estimated risk possibility and risk index for events impacting on the FNQ economy
(Source: Roberts, 2000:70-82; selective listing)

<table>
<thead>
<tr>
<th>Possibility of occurrence over 10 years (%)</th>
<th>Occurrence ranking</th>
<th>Anticipated risk index</th>
<th>Risk ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid changes in exchange rates</td>
<td>84.5</td>
<td>1</td>
<td>0.65</td>
</tr>
<tr>
<td>Natural disaster</td>
<td>82.4</td>
<td>2</td>
<td>0.64</td>
</tr>
<tr>
<td>Changes in government</td>
<td>80.2</td>
<td>3</td>
<td>0.45</td>
</tr>
<tr>
<td>International instability</td>
<td>75.1</td>
<td>4</td>
<td>0.54</td>
</tr>
<tr>
<td>Rising inflation</td>
<td>74.6</td>
<td>5</td>
<td>0.54</td>
</tr>
<tr>
<td>Disruption to transport system</td>
<td>72.5</td>
<td>7</td>
<td>0.57</td>
</tr>
<tr>
<td>Rapid change in consumer demand</td>
<td>66.3</td>
<td>12</td>
<td>0.52</td>
</tr>
<tr>
<td>Pollution</td>
<td>65.4</td>
<td>15</td>
<td>0.35</td>
</tr>
<tr>
<td>Agricultural pests</td>
<td>64.8</td>
<td>17</td>
<td>0.38</td>
</tr>
<tr>
<td>Natural resource depletion</td>
<td>57.1</td>
<td>26</td>
<td>0.36</td>
</tr>
<tr>
<td>Man made disaster</td>
<td>48.3</td>
<td>30</td>
<td>0.27</td>
</tr>
</tbody>
</table>

Events will affect different sectors in different ways. In terms of their overall exposure to anticipated risk, Roberts (2000) ranked the wholesale trade industry highest (index of 0.64). Retail trade ranked 4th (0.54) and tourism, agriculture and fishing ranked 5th, 6th and 7th respectively with risk indices of around 0.5. Different sectors have different exposures to risk factors (Table 4.4), with the agriculture and food sectors particularly susceptible to natural disasters.

Table 4.4: Anticipated risk of different industry sectors experiencing events
(Source: Roberts, 2000:85-92. Note: empty fields indicate that no risk priority assessment was provided against the risk factors by Roberts)

<table>
<thead>
<tr>
<th>Agriculture</th>
<th>Fishing</th>
<th>Food processing</th>
<th>Tourism</th>
<th>Retail trade</th>
<th>Business and producer services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rapid changes in exchange rates</td>
<td>M/High</td>
<td>M/High</td>
<td>M/High</td>
<td>M/High</td>
<td>M/High</td>
</tr>
<tr>
<td>Natural disaster</td>
<td>High</td>
<td>Medium</td>
<td>High</td>
<td>M/High</td>
<td>M/High</td>
</tr>
<tr>
<td>International instability</td>
<td>M/High</td>
<td>Medium</td>
<td>M/High</td>
<td>M/High</td>
<td>M/High</td>
</tr>
<tr>
<td>Rising inflation</td>
<td>M/High</td>
<td>Medium</td>
<td>M/High</td>
<td>M/High</td>
<td>M/High</td>
</tr>
<tr>
<td>Disruption to transport system</td>
<td>M/High</td>
<td>Medium</td>
<td>M/High</td>
<td>M/High</td>
<td>M/High</td>
</tr>
<tr>
<td>Rapid change in consumer demand/Loss of markets</td>
<td>M/High</td>
<td>M/High</td>
<td>High</td>
<td>Medium</td>
<td>M/High</td>
</tr>
<tr>
<td>Pollution</td>
<td>M/High</td>
<td>Medium</td>
<td>M/High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural pests</td>
<td>Medium</td>
<td>M/High</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural resource depletion</td>
<td>Medium</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.4 Sources of risk

4.4.1 Price variability

The majority of primary products produced in the Burdekin Dry Tropics region, both agricultural and minerals, is exported. Revenue is directly dependent on product prices and volatile prices on world markets translate to high volatility of industry revenue. The most pertinent prices in this region are those of beef, sugar, gold, silver and – to a lesser extent – copper, since they are the primary agricultural and mining products of the catchment (see section 5 for details).

Figure 4.2 shows price indices for sugar and beef, the two key agricultural commodities produced in the Burdekin region, for the past nine years. The index has been normalised to prices in June 1993. Most apparent from the chart is the price volatility. In May 2002 both commodities had an index of approximately 70, but the sugar price has recently slumped after ‘booming’ for several years whereas beef prices have been rising steadily from a low of less than 40 during 1995/96 (which incidentally preceded the census 1996 date).

Figure 4.3 shows price indices for gold, silver and copper, also normalised to June 2003. A similar degree of volatility is apparent. Copper was the most price volatile mineral during that period of time; between 1993 and 1995 the price rose more than 60%; between 1995 and 1998 the price index halved.
4.4.2 Rainfall variability

Agricultural production in dryland systems is critically dependent on rainfall. Rainfall in the Dry Tropics is highly variable. Rainfall variability in the Burdekin is illustrated in Figure 4.4, which shows annual rainfall in Charters Towers from 1889 – 2001. During that period, average rainfall was 659 mm. The standard deviation was 254 mm, almost 40% of the mean. Rainfall variability is a further source of volatility in agricultural incomes.
4.4.3 **Demand fluctuations**

The Burdekin Dry Tropics region has much to offer tourists who are interested in a primarily nature-based product. Tourism is a highly competitive industry. Income variability is seasonal as well as between years. This is driven by domestic and international economic and political forces, weather, and tourist preferences among other variables. Figure 4.5 shows quarterly takings from accommodation for three shires within the Burdekin catchment: Belyando, Bowen and Charters Towers.

![Figure 4.5: Quarterly takings from accommodation for LGAs in the Burdekin region, 1997-2000](Data source: ABS, 2001)

Two important trends appear in this diagram. First, seasonality is present; the September quarter consistently out-performs other quarters in terms of accommodation takings – particularly March. Second, Belyando Shire almost doubled its takings from 1998 to 2000. The industry may be small, but growth can be achieved in short periods of time.

4.5 **Secondary economic and employment effects**

The community in many rural shires within the Burdekin region is heavily dependent upon agriculture. Since agricultural incomes tend to vary markedly from year to year, one also expects other sectors of the economies to experience similar variations. This occurs, for example, when farmers and their families alter their expenditure behaviour in response to changed incomes, spending more in good years than in bad.

The economy-wide impact of a change in one sector of an economy will depend upon
a) the significance of the initial change

Eg. If 50% of a region’s economy is derived from agriculture, then fluctuations in the value of agriculture will have a large impact. If only 2% of a region’s economy is derived from agriculture, then fluctuations in agricultural value will have little effect,

and

b) the spending patterns and economic linkages within the economy.

Eg. If those suffering a decline in income are part of a fly-in/fly-out workforce which spends all of its money elsewhere, then others within the region will not be affected by their changes of circumstance. On the other hand, if those who suffer the decline are, for example, ‘regulars’ at the local tavern, then the tavern will also suffer.

More explicitly, the economy-wide impact of a change to one sector will equal the initial impact times a multiplier. The larger the initial impact and/or the larger the multiplier, the more other sectors of the economy will be affected by changes in that industry. The more dependent is a community upon a ‘volatile’ industry sector, the more ‘volatile’ will be its economy.

ABARE (2001) analysed farmers’ expenditure patterns in rural towns. They found that more than half of all farm expenditure occurred in larger towns (populations greater than 20,000), but that small towns were highly dependent upon the (albeit relatively small amount) of farm expenditure they received. In towns with populations of less than 1000, farm expenditure per town resident was almost $12,000 per annum – approximately one-third of per capita income. One would therefore expect to find that sparsely populated shires within the Burdekin experience larger percentage swings in GRP than Queensland as a whole in response to income fluctuations of farmers.

The value of residential building approvals is one (of several) leading indicators of economic activity. Table 4.5 presents minimum and maximum value of residential building approvals for LGAs in the Burdekin region between 1997 and 2001. It also shows the percentage difference between the minimum and maximum as a measure of variability. As expected, variations in the value of this indicator are larger for regional shires than for Queensland as a whole. In Queensland, the difference between the minimum and maximum was only 14%, an amount which is exceeded (sometimes by orders of magnitude) in all shires considered here. In Nebo and Jericho shires, the smallest LGAs in terms of population, the value of residential building approvals varied by almost 200% between years.
### Table 4.5: Value of residential building approvals between 1997 and 2001 for LGAs within the Burdekin region – minimum, maximum and variation
(Source: OESR, 2002a – g)

<table>
<thead>
<tr>
<th>Region</th>
<th>Minimum value of residential building approvals between 1997 and 2001 ($m)</th>
<th>Maximum value of residential building approvals between 1997 and 2001 ($m)</th>
<th>Difference between minimum and maximum values ((\frac{b-a}{\frac{1}{2}(a+b)}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belyando (S)</td>
<td>0.3</td>
<td>2.7</td>
<td>160</td>
</tr>
<tr>
<td>Bowen (S)</td>
<td>2.0</td>
<td>4.1</td>
<td>69</td>
</tr>
<tr>
<td>Burdekin (S)</td>
<td>5.0</td>
<td>8.0</td>
<td>46</td>
</tr>
<tr>
<td>Charters Towers (C)</td>
<td>1.3</td>
<td>3.5</td>
<td>92</td>
</tr>
<tr>
<td>Dalrymple (S)</td>
<td>0.8</td>
<td>2.9</td>
<td>114</td>
</tr>
<tr>
<td>Jericho (S)</td>
<td>0.01</td>
<td>0.4</td>
<td>191</td>
</tr>
<tr>
<td>Mirani (S)</td>
<td>1.5</td>
<td>4.7</td>
<td>103</td>
</tr>
<tr>
<td>Nebo (S)</td>
<td>0.01</td>
<td>1.0</td>
<td>196</td>
</tr>
<tr>
<td>Queensland</td>
<td>3,400</td>
<td>3,900</td>
<td>14</td>
</tr>
</tbody>
</table>

**Figure 4.6: Regional diversity and variations in the value of residential building approvals for LGAs in the Burdekin region**
(Source: Diversity data from ABS, 2001; Building approval data from OESR, 2001a - h)
It is also interesting to note the correlation between measures of regional diversity (Table 4.5) and variations in building approvals. Figure 4.6 shows that the LGAs with the highest variations in residential building approvals are those which are least diversified (where most employment is generated from few industries). The shires that rely most heavily on natural resources are more susceptible to ‘ill winds’ in the natural resource sector than those which are dependent upon a wide variety of industries.

4.5.1 Physical multipliers

The process whereby the economic activity of one industry affects other industries is called the ‘multiplier’ process; one which is often analysed through input-output analysis.

The difficulty with obtaining input-output data for the Burdekin region is that, firstly, the Burdekin catchment spans three different SD’s, and it is difficult to know which SD – if any – best describes the region or the catchment as a whole. Second, even if a single input-output table did exist for the entire catchment, there would be considerable within-region variation because the shires have different economic structure. Differences occur for several reasons, among them being the different industry bases (eg. those which are based, predominantly, on mining – like Belyando; and those based, predominantly, on agricultural – like Jericho). Differences also arise due to spending patterns; in some shires, farmers make at least some purchases locally – eg. in Bowen; in other shires, farmers must make most purchases outside the region.

Regional input-output tables are available for the Queenslands’ Statistical Divisions based upon 1989-90 data (Queensland Government’s Statisticians Office, 1996). Updated tables based on 1996 data will not be available before late 2002 (Bernard Trendor, Office of Economic and Statistical Research, communication from 04/09/2002).

In the absence of more recent – or more regionally specific – data, a selection of transactions recorded in the Northern Statistical Division’s input-output tables for 1989/90 is shown in Table 4.6. The data provide information about the supply and disposal of industry output and describe the structure of, and interrelationships between, regional industries. The transactions refer to real flows, or the physical movement of goods and services from local producers or imports to other producers or final demand (Government Statistician’s Office, 1996).

If one wishes to know which industries purchase the output of a particular sector (eg Sugar cane), then one needs to look along the relevant row. For example, the ‘Sugar cane’ row of Table 4.6 shows that the food manufacturing industry purchased 249.9 million dollars worth of sugar products from the sugar industry in 1989/90 and that the sugar industry purchased 3.5 million dollars worth of sugar products from itself during that same period.
Table 4.6: Value of transactions between industries

(Values are direct allocation of competing imports, basic values ($ million), Source: Government Statistician’s Office, 1996, data for 1989/90)

<table>
<thead>
<tr>
<th></th>
<th>1b Meat cattle</th>
<th>2a Cereal grains</th>
<th>2b Other Agriculture</th>
<th>2c Sugar cane</th>
<th>2e Fishing</th>
<th>3b Other mining</th>
<th>4a Food manufacturing</th>
<th>4f Metals, metal products</th>
<th>9a Finance, property and business services</th>
</tr>
</thead>
<tbody>
<tr>
<td>1b Meat cattle</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>72.4</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2a Cereal grains</td>
<td>0.3</td>
<td>0.1</td>
<td>0.3</td>
<td>-</td>
<td>-</td>
<td>2.4</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2b Other Agriculture</td>
<td>1.9</td>
<td>0.1</td>
<td>0.1</td>
<td>5.2</td>
<td>-</td>
<td>6.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2c Sugar cane</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3.5</td>
<td>-</td>
<td>249.9</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2e Fishing</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.1</td>
</tr>
<tr>
<td>3b Other mining</td>
<td>-</td>
<td>-</td>
<td>0.9</td>
<td>-</td>
<td>31.5</td>
<td>214.2</td>
<td>0.1</td>
<td>-</td>
<td>4.5</td>
</tr>
<tr>
<td>4a Food manufacturing</td>
<td>1.3</td>
<td>0.5</td>
<td>0.0</td>
<td>6.4</td>
<td>4.7</td>
<td>73.3</td>
<td>0.5</td>
<td>8.5</td>
<td>129.7</td>
</tr>
<tr>
<td>4f Metals, metal products</td>
<td>-</td>
<td>-</td>
<td>0.2</td>
<td>0.4</td>
<td>5.7</td>
<td>8.5</td>
<td>129.7</td>
<td>0.7</td>
<td>-</td>
</tr>
<tr>
<td>9a Finance, property and business services</td>
<td>2.2</td>
<td>0.3</td>
<td>3.0</td>
<td>20.8</td>
<td>0.4</td>
<td>19.4</td>
<td>6.1</td>
<td>6.4</td>
<td>86.6</td>
</tr>
</tbody>
</table>

If one is interested in where industries source their inputs, one needs to look down the columns of the table. For example, the ‘Sugar cane’ column of Table 4.6 shows that during 1989/90 the sugar industry purchased: 5.2 million dollars worth of goods from ‘other agriculture’; 3.5 million dollars worth of goods from itself; 6.4 million dollars worth of goods from the food manufacturing sector; and 20.8 million dollars worth of goods from the finance, property and business-service sector. This clearly shows the importance of inter-industry linkages. Downturns in one sector of the economy affect other sectors, to varying degrees of significance. If, for example, there were a downturn in the sugar industry, then one would expect the ‘finance, property and business services sector’ to suffer more ‘collateral damage’ than the fishing sector.

The transaction tables also allow examination of how different sectors distribute revenue across the economy – as shown in Table 4.7.
Table 4.7: Industry distribution of revenues between wages, salaries and supplements and ‘gross operating surplus’
(Values are in ($ million), Source: Government Statistician’s Office, 1996, data for 1989/90)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Total value of production ($ m)</th>
<th>Wages, salaries and supplements ($m)</th>
<th>Wages, salaries and supplements as a proportion of total production (%)</th>
<th>Gross operating surplus ($m)</th>
<th>Gross operating surplus as a proportion of total production (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1b Meat cattle</td>
<td>80.1</td>
<td>9.7</td>
<td>12.1</td>
<td>41.6</td>
<td>51.9</td>
</tr>
<tr>
<td>2a Cereal grains</td>
<td>3.9</td>
<td>0.2</td>
<td>5.1</td>
<td>1.5</td>
<td>38.5</td>
</tr>
<tr>
<td>2b Other Agriculture</td>
<td>127.2</td>
<td>32.4</td>
<td>25.5</td>
<td>39.2</td>
<td>30.8</td>
</tr>
<tr>
<td>2c Sugar cane</td>
<td>253.4</td>
<td>16.3</td>
<td>6.4</td>
<td>108.0</td>
<td>42.6</td>
</tr>
<tr>
<td>2e Fishing</td>
<td>25.6</td>
<td>2.8</td>
<td>10.9</td>
<td>6.2</td>
<td>24.2</td>
</tr>
<tr>
<td>3b Other mining</td>
<td>357.6</td>
<td>65.2</td>
<td>18.2</td>
<td>90.1</td>
<td>25.2</td>
</tr>
<tr>
<td>4a Food manufacturing</td>
<td>788.8</td>
<td>97</td>
<td>12.3</td>
<td>66.3</td>
<td>8.4</td>
</tr>
<tr>
<td>4f Metals, metal products</td>
<td>655.8</td>
<td>70.9</td>
<td>10.8</td>
<td>77.8</td>
<td>11.9</td>
</tr>
<tr>
<td>9a Finance, property and business services</td>
<td>526.2</td>
<td>149.0</td>
<td>28.3</td>
<td>55.3</td>
<td>10.5</td>
</tr>
</tbody>
</table>

Most evident in Table 4.7 is the variation across sectors: in the ‘Finance, Property and Business Services’ sector and in the ‘Other Agriculture’ sector more than 25% of the total value of production is distributed as wages, salaries of supplements. In contrast, less than 10% of the total value of production is distributed as wages, salaries or supplements in the Sugar-cane sector and in Cereals and Grains. In those industries, a larger share is retained as gross operating surplus.

Many of these differences in the distribution of revenues arise because of different company structures. On occasion, they make little difference to the regional economy. For example, a large proportion of grazing properties are family businesses (see section 6). Whether or not revenues are distributed as wages or as gross-operating surplus is essentially irrelevant: the money remains within the local community. In some sectors however, these differences may be important – as when the sectors are dominated by large national or international firms. In these cases revenues retained as gross operating surplus are frequently ‘exported’ interstate and/or overseas, bringing little benefit to regional economies.
4.5.2 Output and employment multipliers

Multiplier effects are commonly estimated through a technique called input-output analysis, which measures the impact of changing demand in any industry throughout the (regional) economy. It can trace the resources and products within the regional economy and show, for example, the interdependence between various sectors of the economy or the effects of government spending (Midmore 1991). It can identify monetary and employment multipliers as well as leakage out of the regional economy (Robinson 1997, Hubbard and Brown 1979).

Knowing the monetary and employment multiplier effects of different (natural resource based) industries can assist the process of prioritising alternative directions of development for the regional community.

In the absence of recent North-Queensland specific data, Table 4.8 and Figure 4.7 present multipliers of industries for the Kimberley region in Western Australia. The purpose is to provide an impression of the size of multiplier values and the relativity between industries. While geographically remote, the Kimberley is not dissimilar to the Burdekin region in terms of its focus on natural resource-based industries and its remoteness from the state capital. While individual values may not be directly transferable from the Kimberley to the Burdekin region due to differences in economic and institutional structure, the relative values might still be relevant.

Table 4.8 shows output multipliers for selected industries. The values for the Kimberley region are presented in the first column. Output multipliers show how much regional output will increase from a one dollar increase in demand for each industry’s output. The figure includes the initial one-dollar increase in that industry’s output.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Kimberley</th>
<th>WA</th>
<th>Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grains</td>
<td>1.29</td>
<td>1.65</td>
<td>2.54</td>
</tr>
<tr>
<td>Beef cattle</td>
<td>1.37</td>
<td>2.33</td>
<td>2.38</td>
</tr>
<tr>
<td>Commercial fishing and aquaculture</td>
<td>1.37</td>
<td>2.05</td>
<td>2.56</td>
</tr>
<tr>
<td>Non-ferrous metal ores</td>
<td>1.48</td>
<td>2.03</td>
<td>2.46</td>
</tr>
<tr>
<td>Accommodation, cafes and restaurants</td>
<td>1.51</td>
<td>2.62</td>
<td>3.12</td>
</tr>
<tr>
<td>Health services</td>
<td>1.68</td>
<td>2.51</td>
<td>2.92</td>
</tr>
<tr>
<td>Education</td>
<td>1.75</td>
<td>2.61</td>
<td>3.06</td>
</tr>
<tr>
<td>Weighted Average</td>
<td>1.53</td>
<td>2.29</td>
<td>2.73</td>
</tr>
</tbody>
</table>

(Source: Johnson, 2001: 24)
As noted earlier, the economy-wide impact of a change in one industry is equal to:

\[
\text{the initial impact} \times \text{the multiplier}
\]

The average regional output multiplier for the Kimberley region is 1.53. This means that if the output of one sector changes by, say, $10.00, then regional output will change by $15.30 ($10.00 \times 1.53).

It is also interesting to note that the output multipliers for Australia are larger than those for the state, which are larger than those for the region. This is true for all sectors, and will be true of most regions. This is because regions are less self-sufficient than states or nations, with higher levels of ‘leakage’ occurring from small regions through the import of inputs and exports of services and products with value adding occurring in other parts of the state and/or country.

Finally, it is important to note that the economic flow-on effects for service industries are almost double that of agricultural industries.

Figure 4.7 shows employment multipliers of sectors for the Kimberley region. The initial effects multiplier indicates how many persons are employed per 1000 dollars turnover of an industry. The total multiplier shows the economy-wide change in employment which is likely to be generated in response to an initial change.

Figure 4.7: Employment multipliers for selected industries in the Kimberley region, 1996
(source: Greiner et al., 2001)
The generic message from the data is that the employment multipliers in a regional community are relatively large for agriculture. This is particularly so when compared to other industries like mining. For example, the gazing industry employed 14 persons per one million dollar of output directly (blue bar for beef cattle), with an additional three jobs generated in other sectors of the regional economy, totalling 16 jobs per one million dollars of output (red bar). The comparative values for non-ferrous metal ores are three jobs for the initial effect and six jobs in total.

High agricultural multipliers indicate that the economies of many rural shires within the Burdekin are somewhat ‘fragile’. The economies are heavily dependent upon agriculture for their employment. Hence, the total impact on employment of any changes of income in the agricultural sector can be expected to be substantial; not only is the initial impact large, but so too is the multipliers.

Personal services, education and health also have higher employment multipliers but these are not particularly relevant to the rural shires (which have such a small proportion of their workforce in these sectors). They are, however, relevant to the urban centres of Townsville/Thuringowa. Urban centres are much less likely to experience wildly fluctuating incomes. First, personal services, education and health are far less volatile than agriculture. Second, the urban economies are much more diverse than the rural ones. Third, urban economies are much larger than rural economies. In rural shires, a decline in one sector may severely impact upon the entire economy. In urban shires a decline in one sector would impact upon the economy. The entire economy is unlikely to be ‘severely’ impacted unless there were a decline in several sectors at once.
5 Agriculture and other natural-resource based activities

Section summary

Grazing is the predominant land use across the Burdekin Dry Tropics while dryland and irrigation cropping is restricted to relatively small areas. Yet, crops contribute about twice as much value to regional GDP as livestock. This is due to a large variation in land productivity between different areas within the region, which ranges from $400 per hectare for the Burdekin and Mirani shires to as little as $10 per hectare for the Dalrymple and Jericho shires.

Land productivity is also extremely variable over time. All shires within the region experience large fluctuations, with the per-hectare value of agricultural production rising (and falling) as much as 30% from one year to the next.

Fluctuations in land productivity in combination with large variation in product prices cause farm incomes to fluctuate widely. ABARE farm survey data for properties in the Burdekin catchment show that profits have oscillated sharply over the past 25 years, also in response to highly variable production expenses, specifically for livestock purchases.

Over the past 25 years the total value of capital has steadily increased (albeit with short-term fluctuations). Most of the rise is attributable to a steady and rapid increase in the value of land. The value of plant and equipment has decreased markedly, while the value of livestock has gone up and down (recent trends are upwards).

Over that same period there has been a general trend of rising debt and falling equity. While farm equity has remained generally high, farms may not be able to service debt during recurring low-income periods.

Large capital investment, specifically when coupled with debt financing, increases the pressure for intensification of production systems to maintain profitability and returns on investment.

Over the past 25 years profit was negative, on average, in two out of every five years. Farm household income is derived from profit. This means that in many years farm families need to go into or increase debt simply to cover ongoing expenses and stay in business. During such periods landholders do not have the financial capacity to engage in significant investment, let alone NRM innovation, despite tax incentives and the prospect of generating returns on investment at some point in the future. The extreme variability in farm incomes makes the implementation of NRM policy all the more difficult, since it is apparent that timing is a vital component success.

Tourism in the Burdekin region is in a fledgling state. There is little supply and little demand and there are few attractions. However, there are niche opportunities for farm-based and other nature-based tourism activities. This also provides an exciting challenge to NRM with issues ranging from access to natural resources to point-source pollution to multiple-use management.

Mining is a small-scale, high-impact activity in the landscape in contrast to the other natural resource-based industries, whose impacts are much more extensive and diffuse. High priority management issues for this industry are associated with optimal exploitation rates of the non-renewable resource and operational optimisation, rather than NRM issues. Gross operation surplus from mining generally leaves the region.
Whenever changes are made to the planning, policy and investment environment in which industries operate, people are worried about the effects on their incomes and jobs. Potential economic changes are the source of much resistance to change and the adoption of innovation. Change in NRM policy and planning may be perceived as potentially threatening by reducing options for responding to opportunities and dealing with risk.

It is important for natural resource management bodies to understand the economic fabric of the industries that their policies and decisions are likely to affect, and to consider the potential implications for the people employed in these industries and their families.

In the context of natural resource management in the Burdekin region, agriculture is the most important industry to consider because it is the most extensive land user and because changes to the policy environment of NRM are likely to affect the many people employed in agriculture and their families in a most immediate fashion.

Agriculture is the most extensive land user with about 98% of the Burdekin Dry Tropics area under agricultural production. To that effect, this chapter offers a detailed insight into agriculture with specific emphasis on rangeland systems and spatial variation across the catchment. Historical context is provided and, where possible, a picture painted of industry relationship to the natural resources and environment. Comparative information for mining, tourism and other nature-based industries is provided in the later parts of this section.

5.1 Industry performance for agriculture

Agriculture in the Northern Statistical Division was worth, at factor prices, in excess of $500 million in 2000/01 (Table 5.1). Gross value of agricultural production for the Burdekin region, (i.e. the eight LGAs that most closely represent the Burdekin River catchment) was estimated to be almost $650 million in 1989/90. This was equivalent to about 10% of agricultural gross value for Queensland while the area represents about 9% of the State (Table 5.1).

Production values vary greatly between rural LGAs in the Burdekin region (Table 5.1). Similarly, the source of agricultural income, whether from cropping and grazing, shows large spatial variation. More than one third of the regional agricultural gross value (33.7%) for 1998/99 was produced in the Burdekin shire. Here, cropping generates 96% of value. Bowen shire contributed a further 25% gross value, also predominantly from cropping. Agriculture in other parts of the Burdekin region is based on beef production from grazing. More than 90% of value of agricultural production in Dalrymple, Jericho and Nebo shires is derived from livestock disposals. These shires contributed five, seven and four per cent to regional production value from agriculture, respectively.

Figure 5.1 shows the total value of agricultural production per head of population for the LGAs in the Burdekin Dry Tropics region. In all rural LGAs the value of agricultural production per head of population was substantially higher than both the Queensland and Australian averages (1994) of $1,680 and $1,310, respectively. In Jericho shire agriculture earned almost $22,000 per resident person in 1997.
Table 5.1: The value of agricultural production
(source: OESR 2002, data for 1998-99)

<table>
<thead>
<tr>
<th>Location</th>
<th>Gross value of agricultural production ($m)</th>
<th>Gross value of livestock disposals ($m)</th>
<th>Gross value of livestock products ($m)</th>
<th>Gross value of crops ($m)</th>
<th>Proportion of gross value from livestock (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belyando (S)</td>
<td>92.8</td>
<td>45.1</td>
<td>0.0</td>
<td>46.7</td>
<td>49.7</td>
</tr>
<tr>
<td>Bowen (S)</td>
<td>159.1</td>
<td>33.2</td>
<td>1.5</td>
<td>124.4</td>
<td>21.8</td>
</tr>
<tr>
<td>Burdekin (S)</td>
<td>240.7</td>
<td>9.1</td>
<td>0.1</td>
<td>231.5</td>
<td>3.8</td>
</tr>
<tr>
<td>Charters Towers (C)</td>
<td>19.2</td>
<td>18.9</td>
<td>0.1</td>
<td>0.2</td>
<td>99.0</td>
</tr>
<tr>
<td>Dalrymple (S)</td>
<td>34.6</td>
<td>33.6</td>
<td>0.0</td>
<td>1.0</td>
<td>97.1</td>
</tr>
<tr>
<td>Jericho (S)</td>
<td>27.3</td>
<td>27.1</td>
<td>0.0</td>
<td>0.2</td>
<td>99.3</td>
</tr>
<tr>
<td>Mirani (S)</td>
<td>47.2</td>
<td>2.6</td>
<td>3.6</td>
<td>41.0</td>
<td>13.1</td>
</tr>
<tr>
<td>Nebo (S)</td>
<td>24.9</td>
<td>22.9</td>
<td>0.0</td>
<td>2.0</td>
<td>92.0</td>
</tr>
<tr>
<td>Burdekin region</td>
<td>645.8</td>
<td>192.5</td>
<td>5.3</td>
<td>447.0</td>
<td>30.8</td>
</tr>
<tr>
<td>Queensland</td>
<td>6384.3</td>
<td>2274.2</td>
<td>567.3</td>
<td>3542.8</td>
<td>44.5</td>
</tr>
<tr>
<td>Eight Shires as a % of Queensland’s Total</td>
<td>10.1%</td>
<td>8.5%</td>
<td>0.9%</td>
<td>12.6%</td>
<td></td>
</tr>
</tbody>
</table>

Figure 5.1: Value of agricultural production ($000) per resident for LGAs, 1997
ABARE (2001:31) reports that Australia’s mean gross domestic product per person was $31,400 during 1998-99. Despite differences in reference year, this suggests that a very large share of GDP per person is derived from agriculture in the rural shires of the Burdekin Dry Tropics region. This is not true of the urban shires. Again, it is evident that agriculture is vitally important to some shires, and less significant to others.

Much of the spatial variation is due to the different economic structure of shires in the Burdekin: an urban/rural divide. Within the rural shires, however, spatial variation can be at least partially attributed to variation in land productivity or land use efficiency. Efficiency is often measured in terms of value of agricultural production per hectare of agricultural land. Figure 5.2 refers production values to land area.

Land-use efficiency varies greatly within the Burdekin region. The LGAs with the highest land-use efficiency were Burdekin and Mirani shires, where value of agricultural production for 1997 was $395 and $372 per hectare of agricultural land, respectively. At the low end of the spectrum, agriculture in Dalrymple shire generated just $5.63 per hectare. The comparative values for Australia and Queensland for 1994 were $51/ha and $38/ha, respectively (OESR, 2002).

The value of agricultural production is subject to seasonal fluctuation. Such fluctuations result from movements of production, predominantly as a result of rainfall conditions, and input and product prices, for example as a result of changes in supply and demand or monetary exchanges rates. The fluctuations can be sharp. Figure 5.3 shows, for the years 1995 to 1997, the value of agricultural production per hectare for the rural LGAs within the Burdekin Dry Tropics region.
In absolute terms, the shire experiencing the largest ‘swing’ of value of production per hectare was Mirani (falling by $50.00 per hectare between 1995 and 1997). It is, however, equally important to consider relative fluctuations as they provide a better indication of the impact on farm income. In Belyando, for example, returns per hectare fell by $4 per hectare, from $22 to $16, between 1995 and 1996. This $4 fall represented a thirty percent reduction in production value (an amount which was recovered in the following year).

White (2000) analysed variations in the gross value of agricultural production in Australia between 1977-78 and 1996-97. He found the value of agricultural production to be highly variable in Northern Australia. He calculated coefficients of variation of farm income in excess of 30% for beef enterprises as well as crops-livestock enterprises. The predominant sources of income variability are changes in the volume of production and price fluctuations.

5.2 Farm business performance

Variability of farm income in the Burdekin is high. Figure 5.4 shows the nominal value of gross receipts and off-farm income for the years 1977/8 to 2000/01 for ABARE survey farms in the Burdekin catchments. 1977/78, 1981/82 and 1995/96 were low-income years. Income in the mid to late eighties was consistently high – 1987/88 having particularly high
receipts in all categories. Receipts from beef cattle sales are the single most relevant factor explaining the variation between years. Off-farm income is generally low, but peaks are evident in years with low farm income.

Some caution is required when interpreting the ABARE data for four reasons. Firstly, the sampling density is rather small with an average 3.7% of the farm population included in the sample. Secondly, the sample varies between years, which may exacerbate variation between years despite the smoothing procedure that ABARE applies (Rasheed and Neeman, 2000). Between 1978 and 2001 there were, on average, 22 farms contributing to the farm survey with variation in sample size between 12 and 51 farms. Thirdly, the rating performed on the sample is in relation to northern pastoral farm-survey region, not the Burdekin catchment. Fourthly, it is important to note that the regular ABARE sample does not include any irrigated farms in the Lower Burdekin. Despite these limitations, the ABARE farm survey data provides the only economic data at the enterprise scale that can reveal key issues and trends.

The success of live cattle export has contributed to recent industry success, not just in the Burdekin but across all of Northern Australia - particularly in the late 1990s. Table 5.2 shows the number of cattle sold into live export for Australia. Figure 5.5 illustrates that...
Townsville port has a varying but significant share in the cattle live export trade, with much of the cattle sourced from the Burdekin.

### Table 5.2: Cattle live export from Australia 1995/96 to 1999/2000.
(Source: Maunsell McIntyre, 2001)

<table>
<thead>
<tr>
<th>Year</th>
<th>Gross Turnoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995/96</td>
<td>565,517</td>
</tr>
<tr>
<td>1996/97</td>
<td>735,919</td>
</tr>
<tr>
<td>1997/98</td>
<td>561,240</td>
</tr>
<tr>
<td>1998/99</td>
<td>566,896</td>
</tr>
<tr>
<td>1999/00</td>
<td>703,453</td>
</tr>
</tbody>
</table>

### Figure 5.5: Market share of ports in export of live cattle from Australia 1995/96 - 1999/2000
(Source: Maunsell McIntyre, 2001)

Figure 5.6 shows the cash expenses of Burdekin dryland farms for the period 1987/77 – 2000/01. Variability in expenses is higher than for receipts. The major factor explaining the variation is livestock purchases, with peak years of livestock influx being 1983/84, 1996/97 and 2000/01. The share of total expenditure going to ‘other’ expenses (which includes items such as interest, rents and rates, freight, handling and marketing, and administration) has been increasing steadily with time.
The variation in income and expenses is expressed in farm profit and rate of return on capital investment. Figure 5.7 shows farm profits over the past 25 years. The Australia-wide recessions of the early 1980s and early 1990s are apparent, but profits and rates of return have been good since the mid 1990s.

The rate of return shown in Figure 5.7 relates to the capital invested in the business. Figure 5.8 shows the estimated value of farm capital and its composition. The late 1970s were a period of considerable capital expansion – most in the form of livestock capital. There was a short period of capital consolidation in the early 1980s, followed by a period (until the mid 1990s) of more or less steady total capital. However, significant shifts in the type of capital occurred during that period. Capital value of land has increased steadily and rapidly, while the value of livestock steadily declined and the value of plant and machinery declined rapidly. Since the mid 1990s, land values have increased very strongly and value of livestock has returned to values in the late 1970s. Total farm capital for 2000/01 was estimated at an average of about $4 million.

The value of land generally reflects its productive capacity. While the general trend for land values in the Burdekin rangelands has followed price trends for beef (Figure 4.2) the magnitude of increase in value of land – from $2000 per sq km in 1978 to $8000 per sq km in 2001 (values normalised for 2001) (Figure 5.9) is quite staggering. While productivity improvements have occurred, this may also be, in part, a reflection of scarcity of land or its increasing accessibility.
Figure 5.7: Farm profit and rate of return for broadacre farms located within the Burdekin catchment
(Source: Data kindly provided by ABARE, 2002)

Figure 5.8: Value of capital for broadacre farms located within the Burdekin catchment
(Source: Data kindly provided by ABARE, 2002)
The increase in land values is significant for the context of NRM in several ways. First, land managers who seek to realise competitive returns on investment will require higher profits. Higher profits may have to come from higher receipts as further cost rationalisation seems unlikely. Second, some people have bought into the industry in recent years and carry high debt. There is an ongoing need to service that debt, and possibly pressure to reduce the risk of low-income years. One way of increasing receipts/income, is to intensify land use – through higher stocking rates and/or shifts into enterprises with higher land-use efficiencies (eg cropping). Intensification has emerged as a major issue for rangeland management and is discussed in detail in section 6.2.

The issue of debt is further explored in Figure 5.10. There is a clear trend of increasing debt over the past 20 years, corresponding to a steady and significant increase in land values since 1977/78. Debts reached a record level of $700,000 in 1996/97. Recent high-income years have seen the level of debt decline to an average of $450,000, and equity levels have recovered to 90% of capital. However, with property sales during 2002 indicating another sharp rise of land values and drought conditions starting to affect the Burdekin region, there is a strong likelihood of declining equity across the industry.

The farm-level economic data presented in this section have important implications for the implementation of NRM policy. Steadily declining agricultural incomes may increase farmers’ inclination to consider more sustainable land management practices on the one hand. On the other hand, the financial capacity of farmers to invest and engage in NRM innovation in years with very low income is very small. The ‘timing’ of policies aimed at improving land management practices may therefore be a vital component of their success.
Social and Economic Issues of NRM in the Burdekin Dry Tropics Region

5.3 Tourism

The statistical description of tourism is difficult and few sources attempt it. For ABS statistical purposes, tourism is regarded as neither an industry nor a sector and, as such, no specific accounts are collected or data compiled, at any spatial scale. The need for tourism to be distinguished in its own right has been recognised and provisions have been made in the ABS Inter-Regional Database (IRDB), but data are as yet not available (ABS 2001). For some important tourist destinations, such as Tropical North Queensland, specific surveys have been undertaken and statistical data collated. However, no special attention has been given to tourism in the Burdekin Dry Tropics region. This section attempts to bring together and interpret the sparse tourism data available for the study area.

Tourism-related economic activities permeate a wide range of recognised industries and sectors to varying degrees. The closest alignment is probably with Accommodation, Cafes and Restaurants as one might reasonably conclude that the vast majority of people staying overnight in a commercial place are a fair way away from home. The match with other industries is less clear. Clearly, tourists like shopping so the Retail trade would receive tourist spending, and tourists go on tours and engage in entertainment, which would come under Cultural and Recreational Services. The proportion of those industry incomes attributable to tourist spending, however, remains unknown.

Figure 5.10: Debt and equity for broadacre farms located within the Burdekin catchment
(Source: Data kindly provided by ABARE, 2002)
Table 5.3 shows that about 6200 tourists were counted during census night in the Burdekin region. 34% and 18% of these tourists were located in Bowen and Burdekin shires, respectively. If compared to resident population, Nebo shires showed the largest share of tourists (22%), followed by Bowen and Dalrymple shires with 16% and 14%, respectively.

About 90% of tourists came from within Australia. Only the Burdekin shire had a proportion of international visitors of over 20%.

**Table 5.3: Domestic and international tourists in the Burdekin region, 31 August 2001**  
(Source: ABS: 2002)

<table>
<thead>
<tr>
<th>Enumerated population</th>
<th>Tourists</th>
<th>Proportion domestic tourists (%)</th>
<th>Proportion internat. tourists (%)</th>
<th>Tourists in proportion to population (%)</th>
<th>Share of regional tourists (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belyando (S)</td>
<td>9,883</td>
<td>815</td>
<td>98</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Bowen (S)</td>
<td>13,698</td>
<td>2,129</td>
<td>88</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Burdekin (S)</td>
<td>18,486</td>
<td>1,142</td>
<td>78</td>
<td>22</td>
<td>6</td>
</tr>
<tr>
<td>Charters Towers (C)</td>
<td>8,492</td>
<td>559</td>
<td>93</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Dalrymple (S)</td>
<td>3,853</td>
<td>542</td>
<td>87</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Jericho (S)</td>
<td>1,021</td>
<td>106</td>
<td>97</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Mirani (S)</td>
<td>5,220</td>
<td>336</td>
<td>88</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Nebo (S)</td>
<td>2,529</td>
<td>552</td>
<td>99</td>
<td>1</td>
<td>22</td>
</tr>
<tr>
<td>Burdekin region</td>
<td>63,182</td>
<td>6,181</td>
<td>89</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Queensland</td>
<td>3,655,139</td>
<td>276,077</td>
<td>75</td>
<td>25</td>
<td>8</td>
</tr>
<tr>
<td>Australia</td>
<td>18,972,350</td>
<td>910,368</td>
<td>78</td>
<td>22</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 4.1 shows a relatively small contribution of 3.3% by the Accommodation, Cafes and Restaurants industry to the regional accounts, less than half of the State average. This is an indication of the fledgling state of tourism at the regional scale, even though there are areas within the region where tourism is significant (eg Townsville/Thuringowa). The lack of tourist establishments across the Burdekin region is illustrated in Table 5.4. The Office of Economic and Statistical Research (OESR, 2000) recorded just 15 accommodation establishments across the region with a capacity of just over 400 guest rooms. This capacity was contained in Belyando shire, Burdekin shire and Charters Towers.

Table 5.4 also includes a row for ‘Townsville’; this is the generic name used in the OESR tourism literature when referring to Townsville/Thuringowa within the Northern Tourism Region.

The Northern Tourism Region coincides with the Northern Statistical Division. It would not normally be considered a good ‘overlap’ of the Burdekin Dry Tropics Area (which spans two other statistical divisions). Nevertheless, tourism in other areas of the BDTR does not appear significant – hence figures relevant to the Northern Tourism Region may provide an adequate representation of the area of interest.
Tourism Queensland estimates that a total of 997,000 domestic visitors came to the region during the year ending September 2001, each staying an average of 4.6 nights. International visitors numbered 149,758 for the same period, and stayed an average of 7.5 nights. Takings from accommodation were $44.3 million. The Office of Economic and Statistical Research (2002) estimates that Tourism GRP in the northern region was close to $290 million in 1998-99, accounting for more that 5.1 percent of the gross regional product of the Northern Statistical division ($5645 million). Again it is clear that tourism is an important, albeit fledgling sector of the economy.

Table 5.4: Regional Tourism  
(Source: OESR 2002, data for the 12 months ending March, 2001)

<table>
<thead>
<tr>
<th>Establishment</th>
<th>Accommodation Establishments</th>
<th>Guest Rooms</th>
<th>Average Occupancy Rate (%)</th>
<th>Takings from accommodation ($m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belyando(S)</td>
<td>5</td>
<td>136</td>
<td>52.7</td>
<td>2.0</td>
</tr>
<tr>
<td>Bowen(S)</td>
<td>6</td>
<td>185</td>
<td>39.9</td>
<td>1.6</td>
</tr>
<tr>
<td>Burdekin(S)</td>
<td>4</td>
<td>103</td>
<td>49.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Charters Towers(C)</td>
<td>4</td>
<td>103</td>
<td>49.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Dalrymple (S)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jericho (S)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mirani(S)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nebo(S)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Townsville</td>
<td>39</td>
<td>1995</td>
<td>51.9</td>
<td>35.6</td>
</tr>
<tr>
<td>Northern Tourism Region (corresponding to the Northern Statistical Division)</td>
<td>54</td>
<td>2418</td>
<td>49.7</td>
<td>42.7</td>
</tr>
<tr>
<td>Queensland</td>
<td>957</td>
<td>52,523</td>
<td>55.9</td>
<td>1,162.8</td>
</tr>
</tbody>
</table>

The inland sections of the Burdekin region offer tourist and essentially nature-based experience, with the exception of Charters Towers, where tourism is heritage-based. There are very few conservation areas or national parks in the region (Roth et al., 2000), so there seems little appeal to nature-based tourists. There are examples of farm stays, offering B&B or farm experiences or accommodation and tours for commercial tours. There are also ideas about improving signage and information to encourage more drive tourism through different parts of the region.

This is some evidence that people are exploring business opportunities associated with tourism in the region, building on the natural assets. Tourism is as yet, a minor issue for NRM but as an important user of natural resources, it is important to consider existing and potential future demands and impacts in NRM planning.
5.4 Mining

As is apparent from the material presented in chapters 3 and 4, mining is vitally important to several shires within the Burdekin Dry Tropics Area. In Belyando and Nebo shires’ the sector employs more than 40% of all workers (Table 4.2) and its importance as an employer has risen over the past decade in Charters Towers.

Table 5.5 lists mines within the region. In a social sense, the listing characterises mining as a point source of employment. This corresponds to a characterisation in a biophysical sense as point extractor and, potentially, point source pollutant.

Mining is further characterised in an economic sense by (1) high leakage – meaning a relatively high proportion of production factors into the region and export of products and gross operating surplus out of the region; and (2), a low employment ratio – meaning that it employs fewer people in relation to turnover than any other industry.

The regional benefits from growth in this industry are therefore lower than for the same value growth in any other industry (Crough and Christophersen, 1993). The majority of resource rents, in terms of economic and employment benefits from mining, are captured at a state and national level. The majority of gross operating surplus, due to the mines belonging to large national and international corporations, leaves the regional economy. There is value-adding to raw mining products happening in processing industries based in Townsville and Thuringowa. However, this is only in relation to nickel and copper, not any of the other metals extracted in the Burdekin mines.

Table 5.5: Mineral mines and quarries in the Burdekin catchment, 1999-2000

<table>
<thead>
<tr>
<th>Name of mine</th>
<th>Commodity</th>
<th>Location</th>
<th>Mining method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charters Towers</td>
<td>Gold, silver</td>
<td>0.9 km east-south east of Charters Towers</td>
<td>Underground</td>
</tr>
<tr>
<td>Far Fanning</td>
<td>Gold</td>
<td>100 km south-west of Townsville</td>
<td>Open cut</td>
</tr>
<tr>
<td>Hadleigh Castle</td>
<td>Gold, silver</td>
<td>29 km west of Ravenswood</td>
<td>Open cut</td>
</tr>
<tr>
<td>Highway-Reward</td>
<td>Copper</td>
<td>33 km south-south-west of Charters Towers</td>
<td>Open cut</td>
</tr>
<tr>
<td>Mount Leyshon</td>
<td>Gold, silver</td>
<td>24 km south of Charters Towers</td>
<td>Open cut</td>
</tr>
<tr>
<td>Nolan's Sarsfield</td>
<td>Gold, silver</td>
<td>1.4 km south-east of Ravenswood</td>
<td>Open cut</td>
</tr>
<tr>
<td>Pajingo Vera Nancy</td>
<td>Gold, silver</td>
<td>72 km south of Charters Towers</td>
<td>Underground</td>
</tr>
<tr>
<td>Puzzler Group</td>
<td>Gold, silver</td>
<td>13.5 km east of Charters Towers</td>
<td>Underground</td>
</tr>
<tr>
<td>Wirralie</td>
<td>Gold, silver</td>
<td>7.5 km north-west of Wirralie Homestead</td>
<td>Open cut</td>
</tr>
</tbody>
</table>
Mining is a (relatively) small-scale, high-impact activity in the landscape in contrast to the other natural resource-based industries whose impacts are much more extensive. It is exploiting non-renewable resources and the core management challenge for the industry is to work within economically optimal exploitation rates of the resource and optimise the mine in an operational sense. In comparison, agriculture is based on renewable resources such as soil, water, vegetation and biodiversity are closely embedded in complex ecological and flow systems that need to be carefully managed for the resources to keep supporting viable industries.
Social and Economic Issues of NRM in the Burdekin Dry Tropics Region

6  Natural Resource Management: Regional Issues, Plans and Policies

Section summary

There are a large number of plans, strategies and policies already implemented with the intention of (a) governing the interactions between individuals and businesses with the environment and natural resource base and (b) providing institutions for administering NRM related processes. The existing policy framework is highly complex, and in many cases characterised by overlap between institutions developed at various levels and inefficiency through lack of monitoring, enforcement of incentives.

Interventions into the way in which landholders manage their land and water resources need to consider the complexity of all factors influencing management decisions. Good consistent policy is cognisant of the full range of instruments available and general criteria and design principles.

Managing rangelands means managing complex systems and dealing with multiple sources of risk. Management systems are the product of historical developments, long-term trends of economic and environmental conditions, short-term circumstances of markets and rainfall, policy incentives, and individual characteristics relating to experience, capacity and motivation.

A survey of landholders across the Burdekin catchment revealed a varying degree of implementation of NRM practices across the Burdekin is varying. Adoption of rangeland and grazing management practices is high. Adoption of NRM practices into cropping systems is low. Implementation of specific environmental activities which target biodiversity conservation is highly sporadic.

Climate variability is the single most important constraint that keep landholders them from implementing more NRM practices. In combination with the other major constraints (lack of staff and time, investment and ongoing costs, and lack of government incentives), there is a clear indication that, while farmers are motivated, their financial situation constrains the degree to which they can change towards more sustainable production systems.

Landholders in the Burdekin see large scope for on-farm environmental and financial improvements from a range of NRM activities. Contrary to traditional economic-environmental trade-off theory, landholders expressed a large degree of congruence between both goals. This indicates an appreciation of natural resource condition as basis for farm profitability.

Landholders expressed a perception that most NRM activities could provide some benefit for the Burdekin catchment as a whole, if implementation was to be wide-spread. This is an indication of the need for (1) a strategy involving a suite of activities, which may vary across different sub-regions, to achieve benefits in multiple environmental domains, and (2) the need for concerted and collaborative effort in implementing chosen activities.

The way landholders make decisions and source their information has important implications for the way the BDTB needs to engage and communicate with its constituency on the land.
This section considers important drivers of natural resource management, both at the property scale and in a policy sense. It draws on the material presented in the other sections of this report as well as in the report by Roth et al., (2003), which described many of the natural resource management issues in the Burdekin catchment from a bio-physical perspective.

The section specifically covers the planning and policy framework for NRM in the Burdekin Dry Tropics as well as providing an important overview of policy instruments, design principles and evaluation criteria. (section 6.1). It provides an in-depth understanding of the complexity of rangelands management (section 6.2), details important information on landholder characteristics and attitudes and draws conclusions what this means for NRM planning in the Burdekin (section 6.3) and, comments on how the Burdekin Dry Tropics Board and other organizations can communicate NRM content more effectively to the landholder community (section 6.4).

6.1 NRM policies

6.1.1 Policy context

There is an abundance of strategies, guidelines and policy statements in place, which are relevant to NRM in the Burdekin Dry Tropics. Table 6.1 provides an overview and demonstrates linkages to the Burdekin Dry Tropics regional and subregional strategies. The listing, while comprehensive, does not include all relevant legislation and plans. To name but a few areas of interest:

1. International agreements oblige Australia (and hence those within the Burdekin region) to protect wetlands and habitats;
2. National agreements and strategies direct the management of pests, weeds, wetlands, rangelands and the Great Barrier Reef;
3. State plans and policies provide guidance on wastewater, tree-clearing, aquaculture, floodplains and wetlands;
4. Regional plans consider pest management, floodplains, soil erosion, biodiversity, water allocations, and socio-economic development; and
5. Local plans focus on tree-clearing, stormwater, and revegetation.

There is considerable overlap of policies between different levels of management (from local to international). There are, for example, multiple plans, strategies and/or guidelines for the protection and management of wetlands. Policy also commonly have unintended side-effects that can end up working against the intended goal. The NRM effects of drought policy (discussed in section 6.2) falls into this category. There are regulations that, in principle, enable achievement on many NRM objectives but, in practice, fail to achieve their goals through lack of monitoring or enforcement, or lack of incentives for implementation. Despite the huge variety of plans and polices aimed to guide NRM, few consider the problem from a holistic perspective, instead focusing on a singular aspect of a complex problem. Fewer policies consider community attitudes.

Phase 1 of the Burdekin Catchment condition study by Roth et al., (2003: p20ff) provides a synopsis of current NRM planning initiatives of relevance for the Burdekin catchment.
### Table 6.1: Strategies, guidelines and policy statements and their links to the Burdekin Dry Tropics regional and sub-regional strategies

<table>
<thead>
<tr>
<th>Strategies, Guidelines And Policy Statements</th>
<th>Links To The Burdekin Dry Tropics Regional And Subregional Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local:</strong></td>
<td></td>
</tr>
<tr>
<td>Burdekin Shire Council Planning Scheme</td>
<td>(1) Provides background information on Shire Characteristics used to inform planning intentions (2) for the Shire's future development.</td>
</tr>
<tr>
<td>Strategic Plan (1997)</td>
<td></td>
</tr>
<tr>
<td>Burdekin Shire Land Protection Plan (1998)</td>
<td>Provides a strategic plan with linkages to ICM and Local Govt Strategic Plans for improved management of prioritised pest species within the Burdekin Shire</td>
</tr>
<tr>
<td>Townsville City Council Planning Scheme (currently under review)</td>
<td>Aims at facilitating the proper use and management of land and resources in Townsville while promoting, among others, environmental welfare</td>
</tr>
<tr>
<td><strong>Regional:</strong></td>
<td></td>
</tr>
<tr>
<td>An Economic/Ecological Strategy for the Burdekin Coastal Regions (1993)</td>
<td>Examines long term planning issues and economic opportunities for the Burdekin Shire considering the resource base and ecological characteristics of the area.</td>
</tr>
<tr>
<td>Burdekin Catchment Study RID (In Prep)</td>
<td>Examines and describes the Burdekin catchment and makes recommendations regarding future water use and allocation.</td>
</tr>
<tr>
<td>Don River Floodplain Management Study (1993)</td>
<td>Examines floodplain hydrology of the Don River and adjoining Euri Creek and proposes structural and non structural means to address flooding impacts.</td>
</tr>
<tr>
<td>Economic Development Strategy for the Bowen Shire</td>
<td>Strategic plan for social and economic development of Bowen Shire</td>
</tr>
<tr>
<td>Preliminary Draft Planning Scheme for the city of Thuringowa (2001)</td>
<td>As per IPA requirements</td>
</tr>
</tbody>
</table>
Table 6.1 continued

<table>
<thead>
<tr>
<th><strong>Queensland:</strong></th>
<th><strong>Table Entry</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Code of Conduct for Australian Aquaculture</td>
<td>Provides a set of principles and recommendations to achieve the ecologically and economically sustainable management of aquaculture.</td>
</tr>
<tr>
<td>Development and the conservation of good quality agricultural land (1992)</td>
<td>Provides for the protection of good quality agricultural land from other uses.</td>
</tr>
<tr>
<td>Farm Size Guidelines for Horticultural Cropping in North Queensland (1998)</td>
<td>Provides recommendations on minimum size of horticultural farms to ensure long-term viability.</td>
</tr>
<tr>
<td>Integrated Planning Act (1997)</td>
<td>A major reform in Queensland’s approach to planning and development assessment which allows opportunities for better planning of natural resources.</td>
</tr>
<tr>
<td>Land Use Practices for Wet Tropical Floodplains (1998)</td>
<td>Provides guidelines for agricultural land development on the wet tropical coast that is sustainable and with minimal adverse impacts.</td>
</tr>
<tr>
<td>Qld State Coastal Management Plan (2001)</td>
<td>Describes how the coastal zone is to be managed as required by the Coastal Protection and Management Act (1995) and gives policy direction for managing major coastal issues.</td>
</tr>
<tr>
<td>Queensland Decade of Landcare Plan (1992)</td>
<td>Sets out a 10-year plan for achieving viable agricultural and pastoral systems while conserving natural resources and protecting the environment.</td>
</tr>
<tr>
<td>Queensland Wastewater Reuse Strategy (1998)</td>
<td>Provides a framework to maximise reuse of urban, rural and industrial effluents in an efficient, economic and ecologically sustainable way.</td>
</tr>
<tr>
<td>The Environmental Code of Practice for Agriculture</td>
<td>Provides guidance for agricultural practices to comply with the General Environmental Duty of Care (Environmental Protection Act 1994).</td>
</tr>
</tbody>
</table>
### Table 6.1 continued

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Protection and Biodiversity Conservation Act (1999)</td>
<td>States that actions that are likely to have a <strong>significant impact on a matter of national environmental significance</strong> are subject to a rigorous assessment and approval process.</td>
</tr>
<tr>
<td>Intergovernmental Agreement on the Environment (1992)</td>
<td>Establishes the ‘ground rules’ under which all tiers of governments will interact on the environment and includes a broad set of principles to guide the development of environment policies in Australia.</td>
</tr>
<tr>
<td>Keeping it Great: a 25 Year Strategic Plan for the Great Barrier Reef World Heritage Area (1994)</td>
<td>Aims at ensuring persistence of GBRWHA while retaining opportunity for use <strong>consistent with Australia’s international obligations</strong>.</td>
</tr>
<tr>
<td>National Principles For The Provision Of Water To Ecosystems (1996)</td>
<td>Aims at <strong>sustaining</strong> and where necessary <strong>restoring</strong> ecological processes and biodiversity of water dependent ecosystems.</td>
</tr>
<tr>
<td>National Strategy for Ecological Sustainable Development (1992)</td>
<td>Provides for development that improves the <strong>total quality of life</strong>, now and in the future, in a way that maintains the ecological processes on which life depends.</td>
</tr>
<tr>
<td>National Water Quality Management Strategy (1998)</td>
<td>Aims at achieving sustainable use of the nation’s water resources by <strong>protecting</strong> and <strong>enhancing</strong> their quality while maintaining economic and social development.</td>
</tr>
<tr>
<td>Vertebrate Pest Strategy (1993)</td>
<td>Aims at reducing the detrimental impact of vertebrate pests on natural ecosystems and sustainable production.</td>
</tr>
<tr>
<td>International: China-Australia Migratory Birds Agreement (1976)</td>
<td>Obliges Australia to <strong>protect habitats of listed birds</strong> that migrate between the two countries.</td>
</tr>
<tr>
<td>Ramsar Convention (1971)</td>
<td>Obliges Australia to <strong>use all wetlands wisely</strong> and conserve them through land use planning, reservation, research and management.</td>
</tr>
</tbody>
</table>
6.1.2 Policy design, instruments and evaluation

This section provides an overview over criteria for policy evaluation, principles for policy design and a typology of instruments for policy design. It is largely taken from Greiner et al., (1997).

Criteria for policy evaluation

As natural resources have become more scarce, governments have looked into new approaches for environmental management. There are many uncertainties about how to design appropriate administrative systems for achieving environmental objectives. As a matter of general principle, it is very unusual for one instrument to be capable of solving a complex problem. Instead, a mix of instruments is necessary to achieve the desired outcome which requires concerted activities from a range of stakeholders and individuals, and to account for the variability in bio-physical conditions. Questions that require answers are whether direct regulations can and should play a supportive role and whether the introduction of a wider range of incentive instruments needs to be accompanied by a change of administrative arrangements for environmental and resource protection.

Government, financial, administrative and community resources are limited and must be deployed where they are most likely to have the greatest positive impact. Therefore, it is important to assess the strengths and weaknesses of the range of possible incentive instruments in terms of the stated objectives and to identify the circumstances in which they are most likely to make a positive contribution to the outcome sought.

Criteria are required for the design and evaluation of policies. Three core criteria are commonly applied; economic efficiency, equity, and environmental implications. In the literature, this core set is expanded to lists of criteria of varying form and number. The following listing provides a comprehensive listing of those criteria. Some of the criteria are inherently related but may be used to evaluate the policy instrument from different perspectives.

1. Effectiveness and dependability relate to whether an instrument is technically suitable for achieving a specified goal and whether it will deliver a desired target even when knowledge about likely responses is uncertain. The type of environmental and natural resource system may be critical for the success or failure of particular instruments. Performance indicators are needed to monitor the effects of policies. Complex species and ecological interdependencies in marine ecosystems complicate their management, because they tend to give rise to the need for detailed information and complex enforcement procedures.

2. Precaution is a criterion of utmost importance to the management and use of living natural resources when scientific information about systems behaviour is limited. This is particularly true for marine ecosystems which are far less well researched than land-based natural systems. Complex biological systems do not always show immediate and linear responses to use and management activities but are characterised by threshold behaviour as well as time lags and spatial distance between cause and effect. Precaution assesses whether an instrument avoids the chance of serious or irreversible consequences.
3. **Efficiency** comprises two aspects. (1) It deals with the effects of a policy on industry profitability. In general, productive efficiency of the industry will improve if a policy mechanism allows structural adjustment. (2) It looks at the economic efficiency in a collective sense, assessing the total benefits of the associated change in resource allocation against its total costs.

4. **Continuing incentive and innovation** address the question whether an incentive instrument encourages experimentation and change and provides an ongoing incentive for improvement of industry efficiency and environmental improvement beyond a set target. In general, because they are designed to save costs and improve efficiency in the use of natural resources and the environment, some market-based instruments and administrative systems based on co-management principles provide an ongoing impetus to improve environmental technologies and management practices. They achieve this, in part, by taking advantage of intrinsic motivation. Intrinsic motivation is a characteristic of people who are already complying. Use is made of such motivation to design policy instruments that encourage people who are not complying to change their behaviour, without crowding out the behaviour of intrinsically motivated individuals. Industry and stakeholder involvement in policy design and administration (co-management) is an important aspect of utilising intrinsic motivation. In contrast, regulatory instruments seek to achieve compliance through reward for just-compliance and punishment for non-compliance, thus leading to extrinsic motivation.

5. **Administrative feasibility and cost** evaluates whether there are impediments to putting a policy mechanism into practice, assesses the risk of government and administrative failure, considers transaction costs, and assesses the efforts involved in administering and policing the instrument. In regulatory systems, these costs may be allocated to industry, especially under a policy of self-regulation (which, in turn, needs to be monitored by government or impartial industry associations). Incentive instruments may be set up for the specific purpose of raising revenue to cover administrative costs incurred by government agencies.

6. **Equity** is a criterion that examines the distribution effects of a policy instrument within and among generations. At an industry and individual level, this includes an assessment of who are the winners and who are the losers when a new instrument is introduced and what are the regional employment impacts and flow-ons to other sectors of the economy. The long-term implications of natural resources management decisions lead to the issue of intergenerational equity, asking whether future generations may be disadvantaged by the introduction of a management system. Equity implications with respect to industry and consumer groups are important for the political acceptability of an incentive instrument.

7. **Political and community acceptability** ask whether the policy is consistent with the previous commitments and philosophies of the parties in power and not likely to contribute to the loss of a subsequent election, and whether the industries involved and community in general are willing to support the policy. This criterion addresses the cultural, historic and social understanding of a society. Political acceptability is often linked to the compatibility of a new instrument with existing institutions and the acceptance by all members of parliament. Acceptability is a necessary condition for the durability of a policy. As a general rule, market-based policies minimise political and
bureaucratic rents and the risk of government and bureaucracy failure because they apply to all people (in an industry) equally and in a transparent and durable manner.

Principles for policy design

Just as there are criteria for policy evaluation, there are a few additional principles that need to be considered in policy design. The following list is not exhaustive but includes the most essential paradigms.

1. **User pays and polluter pays.** The increasing awareness that natural resources are scarce and valuable has seen a move away from the notion that society should pay for their provision for production and consumption purposes. Increasingly, the users of resources are having to pay the full cost of being able to use or consume the resource (as is the case with irrigation and domestic water in Australia). The notion that individuals and companies who want to dispose of waste products into the natural environment should pay for this right to the extent that costs arising from negative impacts of this pollution are internalised (i.e. costed by the polluter).

An area where the polluter-pays principle has been successfully applied is air pollution in major industrial centres in the USA. Although reducing external costs is an important aspect of policy design it is equally important to recognise that the reduction in external costs may reduce the social benefits that arise from the private use of resources. The idea here is to achieve a balancing of benefits and costs at the margin. Polluters can be made to pay either via a direct charge or indirectly via the allocation of property rights.

The user pays principle underlies the COAG water reform in Australia, which will see the full cost of supplying water to consumers and (irrigation) industry reflected in the water price.

2. **Cost sharing** is a principle that takes a comprehensive look at all direct and indirect costs and benefits arising from the use of natural resources. In addition, it applies efficiency and equity considerations and requires that those groups in society who benefit from the provision of non-marketable public goods compensate the people who provide these goods. On this basis contributions to be made by individuals, user groups and society are apportioned.

Society pays for those benefits, generated by individuals’ activities, that do not translate into private benefit, and may finance activities that go beyond what is considered a reasonable individual level of duty of care. Industry pays for those aspects which are part of its duty of care for the resources it uses. When duty of care is redefined, some transitional payments may be justified.

3. **Sense of community, ownership, and stewardship.** This principle is closely related to the concept of intrinsic motivation. It acknowledges the fact that individuals are heterogeneous and motivated in their actions by a myriad of philosophies, of which the pursuit of narrow self-interest is but one extreme abstraction. Pure altruism would be another extreme. The overall use of natural resources is the outcome of the sum of individual activities. It is important that individuals who comply with policy objectives for whatever motivational reason be reinforced in their behaviour. Intrinsic motivation
goes beyond pricing and regulation, particularly in the case of open and common property resources.

If incentive instruments want to achieve an improvement in the management of natural resources, it is imperative that they do not crowd out intrinsic motivation, which would result in a reduced effort to satisfy certain standards of environmentally sound behaviour. Many people have an inherent wish to feel that they play an active role in the solution of a problem, rather than being part of the problem. At the same time, reinforcing ‘good’ behaviour may be complemented by mechanisms which sanction the ‘bad guys’ and put pressure on them to comply with environmentally safe standards.

4. **Adaptive systems.** Incentive instruments should be designed so that better information, as it becomes available, can be easily incorporated into the application of the mechanism. It is therefore essential to make provisions for conditions that specify when and how the framework will be reviewed.

5. **Ecosystem approach.** Rather than addressing individual problems by trying to rectify symptoms, it is crucial that systems behaviour be analysed and causes of problems be identified and addressed in a systemic manner. The underlying causes of a problem and its physical reality need to be understood in a holistic manner.

### Types of instruments for policy design

A substantial literature seeks to set up and analyse different classes of policy instruments. Generally, a distinction is drawn between direct regulations and market-based instruments. Regulations are primarily based on legislative and regulatory provisions and are implemented through directives from regulatory authorities. On the other hand, market-based instruments, while supported by legislation, tend to devolve decision making and opportunities for innovation to the market place. They usually allow for adaptive choice and constrained risk-taking by those whose behaviour is to be modified.

Table 6.2 includes the full range of policy instruments that might be used to ensure sustainable management and use of the environment including natural resources. It includes not only economic incentives and regulation but also voluntary approaches, education and community based mechanisms and research. Detailed discussion of these instruments is not provided here. The overview is provided to alert to the wide range of options for policy development.

Once it is acknowledged that a wide range of incentive instruments have legitimate and important roles to play in the management of land and water resources and biodiversity, it is possible to move beyond an ‘either or’ debate and ask how: which current policies provide perverse incentives and therefore must be removed? And: in what circumstances, and in what combinations can regulation, economic mechanisms and other instruments achieve optimal policy outcomes?

Innovative ways of combining multiple instruments to provide incentives for NRM implementation are continually being discussed and explored (for example: The Allen Consulting Group, 2001).
Table 6.2: Taxonomy of policy instruments to support implementation of land and water management activities

(Source: Adapted from Panayotou, 1994)

<table>
<thead>
<tr>
<th>Property Rights</th>
<th>Charges/ Fees</th>
<th>Leases/Licences</th>
<th>Regulations</th>
<th>Financial Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leasehold</td>
<td>Pollution charges</td>
<td>Extraction licences</td>
<td>Permits</td>
<td>Grants</td>
</tr>
<tr>
<td>Private ownership</td>
<td>Entry fees</td>
<td>Harvest licences</td>
<td>Area restrictions</td>
<td>Compensation payments</td>
</tr>
<tr>
<td>(Tradeable) shares</td>
<td>Royalties</td>
<td>Discharge licences</td>
<td>Output controls</td>
<td>Free advice</td>
</tr>
<tr>
<td>(Tradeable) quotas</td>
<td>User fees</td>
<td>Load-based licences</td>
<td>Input controls</td>
<td></td>
</tr>
<tr>
<td>Conservation covenants</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Enforcement</th>
<th>Bonds Deposits</th>
<th>Accreditation</th>
<th>Empowerment</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fines</td>
<td>Security deposits</td>
<td>Status agreements</td>
<td>Third party rights</td>
<td>Education</td>
</tr>
<tr>
<td>Forfeiture of rights</td>
<td>Conditional resource security</td>
<td>Labelling</td>
<td>Rights of access to information</td>
<td>Extension</td>
</tr>
<tr>
<td>Director liability</td>
<td>Assurance bonds</td>
<td>Industry accreditation</td>
<td>Co-management</td>
<td>Research</td>
</tr>
<tr>
<td>Audit</td>
<td>Performance bonds</td>
<td>Prizes</td>
<td>Self-regulation</td>
<td>Monitoring</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Institutional Mechanisms</th>
<th>Tax policy</th>
<th>Leverage Mechanisms</th>
<th>Awards</th>
</tr>
</thead>
<tbody>
<tr>
<td>International conventions</td>
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<td>Awards</td>
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<tr>
<td>Constitutional settlements</td>
<td>Tax deductions for research</td>
<td>Conditional grants</td>
<td>Prizes</td>
</tr>
</tbody>
</table>

6.2 NRM challenges in rangeland systems

The vast majority of land in the Burdekin Dry Tropics is classified as rangelands and utilised for cattle grazing. The expanse of cattle grazing provides a unique set of challenges in relation to NRM as rangelands are the starting place of many diffuse processes, such as sediment, nutrient or salt transportation through the catchment. This section deals with the complexity of rangelands and grazing as a management systems and the specific challenges in trying to ensure the profitability and therefore, ultimately, viability of grazing properties.
6.2.1 **Historical context**

Historically, the development of the pastoral industry in the Burdekin catchment followed the discovery of gold in the 1860s. As the industry expanded from the south, it brought with it the management practices from those regions, and this has had a persistent influence on the development of the local pastoral industry. Often, southern experiences have not been appropriate in the region, and the industry has gradually adapted to the local conditions. Initially sheep were used for grazing, but these quickly proved to be poorly suited to the tropical environment and were replaced with southern breeds of cattle (Quirk et al., 1996). Cattle numbers continued increasing until a peak in 1894 when the arrival of cattle ticks and tick fever lead to a crash in numbers. A series of droughts at the turn of the century lead to the first depression for the local pastoral industry.

Pastoralists have had to overcome a number of challenges in adapting production systems inherited from the south to the northern tropics. The tropical climate is harsher on animals and is more conducive to pests and diseases. While tropical environments tend to be productive in the quantity of forage produced, diet quality is a major problem for animal production. In the long dry seasons, the nitrogen content of forage falls below maintenance levels, with animals tending to loose weight, while in the wet season, phosphorous is usually limiting. The introduction of hardier cattle breeds and feeding supplements (especially since the 1970s) has helped the pastoral industry adapt to local conditions.

The industry has also been adapting to the need to develop sustainable production systems. In searching for these solutions, a number of natural resource management challenges need to be overcome. These include issues with: water quality; dryland salinity; soil compaction and erosion; pasture condition and vegetation change; tree clearing; regrowth and thickening of woody vegetation; the health of river ways and river frontage country; weeds and animal pests; and the loss of habitats and biodiversity. These issues were discussed in the Phase I scoping study (Roth et al., 2002). Here we look at some of the underlying contributors to these problems and the challenges presented in adapting land use practices to overcome them.

6.2.2 **Income variability**

Probably the two most important factors for determining the annual performance of pastoral enterprises are cattle prices and rainfall. These two factors fluctuate, at times quite widely, in ways that are only partially predictable, creating a great deal of uncertainty for management decision making (see Section 4). The ways in which land managers respond to this variation has important implications not only for enterprise performance, but also for natural resource management. As will be shown below, it is the combined effects of these two sources of risk that is important.

**Economic risk**

The single most important determinant of farm income for grazing enterprises is beef cattle price, which is largely determined on international markets. Additional economic risk arises from international exchange rates and domestic factors such as interest rates.
Australia is the world’s largest beef exporter, and currently exports close to 60% of its beef in 2001 (ABS 2002). This makes the Australian beef industry particularly sensitive to market fluctuations, with access to markets dependent on international trade relations. Foreign agricultural policies can play a major part in setting conditions under which produce can be exported and the commodity prices in those markets. Consequently, the markets for Australian beef are far from secure and beef producers tend to be ‘price-takers’ with little influence over beef prices. This poses a significant challenge to beef producers who have to continually manage for the risks and opportunities of the changing markets rather than simply optimising products and production systems for current conditions. For example, in 1970 in Dalrymple shire, 80% of cattle were sold for export to the USA (low grade beef) and 20% were sold for finishing elsewhere (Quirk et al., 1996). Both these markets declined over the next two decades and in 1993, less than 50% of cattle were sold for export to the USA as new opportunities opened up in Japan and Korea (about 15%) and live export (about 40%). Each market demands different qualities in sale cattle, requiring production systems to be adjusted accordingly. Newer premium markets require higher quality cattle, which can only be achieved with higher quality diets (good quality pastures and diet supplements).

There are also short-term fluctuations in beef prices, and these are often predictably related to seasonal peaks in supply and demand. Production systems aimed only at maximizing the quantity of beef produced (weights of cattle at sale) may miss the opportunities of preparing cattle in ‘sub-optimal’ condition for times of peak demand.

**Rainfall variability**

The other major source of uncertainty in pastoral enterprises is the weather, particularly the amount of effective rainfall received each year (the total amount of rainfall and the way it is distributed in individual rainfall events through the year). Inter-annual variation in rainfall is high and presents a continual challenge to sustainable grazing systems (Pressland & McKeon 1989; Brown & Ash 1996). Recommended stocking rates (based on annual rainfall and forage production) can be more than double the long-term average in good years and can fall below half the long-term average in bad years (Pressland & McKeon 1989). It is not economically viable for properties to be de-stocked and re-stocked so drastically, for grazing pressures to be kept in line with fluctuations in forage production. This has the effect that rangelands tend to be overstocked in dry periods (and that long-term sustainable set stocking rates are lower than the average annual rainfall might suggest).

The effects of climate variability are exacerbated in deteriorated pastures where annual species have replaced perennial tussock grasses and soil resources have been depleted. In these systems, there are much greater fluctuations in pasture production and the greatly-reduced effectiveness of moisture in dry years, means that pastures can be rapidly extinguished during droughts. Perennial tussock grasses provide a more stable (less risky) source of forage (even though some deteriorated pasture may give good animal production in wet years; Ash et al., 1995) and their strong root systems help to maintain and efficiently utilise soil resources.

For eastern and north-eastern Australia, much of the variation in climate is associated with the El Nino – Southern Oscillation (ENSO) phenomenon, with wet and dry periods loosely following a 10-year cycle (Gramshaw 1995; Beckman 1998). Droughts have generally been
associated with El Nino events, when waters off the west coast of South America are warm (Gramshaw & Lloyd 1993). The Southern Oscillation Index (SOI) and sea surface temperatures are strongly correlated with rainfall patterns in the Burdekin and have some predictive value in long-term (> 6 month) forecasting (Partridge 1994). By adjusting stock numbers according to advance warnings of the likelihood of rainfall being above normal, normal or below normal, pastoral enterprises can manage for climate variability and improve their performance (McKeon et al., 2000; Ash et al., 2002).

Managers with effective drought-coping strategies emphasise the importance of taking early pre-emptive action (selling off cattle, selective agistment, purchasing of supplements and culling) before conditions on the land get so bad that they are forced to take action. Delayed action not only increases the immediate financial losses (e.g., lower sale prices, more expensive agistment and wasted expenditure on supplements), but also prolongs the long-term impact on the pasture resource when it is most vulnerable.

**Combined effects of market & rainfall variability**

Beef prices influence decision about buying or selling stock, while recent weather conditions affect both animal production and buying/selling decisions. Together therefore, these two factors are critical in influencing the number of cattle on properties. Historically, this has lead to large fluctuations in cattle populations. Sequences of good rainfall years and high cattle prices have often fostered over-optimistic expectations in the industry with cattle numbers building up to unsustainable levels. In Queensland, there were peaks in cattle numbers in the 1890s (7 million cattle), 1920s (7 million) and 1970s (11 million) associated with periods of good years and high beef prices (Gramshaw & Lloyd 1993). There is evidence of an initial reluctance to sell off cattle early in a drought but ultimately droughts and lowered beef prices lead to crashes in cattle populations after these peaks (to less than half of the 1890s peak during the drought of the 1890/1900s). The coincidence of record cattle numbers with severe drought in these boom-and-crash cycles has lead to many of the most severe cases of resource degradation in Australian rangelands (McKeon et al., 2000). It gives cause for concern that the recent run of years with good rainfall and cattle prices has again lead to cattle accumulating to record numbers in the state.

**Climate change**

Any discussion of climate variation is not complete without mention of the likely impacts of climate change. Increasing atmospheric carbon dioxide concentrations and global warming will produce a set of new challenges and opportunities for pastoral enterprises this century. Increasing temperatures will increase heat stress on cattle and increase water losses to evaporation and transpiration (reducing soil moisture and for plant growth and reducing water yields in river catchments). Increasing carbon dioxide levels can boost plant photosynthesis and the efficiency with which plants use water. This will likely offset some of the negative impacts of increasing temperatures and reduced moisture availability, especially during drought years. However, droughts are predicted to increase in frequency and severity with more El Nino-like conditions. Existing statistical relationships underpinning seasonal forecasting may break down under climate change, so improved, mechanistic models are being developed. Many of the adaptations that will be required to deal with climate change, involve adoption of existing recommendations for improved
natural resource management. Increasingly there are calls for climate change to be incorporated in planning of natural resource use and management, rather than being dealt with as an independent issue.

6.2.3 Intensification

The easiest way to increase profits in the short to medium term is to increase stocking rates. Intensification is the effort to generate more production per hectare of land by increasing cattle numbers on the basis of increased inputs into the production process, thereby raising the long-term capacity of the underlying resource base to support these increases in land resources. In contrast, overstocking is a short-term strategy to generate more production without consideration of the state of the resource based. Overstocking is also the single factor most often singled out for rangeland degradation problems (Tothill & Gilles 1992).

For many grazing enterprises, intensification is the strategy of choice for sustaining farm profitability in the face of long-term declining terms of trade. It is estimated that a carrying capacity of at least 2000 to 3000 adult equivalents, is required to maintain a viable enterprise in the short to medium term in the region (Hinton 1993; Quirk et al., 1996). There is strong pressure to overstock properties that are too small to carry this many animals unless a supplementary source of income can be found or the property is consolidated with others into a large enough management unit.

Cost-price squeeze

The beef industry, as with other agricultural enterprises, has been suffering declining terms of trade over the past decades and this trend is likely to continue into the future. Real prices of agricultural commodities continue to decline over time (with little industry influence in setting prices) while production costs continue to rise. Land prices continue to rise and many recent purchasers of land carry high levels of debt. In the beef industry, many practices have been adapted to minimise labour inputs and reduce input costs. To remain viable, there is increasing pressure to intensify production and increase outputs.

In the past, government agencies have sought to support rural producers by assisting with the development of technologies to boost beef production. But throughout the last century there has been a growing awareness in rangelands around the world that efforts to boost production have often only generated the potential for short-term gains and have come at the expense of land deterioration and reduced long-term production capacity (i.e., desertification). Concern with desertification has lead to a shift away from production technologies to an emphasis on sustaining the long-term production potential of the resources. So, at a time when the industry is seeking to intensify production systems, much attention is still spent grappling with how to sustain current levels of production.

Past increases in beef production

Historically, State and Commonwealth land use policies have sought to promote land development and settlement (see section 6.2.5 below). Part of this has been through the role of government agencies in assisting the beef industry to develop practices to improve cattle production. This has included the incorporation of hardy Bos indicus bloodlines into
herds, the use of feed supplements and rumen additives to improve animal nutrition, and tree clearing and the selection of desirable forage plants for pasture improvement to provide forage that is more productive.

Most of these solutions involved removing major environmental constraints on production. Removing these constraints improved production potential, but removed an ecological safety mechanism, allowing production to be increased but also making it easier for the resource to be damaged. Previously, over-utilization of pastures lead rapidly to negative impacts on animals before major deterioration of the resource base occurred and therefore served as feedbacks mechanism to limit resource damage. The innovations have conferred the responsibility to regulate grazing pressures to the grazier.

**Current trends**

There is evidence that intensification has occurred specifically since the mid 1990s (Figure 6.1). The ABARE farm survey data for the Burdekin clearly show that, despite fluctuations, a constant 5-year moving average of about 2200 head was maintained for a 20-year period leading up to 1995/96 and that the 5-year moving average has since increased to about 3200 head of cattle.

![Figure 6.1: Herd size on farms for the Burdekin catchment](Figure 6.1: Herd size on farms for the Burdekin catchment)
(Source: data kindly provided by ABARE, 2002)

This increase in herd size is, in fact, only partially due to intensification. Rather, a process of ongoing consolidation of grazing properties over the past 25 years can be inferred from Figure 6.2. The moving 5-year average for stocking rate shows the variability of stocking rates over time but reveals a trend of decline in the decades leading up to 1995/95 (from about 11 down to 8 head per sq km) followed by a sharp increase back to initial levels. The
period of stocking rate decrease can only be explained by increases in the average size of pastoral properties, while the recent increase is a clear sign of intensification.

![Figure 6.2: Stocking rate for farms in the Burdekin catchment](image)

(Source: data kindly provided by ABARE, 2002)

Interest in intensifying cattle production in the catchment is currently focussed on increasing infrastructure and adoption of more intensive rotational grazing systems (Bortolussi et al., 1999).

Cattle movements and feeding behaviour determine how the forage resource on pastoral properties is utilized. At present, parts of some properties are under-utilized in productivity terms because they are on types of country that cattle tend to avoid or are too far away from sources of water, while other parts of the property that are close to water and in preferred vegetation may be over-used. By evening out grazing pressure across the property, it should be possible boost production from under-utilized areas while alleviating pressure and reducing resource deterioration from over-used areas. As appealing as this principle may appear, achieving these benefits has often proved elusive in practice.

The simplest form of intensification would involve the addition of extra (or more permanent) water points to service parts of the country where cattle do not yet have sufficient water access. Some degree of control over cattle movement could be achieved by switching supply to water points and strategic placement of feed supplements. But the addition of fences provides the greatest control over animal movement, allowing access to sensitive or preferred parts of the property to be restricted (e.g., fencing of river frontage country) while also allowing animals to be forced onto parts of the property they might otherwise avoid.

The most intensified options include the addition of a rotational grazing systems, which involve strategically planned movements of animals between paddocks to control the duration, intensity and timing of grazing and spelling according to the capabilities of the resources in each paddock.
Intensified grazing systems provide the potential for both modest improvements in cattle production and improved natural resource management. There are other less obvious potential benefits too, such as: improved handling, health, breeding and supplemental feeding of livestock; increased interaction with animals (more feedback on their condition and performance); more interaction with the natural resource base (increased observation, awareness, familiarity and feedback on responses of pastures and soils to management decisions); and improved enterprise management planning and decision-making processes (Holechek, Pieper & Herbel 1989).

Options for the use of fire for vegetation management are often limited by the lack of sufficient fuel loads. Increased fencing provides a greater opportunity for strategic use of fire by restricting animal accesses to target areas before (to allow fuel loads to accumulate) and after (to prevent livestock over-utilizing the green pick) burning. Other forms of pasture improvement (e.g., seeding) can also be more easily managed by controlling livestock distribution.

There are important trade-offs and risks associated with intensified grazing systems that need to be considered. Currently, parts of pastoral properties with poor livestock access often act as refuges for grazing-sensitive species, helping to maintain biodiversity. Increases in infrastructure that even out pasture utilization across the property may put these refuges at risk. Intensified grazing systems increase the control that managers have over stock movements but restrict the movement and self-regulating behaviour (e.g., moving off over-utilized country or low quality forage) of livestock. This increases the impact of management decisions (especially since stocking rates are usually higher). This, in turn, provides the opportunity for improved production but also the risk of more severe resource damage from incorrect or short-term decisions. As such, these systems require a much higher level of management expertise to be successful (and avoid potential risks). On the positive side, where this need is recognised it can stimulate enthusiasm and interest among graziers in improving their land management capability and an openness to adopting new management practices to achieve this.

Probably the greatest risk posed by intensified grazing systems is the financial pressure to recoup the substantial capital investments in infrastructure. Increases in infrastructure provide both the means and the pressure to overstock to lift short-term production. Decisions to intensify require a long-term commitment because increases in sustainable production levels are slight and financial planning has to allow for the investments in infrastructure to be returned over long periods (including the risks of wet-dry cycles and fluctuating markets mentioned before). International experiences with specialized grazing systems show that rates of abandonment are often high and that economic benefits may not meet the costs, particularly where the level of infrastructure is excessive relative to pasture production (Holechek, Pieper & Herbel 1989). It takes greater management skill (production, financial and environmental) and restraint for intensified systems to be operated in a sustainable manner, relative to traditional, less intensive options.

Intensification incurs cost increases and positive net economic benefits are not guaranteed in the risky climate of beef production in the dry tropics. This is why conservative stocking is seen by some as an alternative strategy. Conservative stocking rates provide important flexibility for risk/opportunity management to cope with the many market, climate and other uncertainties confronting graziers. In addition, at lower stocking rates, animals can be
more selective in their diets, improving diet quality and energy efficiency. This can reduce the requirement for supplements or allow for production of higher quality beef (providing access to a wider range of markets). However, conservative stocking may only be an option for relatively small pastoral properties in combination with either diversification (e.g., off-farm income or alternative enterprises such as farm-stay tourism) or expansion.

6.2.4 Ecological time scales and complexity

Mismatch between human and ecological time scales

Land managers are caught in a dilemma in that the system they are managing is operating at two very different scales of time. While social, economic and political processes operate at time steps of days to years, ecological and physical processes operate much slower (years to centuries), so responses of ecosystems to human actions are usually not well matched with the timeframes within which human decisions are made. The often long delays between human actions and the ecological responses constitutes a major impediment to the sustainable use of rangelands.

A pastoral enterprise that is both profitable and sustainable can become non-sustainable when economically optimised with discounting of future returns at commercial rates (Wang & Hacker 1997), i.e., future discounting provides an economic incentive for gradual overexploitation of resources. There are indications that managers who have succession plans (and a stronger incentive to maintain the long-term prospects of their enterprise) are more likely to adopt improved land management practices.

The mismatch between human and ecological timescales can also make learning difficult. It is probably easiest for us to learn and modify our behaviour in systems where our actions and the responses to them have immediate and simple cause-and-effect relationships. This is probably true for many of the technical, production and financial aspects of managing pastoral enterprises. But in ecological systems, most responses are the result of multiple, interacting factors with long time lags and many of the events that are important in shaping and maintaining landscapes occur infrequently in human lifetimes (e.g., extreme droughts and fires). It is difficult to attribute perceived pasture responses to the success or failure of management actions when so many other factors are affecting responses and when many of these responses are not immediately obvious (e.g., slow trends, delayed responses, below-ground effects, or off-site impacts).

Spatial complexity

In rangelands, the natural resource condition, constraints and opportunities can vary considerably both between and within properties. Effective property management needs to take into account the variation in resources within and between paddocks and adapt management strategies accordingly.

Spatial variation introduces additional uncertainty, risk and complexity to decision making in rangeland management. In intensive land uses, there are many opportunities to modify the land and homogenise enterprises regionally to suit and simplify the management of agricultural production systems. Extensive land uses such as pastoralism, however, are
characterised more by adapting land use practices to the local land resources. Within rangeland systems there are only limited opportunities for modifying ecological constraints, so the emphasis needs to be on adapting land management practices to fit within them.

Patterns of variation in soils, topography and vegetation within individual properties can present major challenges for management. Different types of country vary in their production potential, ecological constraints, responses to climate events, sensitivity to disturbance, potential for weed invasions, ability to recover from damage and responses to management actions. In addition, cattle tend to show strong preferences for some areas (e.g., river frontage) while avoiding others. Fencing and water points provide an effective means of controlling animal access and levels of utilization to protect sensitive areas, while they also help provide other options for targeted management intervention (discussed above).

Within country types, there is further complexity in the diversity of species, with each species differing in its forage production, forage quality, and the functions and services it provides in the ecosystem. Livestock are selective in their utilization of different pasture species (Ash & Corfield 1998) and with over-utilisation, there are predictable sequences of changes in pasture composition with desirable ‘3P’ (productive, perennial, preferred) grasses eventually being replaced by shallow-rooted annuals. Associated with this is a loss of ecosystem function, affecting the ability to maintain soil and nutrients, sensitivity to drought, pasture production, forage quality and biodiversity.

Roth et al., (2003) describe the patterns of geologic formations, soils, topography, and vegetation across the catchment. The complexity of the patterns of variation of these basic resources across the catchment indicates that there are likely to be site-specific constraints and circumstances for individual properties. Further variation between properties across the catchment is added by differences in past management histories (changes to vegetation and soils, and degree of property development), much of which is captured in the indicators of landscape health presented in section 2.4 of this report. Further spatial variation is generated by the differing structures of current businesses, and the diversity of people who manage them.

Many general principles can be used to guide land use practices and policies for the rangelands in the Burdekin catchment and the land types within it. But the complexity of the natural resource base and the uniqueness of conditions on each property make it difficult to develop detailed, specific guidelines that are equally relevant and appropriate to every enterprise. For individual land managers spatial variability can mean that experiences gained on one property may not always be applicable elsewhere (e.g., when moving, acquiring additional properties, or sharing knowledge with other producers). For institutions with a regional/catchment scale focus, guidelines and policies will never be able to take into account the detail of unique property-to-property differences.

**Regional complexity and challenges for NRM planning and policy**

Misunderstandings can arise from the differences in perspective at different scales (property/enterprise/individual versus regional/policy/community) even when there is a common goal.
There can be differences in values systems at the individual/enterprise and community/regional scale. In addition to those already mentioned, there are differences in how people value costs and benefits. At the enterprise scale, the economic incentive is to value on-property costs and benefits, and less incentive to value off-site costs and benefits (or future costs and returns). When trying to achieve regional outcomes, off-site effects have to be fully accounted for, despite difficulties in attributing them to often diffuse sources. There are win-win situations, where co-ordinated regional action is more effective than independent, individual efforts. Examples would include programs such as weed control strategies, management of animal pests and fencing of river frontage country. Difficulties arise when spatial trade-offs exist and decisions have to be taken about priorities and how costs and benefits should be attributed to people in different parts of the region.

Regional policies and guidelines are necessarily general and cannot accommodate the detailed variation between individual properties. Broad strategies, which may be effective in achieving an outcome for a region as a whole, will differ in their effectiveness on individual properties (in the worst case, even possibly adversely some properties). This can create conflicts on particular properties where broad recommendations to achieve regional scale goals may not be optimal or entirely appropriate for those particular enterprises.

Ideally, sustainable use of rangeland resources requires proactive action from skilled land managers (with a more detailed, property-specific perspective) in partnership with government agencies (with a more general, regional perspective). Such actions within flexible policies and guidelines (allowing management actions to be tailored to the unique circumstances of individual enterprises) and should avoid the conflicts that arise from rigid (‘one-size-fits-all’) prescriptive legislation.

6.2.5 Policy and NRM in the rangelands

Settlement

Since the separation of Queensland from New South Wales in 1859, the emphasis of policies related to rangelands has been the allocation, settlement and development of land; equitable distribution of land; and the generation of State revenue (QNRM 2001). This lead to development of the ‘populate or perish’ strategy in 1959, which influenced the Land Act 1962. While some environmental provisions existed, a ‘lease-holder first’ philosophy has been applied with minimal enforcement of environmental provisions and penalties that were too lenient to serve as deterrents (Hannam 2000).

The paradox of Australia’s rangelands is that this seemingly limitless space provides such a limited natural resource base. In the past, the resource limitations of these areas have not always been fully recognised and there has been a tendency to equate space with undeveloped resources that only require settlement and development with industrious communities to prosper. However, industrious people alone are not enough for successful enterprises. Effective land settlement/development requires at least a natural resource base (sufficient to support enterprises at the individual property scale and whole industries/communities at the regional scale); technical capacity (for individuals and institutions to know how to manage viable, sustainable enterprises on this resource base);
and financial capacity (to have the means to establish the enterprises, industries and supporting institutions). Priorities of past policies affecting rangelands have, at times, been at odds with ensuring that these requirements were met.

**Drought**

Drought is an unfortunate but natural and recurrent part of life in rangelands. Drought relief assistance plays an important social role in helping affected pastoral enterprises through these tough times. However, current processes of assistance serve as a disincentive for responsible land stewardship (Mortiss, 1995 and Stafford-Smith, 2000). Properties that do not have drought-coping strategies tend to be worst affected by drought but also tend to receive the greatest drought subsidies for, eg. forage and transport. Drought assistance can therefore act as a perverse incentive as it potentially reduces the economic incentive for those managers who are proactive in dealing with climate variability and thereby protect their rangeland resource base. Increasingly provision of disaster relief (e.g. flood and fire) is being linked to adoption of practices and standards that lower future risks and losses (lowering the likelihood and magnitude of future requirements for assistance).

**Sustainability**

Early optimism about the production capability of rangelands and their ability to recover from over-use has, in places, lead to deterioration. There has been a growing awareness of the resource limitation of rangelands, the ecosystem services and other values they provide, and the need for sustainable use that will continue to support the communities and industries that depend on them. Recent legislation in Queensland has moved towards emphasising the broader, longer-term benefit of rangeland resources. This includes the *Rural Lands Protection Act 1985*, the *Land Act 1994*, the *Nature Conservation Act 1992* and the *Vegetation Management Act 1999*. The National Action Plan for Salinity and Water Quality is part of this commitment to sustainability.

**Tenure**

About 65% of Queensland is State leasehold land. That proportion is even higher for the Burdekin region. Many of these leases will be reaching the end of their term over the next 20 years (QNRM 2001). As is evident from the above sections, there has been an increasing awareness by society of the broader values and utility of rangelands and the need to maintain both production and non-production services into the future. This has lead to changing expectations of how leasehold land should be administered (partly reflected in new policies and legislation) and nature of future leases, with the public demanding greater accountability from those placed in stewardship of our natural assets. The Queensland government is currently considering how future leases should be managed and alternative arrangements for encouraging improved land management practices (QNRM 2001).

In many rangelands of the world, initial policies allowed unrestricted communal access to grazing lands leading to over-utilization and deterioration (‘the tragedy of the commons’ phenomenon – Hardin, 1968). The provision of land tenure (long-term leases for 99 years) was seen as a means of restricting access, with land use rights providing a private incentive for land stewardship. But this has only proved to be a partial success. While secure tenure...
has been a useful tool for promoting improved land management practices, by itself, it has not provided a sufficient financial incentive for the adoption of sustainable land use practices and levels of utilization (as has been discussed through the above sections). In particular, there is a mismatch of socio-economic and ecological timeframes in which the financial incentive is only to ensure that the resource base is maintained for the (short-term) planning horizon of the enterprise (although managers often have other values that motivate longer-term planning). However, insecurity over land tenure is likely to be a strong driver for very short-term decision making (coinciding with the short-term certainty of tenure) and needs to be managed carefully during the current review process. The revision of land lease arrangements in the state provides an opportunity to recognise the successes and failures within the current framework and to develop new incentives to ensure that rangeland resources continue to provide benefits to society.
6.3 Landholder attitudes to NRM: adoption, impediments and opportunities

As part of this study, the Burdekin Dry Tropics Board commissioned CSIRO to undertake a survey of landholders across the Burdekin Catchment. The rational for surveying landholders – as opposed to landowners or a broad section of resource users or the general public – was to find out about the NRM practices and attitudes of the group of people whose actions relate most directly to the natural resource base and ultimately determine the environmental state of the catchment, ranging from water quality to salinity to biodiversity conservation.

After a pilot and pretesting period, the survey took place during the period August to October 2002. A representative sample of landholders in each sub-catchment of the Burdekin was selected to participate. Due to the length and complexity of the survey, the questionnaires were mailed to landholders. Interviewers then contacted the landholders to conduct the interviews over the phone. A small proportion of landholders chose to reply mail the questionnaire.

Survey forms, copy of the cover sheet, letter of introduction and questionnaire is provided in Appendix 3. Many of the questions aimed to measure social and economic indicators, which can help explain the likelihood of adoption of NRM practices. Other questions established current use of NRM practices, elicited issues of NRM and sought opinions and attitudes to NRM practices and policy options.

A total of 170 landholders were selected for the survey (Table 6.3). 82 surveys were completed, equalling a response rate of 48%. The response rate was highest in the Bowen-Broken (56%) and lowest in the Lower Burdekin (36%).

Table 6.3: Overview of response to landholder survey

<table>
<thead>
<tr>
<th>Sub-region</th>
<th>Mail-out</th>
<th>Completed surveys</th>
<th>Declined to participate</th>
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<td>20</td>
<td>8</td>
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<td>Lower Burdekin</td>
<td>69</td>
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<td>Total</td>
<td>170</td>
<td>82</td>
<td>40</td>
<td>48</td>
<td>48</td>
</tr>
</tbody>
</table>

The key survey results are presented below. An overview of the total sample is provided. Details for sub-catchments are provided where deemed relevant for NRM.
### 6.3.1 Landholder characteristics – ‘indicators’ of adoption

Consistent with tenure conditions across the catchment, most (70%) surveyed rangeland properties were leasehold. A large majority (89%) of farms were owner-operated (Figure 6.3). The number was in excess of 95% for all sub-catchments with the exception of the Bowen-Broken, where only 45% were owner operated. The remainder was manager operated, with 45% of responding farms owned by persons residing in Queensland 9% by owners residing elsewhere.

![Figure 6.3: How properties are operated](image)

On the majority of farms (60%), management decisions are being made by the owner/manager in consultation with other family members (Figure 6.4). On one quarter of farms, decisions are made by the property manager alone. This proportion is higher in the Upper Burdekin (35%) and the Lower Burdekin (37%). Consultative management is particularly high in the Belyando-Sutton (79% consult with other family members) and in the Bowen-Broken, where most managers consult with family or non-family staff.

On average, each property had four (3.9) people working on it – both full-time and part-time – more than half of which (2.6) were family members. Evidently, most properties within the district are ‘family affairs’.

The age of a land manager is often correlated with his/her willingness to adopt innovative practices. The older the manager/owner, the less likely is adoption (Bureau of Rural Sciences, 2001). Figure 6.5 shows that 55% of respondents were younger than 50 years old. About 18% of landholders were over the age of 60; and almost 26% were under the age of 40. Landholders in the Upper Burdekin were significantly older (37% were 60 and over)
while landholders in the Bowen-Broken tended to be younger (45% under 40 and a further 36% between 40-50 years old). The Belyando-Sutor showed the narrowest age distribution with 71% of landholders aged between 40 and 60 years old.

Figure 6.4: Decision making process on properties

Figure 6.5: Age distribution of (surveyed) landholders in the Burdekin
It is promising from a NRM perspective that a large proportion of land managers is relatively young. However, two thirds of land managers stipulate that they make decisions in consultation with other family members and there is anecdotal evidence to suggest that generational issues in relation to NRM may be perpetuated.

The average length of time that the current manager had been running the property was 24 years. The BRS notes that the effect of years of management experience on adoption is ‘ambiguous’, so it is difficult to determine whether that is a good or a bad thing for NRM.

Membership of Landcare is positively correlated with adoption, in so much as it tends to reflect environmental attitudes of the property owners (higher motivation), and may improve capacity with its decision support networks (Bureau of Rural Sciences, 2001). Historically in the Burdekin, Landcare activity and membership in the Upper Burdekin has been strong, while in the Belyando-Sutter the movement has never taken hold as such. There were a total of 21 Landcare groups active in the Upper Burdekin in 2001 with 309 members listed (Marie Vitelli, QDPI and Dalrymple Landcare Committee, email communication 24 April 2002). This equates to about 60% of landholders in that region, which is less than in the initial phases of Landcare when membership had been around 80%. Map 6.1 shows the approximate position of Landcare groups in the Burdekin Dry Tropics Region.

Map 6.1: Landcare groups across the northern areas of the Burdekin Dry Tropics Region, 2001

(Source: Map kindly provided by Marie Vitelli, 24/04/2002)
Of those surveyed in the Burdekin, membership in Landcare was relatively high; 49% of the responding properties indicated that somebody on their property (themselves, a family member or a member of staff) was a current member (Figure 6.6). The only organisations with higher membership were Agforce (51%) and the rural fire brigade (87%).

![Figure 6.6: Membership of landholders in associations](image)

### 6.3.2 Implementation of NRM practices and impediments

Question 17 of the survey asked respondents about the degree to which they had implemented a range of NRM practices on their property. The listing included specific practices under the following groupings: grazing management, crop management, pest and weed control, soil and water management, environmental management.

Figure 6.7 shows the average degree of implementation of these practices across the catchment. The value range is from 0 (no implementation) to 1 (implemented on parts of the property) to 2 (implemented right across the property). The implementation of grazing management practices that are aligned with NRM objectives is high. Regular stock monitoring and stock adjustment to pasture condition are standard practice across most of the respondents’ properties. There is also a large degree of implementation of subdivisional fencing and complementary stock feeding. Regular pasture monitoring and paddock spelling are implemented to varying degrees.
The implementation of NRM practices in the cropping systems across the rangelands is generally low. While conservation tillage is practiced on parts of most properties with cropping land, only a minority of properties include break crops or fallow for soil water storage.

There is a significant level of weed and pest control going on across the catchment, specifically in relation to the control of feral animals. Weed control is practised predominantly chemically and with fire, but also mechanically. Integrated or biological pest control are practised on parts of many properties.
In terms of water management practices, the stock water points have been widely added across properties, while landholders have implemented practices to increase irrigation efficiency only sporadically. In terms of environmental management, there is some evidence that people plant or fence off riparian vegetation in places, but fencing off or planting vegetation for conservation purposes is very sporadic.

Table 6.4 shows the average degree of implementation of those NRM practices in the sub-catchments. The table shows, for example, that there is virtually no cell grazing by respondents in the Upper Burdekin and Belyando-Sutter. On the other hand, fire is the major management instrument for the control of woody weeds.

Interestingly, monitoring of water consumption is adopted across most respondent properties in the Belyando-Sutter, whereas in the Lower Burdekin monitoring is patchy. At the same time, landholders in the Lower Burdekin say they have largely adopted irrigation practices to increase water use efficiency.

Figure 6.8 investigates what landholders see as the constraints they face to the implementation of NRM practices. The perceived importance of the constraints is measured on a scale from 1 to 5, with “1” indicating that this is not a constraint or factor or consideration and “5” indicating a very important factor or constraint.

Operational and financial constraints and uncertainty are most important impediments to NRM implementation. The single most important constraint is climate variability. This corroborates previous data that shows that climate variability is a major cause for profit swings and cash-flow problems and that in drought years farmers do not have the financial capacity to invest in the implementation of NRM measures.

Other very important impediments are the high initial investment costs involved, a perceived lack of government incentives, and high ongoing effort or costs. All these constraints can be summed up as being financial.

Uncertainty rated as a secondary issue – in relation to tenure, future of industry, future of property, native title. Landholders also did not consider lack of science or information to be significant impediments.

Respondents did not perceive that there was a lack of skills on their properties or a lack of local leadership.
### Table 6.4: Average degree of implementation of NRM practices in the sub-catchments

<table>
<thead>
<tr>
<th>Practice</th>
<th>Upper Burdekin</th>
<th>Belyando-Suttor</th>
<th>Bowen-Broken</th>
<th>Lower-Burdekin</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grazing management</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular pasture monitoring</td>
<td>1.3</td>
<td>1.6</td>
<td>1.3</td>
<td>1.5</td>
</tr>
<tr>
<td>Regular stock monitoring</td>
<td>1.8</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Spelling paddocks regularly</td>
<td>1.1</td>
<td>1.6</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Stock numbers adjusted to pasture condition</td>
<td>1.8</td>
<td>1.9</td>
<td>1.9</td>
<td>2.0</td>
</tr>
<tr>
<td>Complementary stock feeding</td>
<td>1.7</td>
<td>1.7</td>
<td>1.8</td>
<td>1.7</td>
</tr>
<tr>
<td>Planting fodder crops</td>
<td>0.3</td>
<td>0.5</td>
<td>0.4</td>
<td>0.0</td>
</tr>
<tr>
<td>Subdivisional fencing</td>
<td>1.7</td>
<td>1.8</td>
<td>1.5</td>
<td>1.7</td>
</tr>
<tr>
<td>Cell grazing</td>
<td>0.0</td>
<td>0.1</td>
<td>0.9</td>
<td>0.7</td>
</tr>
<tr>
<td><strong>Crop management</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fallow for soil water storage</td>
<td>0.5</td>
<td>0.6</td>
<td>NA</td>
<td>0.4</td>
</tr>
<tr>
<td>Break crops</td>
<td>0.0</td>
<td>0.8</td>
<td>NA</td>
<td>0.6</td>
</tr>
<tr>
<td>Green trash blanketing</td>
<td>0.0</td>
<td>0.3</td>
<td>NA</td>
<td>0.3</td>
</tr>
<tr>
<td>Conservation tillage</td>
<td>0.5</td>
<td>1.0</td>
<td>NA</td>
<td>1.1</td>
</tr>
<tr>
<td><strong>Pest and weed management</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control woody weeks with fire</td>
<td>1.3</td>
<td>1.5</td>
<td>0.7</td>
<td>0.5</td>
</tr>
<tr>
<td>Control woody weeds mechanically</td>
<td>0.8</td>
<td>0.9</td>
<td>0.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Chemical week control</td>
<td>1.4</td>
<td>1.3</td>
<td>1.2</td>
<td>1.6</td>
</tr>
<tr>
<td>Integrated or biological pest control</td>
<td>1.1</td>
<td>1.0</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Control feral animals (goats, rabbits, pigs etc)</td>
<td>1.6</td>
<td>1.6</td>
<td>1.8</td>
<td>1.0</td>
</tr>
<tr>
<td>Control native animals (kangaroos, wallabies, etc)</td>
<td>0.5</td>
<td>1.2</td>
<td>0.7</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Soil and water management</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contour banks</td>
<td>0.9</td>
<td>1.0</td>
<td>0.7</td>
<td>0.1</td>
</tr>
<tr>
<td>Monitor total water consumption</td>
<td>0.3</td>
<td>1.4</td>
<td>0.9</td>
<td>0.8</td>
</tr>
<tr>
<td>Monitor water consumption on area basis</td>
<td>0.3</td>
<td>1.3</td>
<td>1.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Control water flow from artesian bores</td>
<td>0.5</td>
<td>0.6</td>
<td>1.3</td>
<td>0.8</td>
</tr>
<tr>
<td>Additional stock waterpoints</td>
<td>1.4</td>
<td>1.8</td>
<td>1.5</td>
<td>0.7</td>
</tr>
<tr>
<td>Increase efficiency of irrigation practices</td>
<td>0.0</td>
<td>0.5</td>
<td>0.8</td>
<td>1.7</td>
</tr>
<tr>
<td>Artificial wetland(s)</td>
<td>0.3</td>
<td>1.0</td>
<td>0.5</td>
<td>0.6</td>
</tr>
<tr>
<td><strong>Environmental management</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant and/or fence off riparian vegetation</td>
<td>0.7</td>
<td>0.6</td>
<td>0.9</td>
<td>0.5</td>
</tr>
<tr>
<td>Fence off remnant vegetation for conservation</td>
<td>0.1</td>
<td>0.3</td>
<td>0.6</td>
<td>0.3</td>
</tr>
<tr>
<td>Plant vegetation for conservation</td>
<td>0.2</td>
<td>0.2</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>Keep some areas deliberately remote from water points</td>
<td>0.3</td>
<td>0.5</td>
<td>0.5</td>
<td>0.4</td>
</tr>
</tbody>
</table>
Table 6.5 provides the mean values of perceived constraints for the sub-catchments. Drought and climate variability affects landholders in the Upper Burdekin more than anywhere else. Landholders in the Lower Burdekin are least affected given their access to irrigation water. On the other hand, cane growers rate low returns on investment, lack of government incentives and uncertainty about the industry’s future as their main impediments.
Table 6.5: Average rating of importance of barriers to adoption of NRM

<table>
<thead>
<tr>
<th>Operational and financial constraints</th>
<th>Upper Burdekin</th>
<th>Belyando-Suttor</th>
<th>Bowen-Broken</th>
<th>Lower-Burdekin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not enough time</td>
<td>4.1</td>
<td>3.9</td>
<td>3.5</td>
<td>3.6</td>
</tr>
<tr>
<td>Not enough staff or labour</td>
<td>4.0</td>
<td>4.0</td>
<td>3.9</td>
<td>3.5</td>
</tr>
<tr>
<td>Lack of skills on property</td>
<td>2.1</td>
<td>1.7</td>
<td>1.7</td>
<td>2.0</td>
</tr>
<tr>
<td>High initial capital costs involved</td>
<td>4.2</td>
<td>3.6</td>
<td>4.2</td>
<td>4.2</td>
</tr>
<tr>
<td>High ongoing effort or costs</td>
<td>3.9</td>
<td>3.7</td>
<td>3.8</td>
<td>4.2</td>
</tr>
<tr>
<td>Loss of productive capacity or property and income</td>
<td>3.6</td>
<td>3.5</td>
<td>2.9</td>
<td>3.5</td>
</tr>
<tr>
<td>Low returns on investment</td>
<td>3.3</td>
<td>3.5</td>
<td>3.5</td>
<td>4.4</td>
</tr>
<tr>
<td>Lack of government incentives</td>
<td>4.1</td>
<td>3.7</td>
<td>3.5</td>
<td>4.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Knowledge constraints</th>
<th>Upper Burdekin</th>
<th>Belyando-Suttor</th>
<th>Bowen-Broken</th>
<th>Lower-Burdekin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link between property management and environmental outcomes unclear</td>
<td>2.9</td>
<td>2.3</td>
<td>2.4</td>
<td>2.4</td>
</tr>
<tr>
<td>Lack of information on best management practices and their improvements</td>
<td>2.6</td>
<td>2.3</td>
<td>2.7</td>
<td>2.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Uncertainty</th>
<th>Upper Burdekin</th>
<th>Belyando-Suttor</th>
<th>Bowen-Broken</th>
<th>Lower-Burdekin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable climatic conditions and drought</td>
<td>4.8</td>
<td>4.2</td>
<td>4.2</td>
<td>3.6</td>
</tr>
<tr>
<td>Uncertainty about future of property</td>
<td>3.3</td>
<td>3.0</td>
<td>3.4</td>
<td>3.8</td>
</tr>
<tr>
<td>Uncertainty about future of industry</td>
<td>3.5</td>
<td>3.0</td>
<td>2.5</td>
<td>4.2</td>
</tr>
<tr>
<td>Uncertainty about tenure</td>
<td>3.5</td>
<td>3.2</td>
<td>2.5</td>
<td>1.9</td>
</tr>
<tr>
<td>Uncertainty associated with native title</td>
<td>3.6</td>
<td>3.1</td>
<td>2.8</td>
<td>1.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other constraints</th>
<th>Upper Burdekin</th>
<th>Belyando-Suttor</th>
<th>Bowen-Broken</th>
<th>Lower-Burdekin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of broader community support</td>
<td>2.9</td>
<td>2.4</td>
<td>1.5</td>
<td>2.8</td>
</tr>
<tr>
<td>Lack of local leadership</td>
<td>2.3</td>
<td>1.7</td>
<td>1.5</td>
<td>2.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attitude</th>
<th>Upper Burdekin</th>
<th>Belyando-Suttor</th>
<th>Bowen-Broken</th>
<th>Lower-Burdekin</th>
</tr>
</thead>
<tbody>
<tr>
<td>My property is in good shape. There is no environmental improvement required</td>
<td>3.2</td>
<td>3.0</td>
<td>3.0</td>
<td>3.5</td>
</tr>
<tr>
<td>No-one else cares, so why me?</td>
<td>1.8</td>
<td>1.4</td>
<td>1.3</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Question 21 of the survey asked respondents to rate the effectiveness of a variety of policies and programs aimed at encouraging the widespread adoption of measures to achieve environmental improvements. Figure 6.9 shows the mean ratings of perceived effectiveness.

Landholders rated financial incentives, specifically income tax incentives as the single most effective mechanism, closely followed by cost sharing arrangements. On-farm demonstration sites were rated most highly out of the range of educational/training/extension alternatives. Conversion from leasehold to freehold land was rated highly effective in achieving NRM implementation.
Increased government regulation received by far the lowest rating. Of low efficiency (mean value <3) were also rated cross-compliance mechanisms, accreditation of landholders and community involvement in on-farm work. An increase in extension services by state departments was seen as being not very effective.

Asking people to rate the effectiveness of policies is bound to be met with strategic responses, i.e. respondents rate those instruments and policies highly, which they would like to see implemented. In this context, there are some interesting differences between the sub-catchments, as Table 6.6 shows.

**Figure 6.9: Perceived level of effectiveness of policies and programs to enhance adoption of NRM**
Table 6.6: Average rating of effectiveness of policies for sub-catchments

<table>
<thead>
<tr>
<th>Policy Category</th>
<th>Upper Burdekin</th>
<th>Belyando-Suttor</th>
<th>Bowen-Broken</th>
<th>Lower-Burdekin</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education, training, extension, research</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>More state government extension</td>
<td>2.7</td>
<td>3.6</td>
<td>3.4</td>
<td>2.9</td>
</tr>
<tr>
<td>Better access to existing information</td>
<td>3.6</td>
<td>3.2</td>
<td>3.9</td>
<td>3.6</td>
</tr>
<tr>
<td>Better environmental education at school</td>
<td>3.2</td>
<td>3.6</td>
<td>3.7</td>
<td>3.5</td>
</tr>
<tr>
<td>Offer courses in book/record keeping</td>
<td>3.5</td>
<td>3.7</td>
<td>3.8</td>
<td>3.7</td>
</tr>
<tr>
<td>Technical and applied management courses</td>
<td>3.0</td>
<td>3.3</td>
<td>4.2</td>
<td>3.2</td>
</tr>
<tr>
<td>Environmental management courses</td>
<td>3.2</td>
<td>3.2</td>
<td>4.2</td>
<td>3.0</td>
</tr>
<tr>
<td>On-property demonstration sites</td>
<td>4.1</td>
<td>3.8</td>
<td>4.4</td>
<td>4.0</td>
</tr>
<tr>
<td>More research</td>
<td>3.4</td>
<td>4.0</td>
<td>4.1</td>
<td>3.4</td>
</tr>
<tr>
<td><strong>Voluntary measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voluntary codes of conduct</td>
<td>3.8</td>
<td>3.6</td>
<td>3.3</td>
<td>3.8</td>
</tr>
<tr>
<td>Accreditation of land managers</td>
<td>2.4</td>
<td>2.5</td>
<td>3.3</td>
<td>2.6</td>
</tr>
<tr>
<td>Community involvement in work</td>
<td>2.3</td>
<td>3.2</td>
<td>3.1</td>
<td>2.9</td>
</tr>
<tr>
<td>Property management plans</td>
<td>3.1</td>
<td>3.5</td>
<td>4.3</td>
<td>3.3</td>
</tr>
<tr>
<td>Voluntary co-operative arrangement between properties</td>
<td>2.7</td>
<td>4.1</td>
<td>3.4</td>
<td>3.6</td>
</tr>
<tr>
<td>Conservation credit system for properties</td>
<td>3.1</td>
<td>2.7</td>
<td>4.0</td>
<td>3.8</td>
</tr>
<tr>
<td>More funding for Landcare projects</td>
<td>3.4</td>
<td>3.5</td>
<td>4.4</td>
<td>3.8</td>
</tr>
<tr>
<td><strong>Financial incentives</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income tax incentives for landholder/managers</td>
<td>4.7</td>
<td>4.7</td>
<td>4.6</td>
<td>4.6</td>
</tr>
<tr>
<td>Cost sharing arrangements unrelated to Landcare</td>
<td>4.0</td>
<td>4.1</td>
<td>4.6</td>
<td>3.9</td>
</tr>
<tr>
<td>Rate and lease payment reduction for on-property conservation</td>
<td>3.6</td>
<td>3.7</td>
<td>4.4</td>
<td>4.3</td>
</tr>
<tr>
<td>Dept for conservation swaps</td>
<td>3.6</td>
<td>3.2</td>
<td>4.1</td>
<td>4.2</td>
</tr>
<tr>
<td><strong>Regulation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased government regulation</td>
<td>1.2</td>
<td>1.7</td>
<td>3.1</td>
<td>1.9</td>
</tr>
<tr>
<td>Cross-compliance</td>
<td>2.3</td>
<td>2.5</td>
<td>4.3</td>
<td>2.9</td>
</tr>
<tr>
<td>Conversion of leasehold to freehold</td>
<td>4.3</td>
<td>3.2</td>
<td>4.6</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Responses from the Bowen-Broken sub-catchment stand out as being least aligned with the general assessment of policies, specifically in the area of regulation, which is entirely rejected as an effective tool by all other sub-catchments. Respondents from the Bowen-Broken also rate cross-compliance measures highly. Given that a large proportion of properties surveyed in that area is manager-operated, this may indicate a perception that strong regulation is required to ensure NRM implementation on absentee-owner properties. Respondents there also rate property management plans highly and various measures
designed to offset conservation activities with financial benefits. They also rated Landcare funding as highly effective and research.

Respondents in the Belyando-Suttor were equally keen on research as well as on voluntary co-operative agreements and arrangements between properties. Here, conversion of leasehold to freehold rated lowly, probably since vast areas are already freehold, whereas conservation credits did not rate highly.

The important message from this data is that because of different land-use systems and farming structures (including tenure, ownership/management, etc), the effectiveness of policies and instruments can be expected to vary across different parts of the Burdekin. This points to a need for an integrated policy package focused on financial incentives and supported by a realm of other measures to provide incentives for landholders in different situations.

6.3.3 Landholder views on the economic and environmental benefits of NRM practices

Question 18 of the survey asked respondents to consider a range of NRM ‘actions’ – noting whether these were likely to incur (a) economic benefit for the farm and (b) on-site environmental benefits and, in case they thought there was a benefit, to express whether benefit was small or large. Responses were coded on a scale of 0 to 2 (0 indicating no benefit and 2 indicating large benefit), and averages were calculated.

Figure 6.10 shows the mean scores for economic benefits against the mean scores for on-site environmental benefit. The labels correspond to the different activities listed in question 18. These are listed below the graph.

This figure highlights several important points. First, the perceived financial and on-site environmental benefits of NRM practices are highly correlated. Practices, which landholders perceive as bringing financial benefit, are also viewed as bringing on-site environmental benefits. This goes against the traditional view that landholders perceive ‘trade-offs’ between financial and environmental objectives. This finding seems to indicate one of two things; Either that landholders can see the production benefits that environmental actions can generate and know how to capture them, or that they believe that whatever generates economic benefit must also be environmentally sound.

Second, some NRM activities are deemed to bring low financial and on-site environmental benefits, some large. Activity ‘e’ (adjusting stocking rate to carrying capacity) stands out as the as the most highly rated against both criteria. A group of activities follows closely in rating. The activities include the control of weeds and feral animals (n, o), establishment of off-stream water points for stock (g), and use of fire as a management tool (m).

Third, respondents differentiated between economic and environmental improvement for some actions. Specifically, they saw minor economic but virtually no environmental benefits arising from enterprise diversification (a). All the environmental management options, specifically planting or extending riparian buffer zones (j) and fencing remnant vegetation (k) also rated lowly overall but were perceived to have more environmental than economic benefit.
Figure 6.10: The perceived economic and on-site environmental benefits of NRM practices - surveyed landholders in the Burdekin

(Explanation of symbols is provided in listing below, group of options rated most highly are highlighted in red; group of options rated well are highlighted in yellow)

- a Enterprise diversification (eg. Tourism)
- b Continuous stocking at reduced pasture utilisation
- c Rotational grazing system
- d Wet season spelling
- e Adjust stocking rate to carrying capacity (land type, pasture condition)
- f Fence and manage land according to land type
- g Add new off-stream stock watering points
- h Establish additional riparian buffer zones
- i Fence off existing (and new) riparian buffer zones
- j Plant new or extent existing riparian buffer zones
- k Fence off remnant vegetation (other than riparian)
- l Clear native trees
- m Use fire as management tool
- n Control weeds (woody and other)
- o Control introduced pest animals
- p Control native pest animals
- q Fence off marginal grazing land
- r Revegetate marginal cropping land
- s Establish artificial wetlands
- t Increase efficiency of irrigation practices
- u Improve crop rotations
- v Improve crop management
The same options were put to respondents in the catchment context in question 20, when they were asked for an estimate of whole-of-catchment benefit that could be generated by the widespread implementation of these activities.

Figure 6.11 shows how responded rated the catchment-scale environmental benefits of measures (x-axis) in relation the mean value of responses for on-farm benefits (y-axis), which have already been discussed.

Environmental outcomes for the catchment include those benefits from on-farm activities, which are not captured by the persons implementing the action. They represent ‘positive externalities’. The beneficiaries of those externalities include, for example, the irrigators in the Lower Burdekin who have good-quality irrigation water available, and society and future generations who derive value from the conservation of biodiversity on the land, in-stream and off-shore.

It is important to note that the values shown here reflect the perceptions of landholders and do not represent objective measures of social value. Given the group of society that was targeted with the survey, this measure can be seen as reflecting an estimate of the benefit that landholders think they can derive if extensive implementation of certain activities was achieved.

Unlike perceptions of the on-site environmental benefits (which vary from an average of approximately 0.25 up to 1.8), the average values of respondent perceptions of the
catchment-wide environmental benefits of different NRM activities do not vary much (from 0.8 for clearing of native trees (l) to 1.8 for weed control (n)).

The activity seen to generate the largest environmental benefit at the catchment scale is weed control (n), indicating the importance of this issue for all landholders. The top scoring on-farm activities also rate highly at the catchment scale, indicating that landholders recognize that (1) a combination of various NRM activities is required for the achievement of regional-scale environmental improvements because of the multiple environmental issues and the inability of single activities to affect multiple issues equally positively and (2) broad-scale adoption is required.

Landholders see little catchment-scale value in conserving and maintaining riparian and remnant vegetation. From society’s perspective, the social benefits from these measures would need to be rated more highly, but obviously landholders can only partially capture benefits from improved production.

Landholders perceive there to be catchment-scale environmental benefits from further tree clearing (l) in the catchment. It is unlikely, that a cross-section of society would share this assessment. This activity is seen to have a medium-level financial benefit but also on-farm environmental benefits. This finding confirms the above stipulated warning that estimated environmental benefit, both on-farm and at catchment-scale, might be biased by the expectation of on-farm economic benefit derived from adoption either on-farm or catchment-wide.

Despite the caution required in data interpretation, the results show some important differences between sub-catchments, which highlight the ecological and farming differences between those areas. Appendix 5 shows the findings at the sub-catchment scale, which correspond with Figure 6.10 and Figure 6.11. For the Upper Burdekin and Bowen-Broken, there is close alignment between perceived on-farm economic and environmental benefits. In contrast, respondents in the Belyando Suttor identified specifically rotational grazing (c) to have much larger environmental than economic benefits with the reverse being true for enterprise diversification (a).

As for the catchment-wide environmental benefits of widespread adoption, respondents in the Upper Burdekin and Bowen-Broken rated those categorically higher than on-farm environmental benefits. In the Upper Burdekin the control of introduced pest animals (o) was seen to provide the highest benefits for the catchment. In the Bowen-Broken the adjustment of stocking rates (e) and fencing off existing (and new) riparian buffer zones rated highest. In contrast, respondents in the Belyando Suttor identified rotational grazing (d) and wet season spelling (d) as having much larger on-farm environmental benefits than catchment benefits.

_Broadly speaking, there was a consistent pattern across sub-catchments emerging from the rating of benefits. There were, however, some interesting differences._

Figure 6.12 shows, as separate chart for each of the four sub-catchments, the aggregate benefit attributed to each NRM activity listed in the survey. This can be interpreted as an indicator of perceived total value. The individual components of that value are shown in different colours. The options are listed alphabetically on the x-axis.
There is basic agreement across the sub-catchments about relative value of NRM options. Adjustment of stocking rate to carrying capacity (e) is rated most highly across all regions. The addition of off-stream water points for stock (g), weed control (n) and the control of introduced pest animals (o) achieve a combined score above 4 (out of a maximum 6) for all regions. The control of native pest animals (p) rates as being of secondary value in all regions.

The use of fire as a (woody) weed management tool is rated highly in all sub-catchments except the Bowen Broken. Wet-season spelling of paddocks (d) rated highly in all sub-catchments except the Upper Burdekin.

Additional fencing according to land type (f) rated highly in the southern parts of the catchment, as did improved crop rotations. Rotational grazing (c) came up as another highly valued pasture management option in the Bowen-Broken and the Lower Burdekin. In contrast, wet season spelling (d) was rated highly in the Belyando-Suttor region and featured less prominently in the Upper Burdekin.

Clearing of native trees (l) rated highly in terms of on-farm economic benefit in the Belyando-Suttor area but rated lowly on this criterion in the Bowen-Broken and Lower Burdekin and only moderately in the Upper Burdekin. Interestingly enough, the Belyando-Suttor is the area with the highest proportion of freehold land. In comparison to other sub-catchments, it been most extensively cleared to date and shows signs of landscape stress due to habitat fragmentation and changes to hydrological systems. It is curious that respondents in that sub-catchment also see quite substantial catchment-wide environmental benefits arising from large-scale tree clearing.
The series of environmental management options with respect to riparian buffer zones and remnant vegetation were rated lowly. The only sub-catchment to give some establishment of additional riparian buffer zones (h) and fencing off of riparian buffer zones (i) a medium total value was Bowen-Broken.

For NRM in the Burdekin, this data sends two messages. First, landholders have a clear sense that some on-farm environmental improvements generate financial benefit for their businesses. They also see that irrespective of the level of on-farm benefits, these activities could generate catchment-wide benefits. If landholders’ perceptions are accurate and substantial benefits from NRM activities accrue beyond the farm fence, this raises issues of who should pay for investment into NRM if one was to apply the beneficiary-pays principles (Section 6.1.2). On one hand, there is little argument for public support if environmental improvements generate on-farm financial benefits. On the other hand, there is some argument for public support to (1) acknowledge wider social benefits arising from adoption in the form of cost sharing and (2) generate catchment-scale outcomes quicker by providing incentives to entice faster and wider adoption of preferred actions.

Second, assuming that high ratings indicate high levels of support for NRM activities, these data indicate that while there are NRM options that are supported across the catchment, there are specific issues within sub-catchments, factual or perceived, that require more specific attention. NRM strategies may need to be tailored according to landscape type and NRM issues. However, a low rating by landholders does not necessarily mean that a specific NRM measure should not be supported for other reasons, which raises the issue of communicating NRM to landholders. And conversely, high ratings such as that for perceived environmental benefit of clearing of native vegetation by some landholders might indicate an urgent need for clarification of such important issues and education of landholders.
6.4 Communicating NRM

It is essential for the Burdekin Dry Tropics Board to be engaging with its constituency across the vast and sparsely populated region and, ultimately, to be effecting land-use change to meet end-of catchment water quality targets and other NRM objectives.

To communicate effectively, the strategy needs to consider both content and method. As a basis for consideration of method, a clear understanding is required to what sources of information influence people’s decision making – and how to get information to them. The landholder survey explored both aspects in some detail. The findings are presented below.

Question 15 of the questionnaire asked respondents to rate the sources of information in relation to their influence on on-farm land management decisions, on a scale from 1 (irrelevant) to 5 (extremely important). Figure 6.13 lists the sources and shows aggregate estimates value of the information sources to landholders in the Burdekin.

![Figure 6.13: Importance of different sources of information to (surveyed) landholders in the Burdekin](image)

Family members are the single most important source of information for landholders in the Burdekin in influencing the land and water management decisions that are made, receiving the only aggregate rating >4 (out of a maximum of 5). This level of influence means for NRM communication that it is essential to educate and inform not only managers but also family members (and other staff).

Second most important are three information sources: business advisors, school education and additional training. This highlights three things. (1) NRM policy directed at the
financial bottom line, eg. tax incentives, will be communicated to landholders via advisors and can be effective if they account for the idiosyncrasies of agricultural production in multiple variable environments. (2) A long-term strategy of education is of paramount importance in relation to NRM and other issues of ecological sustainability by including subjects to that effect into school curricula. What people learn at school will have a lasting impact long into their working lives. (3) Training and adult learning are effective in influencing on-farm decision making.

A third cluster of important sources of information includes what people see on their farms, their neighbouring farms and in field trials, and what they read in magazines.

Media and scientific reports influence some landholders more than others. The influence of state government agencies is rated relatively low, specifically for the DNR&M. The internet is (as yet) a minor source of information.

It is important to note that some of the traditional avenues thought as important for informing and educating farmers (including industry magazines, field days, training and what neighbours do) are indeed rated to be important sources of information. However, they do not have the same level of influence on NRM behaviour as the above-mentioned sources of information.

Question 16 of the survey explored in more details the specific print and other media that landholders in the Burdekin read, listen to, and watch. Figure 6.14 shows the print media that landholders read. The *Country Life* and *NQ Register* emerge as the only two papers of significant circulation.

![Popular newspapers among the (surveyed) landholders in the Burdekin](image-url)
Figure 6.15 shows the coverage that radio gets with landholders in the Burdekin. The ABC and its various regional channels are listened to most. ABC radio reaches the vast majority of landholders (92%).

![Popular radio stations among the (surveyed) landholders in the Burdekin](image)

**Figure 6.15: Popular radio stations among the (surveyed) landholders in the Burdekin**

For the communication of information and messages by the BDTB to its constituency, this means that a large variety of newspapers need to be involved in the circulation of material to achieve coverage of the Burdekin catchment and that this is ideally supported by broadcasts through the ABC stations.
7 Conclusions

This study is aimed at informing natural resource management and planning in the Burdekin region by (1) providing a better understanding of social and economic issues of relevance to NRM, (2) contributing to prioritisation of public investment in NRM and (3) informing processes for setting targets to be achieved for the NAPSWQ and beyond. It also highlights some of the key drivers and impediments to bringing about the types of changes in NRM that are likely to be encountered in trying to achieve these targets.

Landholders and vast parts of the rural community across the Burdekin Dry Tropics region are entirely dependent (directly or indirectly) on the natural resource base, and therefore on the state of the environment and its productive capacity. This places enormous pressure on the environment to keep delivering livelihoods and lifestyles.

Resource management policy traditionally considers environmental issues in isolation (e.g. salinity as a singular issue at a particular point in time). Typically, the focus is heavily skewed towards biophysical aspects and technological solutions, with little consideration of social context.

There is a plethora of NRM plans, policies and strategies at local, regional, state, national and international levels. The BDTB is required to operate within the existing legislative framework. While having statutory authority, it has no regulatory powers. A critical role for the BDTB, therefore, is to add value to the existing framework by serving as a catalyst for NRM implementation.

Actions to that effect would include:

- Determining the feasibility of actions from a variety of different perspectives, including agronomic, economic, social, psychological;
- Identifying priority on-ground actions appropriate to the region (this process is already underway);
- Identifying and lobbying for policy mechanisms to support NRM implementation, based on principles of policy design and evaluation and grounded in empirical data;
- Working with the regional constituency to maximise community and environmental benefits from policy implementation (e.g. through a process of target setting for NAP and priority-based investment of public funds).

This document provides valuable information to assist the BDTB in those tasks.

It is important to note that many Aboriginal groups regard their widespread traditional and continuing land interest in the region as being tantamount to “landholding”, hence the expression; traditional owner. In any case there is clear evidence of land management aspirations by Aboriginal traditional owners and potential land management synergies with other land managers such as pastoralists. More consideration needs to be given to negotiating the mutually agreed use of terms, such as landholder, which describe the role of stakeholders in land management. Such issues deserve careful attention and their resolution is outside the scope of this study.
7.1 Key messages from the data

Landscape health across the region appears generally good based on low-resolution data, which the National Land and Water Resource Audit provides for its assessment of landscape health. It does, however, identify some coastal areas and parts of some shires in the south show signs of stress where modification of ecosystems and hydrological conditions has been extensive. In terms of water quality and salinity, high-resolution modelling has identified problem areas for soil erosion, dryland salinity and water quality as reported in Roth et al., (2003).

Social trends on the status of communities in the region are conflicting. While declining populations (especially in young people) indicate a low ‘desire to remain’ in the region, low unemployment, high home ownership and families that are generally ‘intact’, tend to indicate a strong ‘desire to remain’.

The Burdekin Dry Tropics is a rural region, with cattle grazing as the dominant land use. The economy of the region is heavily reliant on natural resource-based industries, especially agriculture. The productivity of agricultural land varies greatly across the region ($<10/ha – $400/ha). Natural resource-based industries, particularly agriculture, are also subject to a high degree of revenue and profit variation over time with the value of agricultural produce per hectare changing by up to 30% between years. Sources of this volatility include fluctuations in land productivity based on rainfall, variation in product prices, variable expenses, and changes in government policy.

Since natural resource-based industries are strongly linked into the regional economy, this volatility is amplified in its impacts on the regional economy as a whole (through the multiplier process). This can have important implications for rural areas because agriculture is the dominant source of employment. Consequently employment multipliers for the agricultural sector are high. Some shires in the region have fairly diversified economies but others (e.g., Nebo, Jericho and Belyando) are less diverse and much more susceptible to boom-bust cycles in agricultural industries.

The total value of capital for broadacre agricultural enterprises has shown a general upward trend since the late 1970s, mostly due to substantial increases in land prices. This has been accompanied by a long-term trend of rising debt and falling equity, although this has started to improve since the mid 1990s.

There is a long-term trend of steadily declining terms of trade, which is coupled with a highly erratic rainfall environment and volatile markets for key products. In combination, these factors generate great pressure for landholders to intensify land use (increase stocking rates, clearing, conversion to cropping) and/or consolidate. There is evidence that both processes are occurring in the Burdekin.

Landholders identify these factors as the predominant constraints to adopting NRM practices. While there is widespread adoption of what would be considered good grazing management practices, there is very little implementation of specifically environmental practices such as the management of riparian and native vegetation. There is also as yet only moderate adoption of NRM-focused practices for cropping and water management.

Landholders can see potentially large on-farm economic and environmental benefits flowing from the implementation of various NRM practices and believe that a similar
extent of catchment-wide benefits would flow from large-scale implementation. This means that landholders do not perceive a trade-off to exist between environmental improvements and economic business imperatives.

From an NRM perspective, this is good news, if only because it indicates that the environment is not seen as an adversary to business objectives. It may, therefore, reflect an increased understanding on the part of landholders of the important links between environmental and long-term financial health. However, it may also reflect a tendency for landholders to self-justify financially profitable practices, with environmental claims (e.g., in Belyando-Suttor, 'clearing native trees' is ranks highly for financial, on-site, and catchment-wide environmental benefits). To the extent that this is so, NRM policy may need to target practices which are proven to have high environmental benefits, and which are perceived to generate financial benefits.

NRM activities have been identified, which - in the perception of landholders - could generate catchment-wide benefits if adopted more broadly. If landholders’ perceptions are accurate and substantial benefits from NRM activities accrue beyond the farm fence, this raises issues of who should pay for investment into NRM if one was to apply the beneficiary-pays principles (Section 6.1.2). On one hand, there is little argument for public support if environmental improvements generate on-farm financial benefits. On the other hand, there is some argument for public support to (1) acknowledge wider social benefits arising from adoption in the form of cost sharing and (2) generate catchment-scale outcomes quicker by providing incentives to entice faster and wider adoption of preferred actions. There is also need for ongoing information and education of landholders. In addition it seems that a regulatory framework and cross-compliance mechanisms, provided there is adequate monitoring and enforcement, can ensure that minimum standards of NRM are adhered to by all landholders.

The data indicates specific issues within different sub-catchments, which are most likely based on the biophysical and ecological conditions encountered there, as highlighted in the bio-regionalisation. This translates into specific issues within sub-catchments, factual or perceived, that require more specific attention. NRM strategies may need to be tailored according to landscape type and NRM issues. However, if landholders rate some activities lowly, this does not mean that a specific NRM measure should not be supported for reasons of generating benefits for society as a whole. Conversely, if landholders perceive large benefits to be generated by specific actions, those might not necessarily be favourable from a whole-of-community perspective, as has been shown in the case of landholder-perceived environmental benefit from clearing of native vegetation might. Rather, this would indicate an urgent need for clarification of such important issues and education of landholders, and the population at large.

In terms of the BDTB communicating information and messages to its constituency, the data shows that a large variety of newspapers need to be involved in the circulation of material to achieve coverage of the Burdekin catchment and that this is ideally supported by broadcasts through the local ABC stations.
7.2 Conclusions for NRM

NRM policy needs to start considering the socio-economic conditions that impede NRM implementation either through lack of capacity or willingness. These constraints need to be addressed in designing NRM policy and implementing priority actions.

Several important conclusions emerge from the data presented in this report. They show how the BDTB might broker and value-add to the complex web of environmental and NRM-related laws and policies. Some of the suggested actions lie outside the direct domain of the BDTB. Nevertheless, it has an important role to play in talking to relevant agencies, and advising on change.

Specifically, it needs to consider ways of:

- Managing the social and economic pressures and dependencies on the natural resource base. Actions may include:
  
  (1) encouraging diversification of regional economies particularly into secondary and tertiary industries;
  
  (2) conducting scientific research into ways of using natural resources more effectively (without jeopardising long-term sustainability); and
  
  (3) facilitating farm-level structural adjustment (be it enterprise diversification, expansion, changes to management, etc), while recognising and where possible mitigating the social, economic and environmental consequences.

- Maximising the benefits of policy implementation at a broad regional level while encouraging flexibility to allow tailoring to sub-regional and site-specific circumstances. Actions may include:
  
  (1) refining ‘blanket-type approaches’ such as environmental regulation and tax incentives for NRM,
  
  (2) developing a suite of supportive policies, by:
    
    (e) drawing on the full suite of potential policy instruments available;
    
    (f) taking into consideration the likely acceptability by the community and landholders;
    
    (g) tailoring policy to biophysical and ecological conditions in certain areas; and
    
    (h) co-ordinating public investment into NRM from programs such as the National Heritage Trust (NHT) and Bushcare in a strategic manner.

- Providing consistent policy signals over time. Given the boom-and-bust cycles in agriculture, caused predominantly by climatic and market volatility, long-term perspectives of policy are essential. For example, tax incentives are only effective in years where landholders generate sufficient profit. Short-term policies (such as one-off funding of individual and small-scale projects by NHT) run the risk of being ineffective because they cannot be strategically applied in a highly volatile environment.
• Integrating existing policies and co-ordinating actions across multiple NRM and environmental management issues, thereby offering complex solutions to complex problems, which typically span multiple dimensions and time scales. The current legislative and policy environment is characterised by a multiplicity of plans and policies, developed largely in isolation of each other. This leads to overlap, unintended side-effects, and even conflicting messages. It is a challenge to work within this framework to take advantage of synergies.

Ideas for improvement include:

(1) facilitating a whole-of-government approach, which could provide substantial benefits by making it easier for agencies to administer NRM, and for NRM bodies and businesses to understand and operate within; and

(2) establishing an overarching monitoring program that can provide the basis for an improved data and knowledge base to support decision making (eg. higher resolution land and water audit data which is freely available and timely).

• Enhancing the understanding of NRM issues of landholders and the community at large through communication, consultation and education.

• Involving research to answer priority questions and working with agencies to maximise implementation and monitor progress. Specifically there is a need for further research into the 'real' (as opposed to perceived) economic benefit of a range of different NRM practices, with a view towards using that information to prioritise policy.
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Sydney, New South Wales, Mapping Sciences Institute Australia, 3-6 December 2000, pp. 215-222.


9 Appendices

Appendix 1 Indicators of Adoption

Table 9.1: Individual and business-related indicators of adoption
(Source: BRS Social Sciences Centre 2001:5)

<table>
<thead>
<tr>
<th>Type of Indicator</th>
<th>Anticipated relationship/Linkage to adoption</th>
<th>Direction of expected Impact (positive/negative)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Individual Attributes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age of property manager/owner</td>
<td>Desire to remain on property, Environmental attitudes</td>
<td>Negative</td>
</tr>
<tr>
<td>Formal education</td>
<td>Skills, Environmental attitudes, Desire to remain on property, Information</td>
<td>Positive</td>
</tr>
<tr>
<td>Participation in recent training</td>
<td>Skills, Environmental attitudes, Information, Pressure to Adopt</td>
<td>Positive</td>
</tr>
<tr>
<td>Years of management experience</td>
<td>Skills, Habit</td>
<td>Ambiguous</td>
</tr>
<tr>
<td>Membership of Landcare</td>
<td>Environmental attitudes, Skills, Pressure to adopt, Decision support</td>
<td>Positive</td>
</tr>
<tr>
<td>Farm family with dependent children</td>
<td>Financial capacity, Desire to remain</td>
<td>Positive</td>
</tr>
<tr>
<td><strong>Business Related Attributes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property Management plan</td>
<td>Skills, Information</td>
<td>Positive</td>
</tr>
<tr>
<td>Family members working on property</td>
<td>Pressure to adopt, Decision support</td>
<td>Positive</td>
</tr>
<tr>
<td>Employment of non-family labour</td>
<td>Financial capacity, Skills</td>
<td>Positive</td>
</tr>
<tr>
<td>Total farm family income</td>
<td>Financial capacity, Security</td>
<td>Positive</td>
</tr>
<tr>
<td>Farm family off-farm income</td>
<td>Financial capacity</td>
<td>Positive</td>
</tr>
<tr>
<td>Farm cash income</td>
<td>Financial capacity, Desire to remain, Security</td>
<td>Positive</td>
</tr>
<tr>
<td>Farm profit at full equity</td>
<td>Desire to remain</td>
<td>Positive</td>
</tr>
<tr>
<td>Farm equity ratio</td>
<td>Financial capacity, Security</td>
<td>Positive</td>
</tr>
</tbody>
</table>
### Table 9.2: Community indicators of adoption
(Source: BRS Social Sciences Centre 2001: 6)

<table>
<thead>
<tr>
<th>Community Attributes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age dependency ratio</td>
<td>Provides a useful socio-demographic snapshot of the population structure/composition of a specific area, particularly in situations where detailed social and economic data are lacking. Expressed as the ratio of children and elderly people relative to a region’s population of working age (15-64), this value is a useful indicator of the “economic burden the productive portion of a population must carry.”</td>
</tr>
<tr>
<td>Youth net migration</td>
<td>A useful indicator reflecting on local opportunities for young people (e.g., with regard to education/training; employment prospects; social and economic diversity). Would have a strong impact on desire to remain.</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>A frequently used indicator to describe some aspects of economic and social wellbeing. Great care is advisable with interpretation, as this measure cannot capture the “true” extent of unemployment, with those not/no longer actively looking for work (because there is no work, for example) not captured by this measure.</td>
</tr>
<tr>
<td>Degree of socio-economic disadvantage</td>
<td>Developed by the ABS, a frequently used indicator to describe the relative state of social/economic well-being/options available in a specific area.</td>
</tr>
<tr>
<td>Accessibility/remoteness</td>
<td>Measuring the relative degree of geographic isolation, the ARIA index (Accessibility and Remoteness Index of Australia) provides information about the distance between a specific location to a set of defined services. With all IBRA regions falling in either the remote or very remote category, not a very powerful “indicator” to describe social and economic conditions in the rangelands.</td>
</tr>
<tr>
<td>Social Capital</td>
<td>Community strength and resilience go hand in hand with social capital, and to important components of the latter are the number of, and the extent of participation in local voluntary organisations.</td>
</tr>
<tr>
<td>Regional Diversification</td>
<td>Expressed as the number of different types of industry providing a total of more than 80% of employment in a region, such a measure could easily be calculated from ABS labour force statistics.</td>
</tr>
</tbody>
</table>

### Table 9.3: Institutional indicators of adoption
(Source: BRS Social Sciences Centre 2001: 8)

<table>
<thead>
<tr>
<th>Institutional Indicators</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total expenditure on resource management</td>
<td>Care must be taken not to double count funding transfers between levels of government, such as with NHT funding</td>
</tr>
<tr>
<td>Share of total expenditure for monitoring pasture/soil/biodiversity</td>
<td>Ideally monitoring activities would be distinguished by different objectives</td>
</tr>
<tr>
<td>Share of total expenditure for conservation on ground works</td>
<td>This should be allocated by expenditure on parks and equivalent reserves, crown-lands, off-reserve, defence land and Aboriginal land.</td>
</tr>
<tr>
<td>Share of total expenditure for extension work</td>
<td>Need to differentiate by subject matter of biodiversity and production</td>
</tr>
<tr>
<td>Share of total expenditure for subsidies and other transfers to private managers (including value of tax subsidies for NRM)</td>
<td>Need to differentiate between programs targeting pastoralists, Indigenous managers or other managers</td>
</tr>
<tr>
<td>Share of total expenditure for other purposes</td>
<td>For example, for program management.</td>
</tr>
</tbody>
</table>
Appendix 2A Variables for SEIFA indices

Index of Relative Socio-Economic Disadvantage

weight between 0.2 and 0.3
- Persons aged 15 and over with no qualifications (%)
- Families with income less than $15,600 (%)
- Families with offspring having parental income less than $15,600 (%)
- Females (in labour force) unemployed (%)
- Males (in labour force) unemployed (%)
- Employed Females classified as ‘Labourer & Related Workers’ (%)
- Employed Males classified as ‘Labourer & Related Workers’ (%)
- Employed Males classified as ‘Intermediate Production and Transport Workers’ (%)
- Persons aged 15 and over who left school at or under 15 years of age (%)
- One parent families with dependent offspring only (%)
- Households renting (government authority) (%)

weight between 0.1 and 0.2
- Persons aged 15 and over separated or divorced (%)
- Dwellings with no motorcars at dwelling (%)
- Employed Females classified as ‘Intermediate Production & Transport Workers’ (%)
- Employed Females classified as ‘Elementary Clerical, Sales & Service Workers’ (%)
- Employed Males classified as ‘Intermediate Production and Transport Workers’ (%)
- Persons aged 15 and over who did not go to school (%)
- Aboriginals or Torres Strait Islanders (%)
- Occupied private dwellings with two or more families (%)
- Lacking fluency in English (%)

Urban Index of Socio-Economic Relative Advantage

weight between 0.3 and 0.5
- Families with income greater than $77,999 (%)
- Employed Males classified as ‘Managers or Administrators’ (%)
- Employed Persons classified as ‘Professionals’ (%)
- Persons aged 15 and over with degree or higher (%)

weight between 0.2 and 0.3
- Employed Females classified as ‘Managers or Administrators’ (%)
- Employed Males classified as ‘Associate Professionals’ (%)
• Dwellings with 4 or more bedrooms (%)
• Persons aged 15 and over at CAE or university (%)

  weight between 0.1 and 0.2

• Employed Females classified as ‘Advanced Clerical & Social Workers’ (%)
• Employed Males classified as ‘Advanced Clerical & Social Workers’ (%)
• Employed Females classified as ‘Associate Professionals’ (%)
• Dwellings with 3 or more cars (%)
• Households owning dwellings (%)
• Average number of bedrooms per person
• Households owning or purchasing dwellings (%)

Rural Index of Socio-Economic Relative Advantage

  weight between 0.3 and 0.4

• Employed Males classified as ‘Professionals’ (%)
• Employed Males classified as ‘Associate Professionals’ (%)
• Persons aged 15 and over with degree or higher (%)

  weight between 0.2 and 0.3

• Households purchasing dwelling (%)
• Employed Females classified as ‘Professionals’ (%)
• Employed Females classified as ‘Advanced Clerical & Social Workers’ (%)
• Employed Females classified as ‘Associate Professionals’ (%)
• Employed Males classified as ‘Intermediate Clerical, Sales and Service Workers’ (%)
• Persons aged 15 and over with trade or ‘other’ qualification (%)
• Persons aged 15 and over at CAE or university (%)
• Families with income greater than $77,999 (%)

  weight between 0.1 and 0.2

• Persons aged 15 and over at TAFE (%)
• Employed Males classified as ‘Advanced Clerical & Social Workers’ (%)
Index of Economic Resources

weight between 0.2 and 0.4

- Households owning or purchasing dwelling (%)
- Dwellings with 4 or more bedrooms (%)
- Families with family structure other than two parent or single parent with dependent offspring or consisting of a couple only, and income greater than $77,999 (%)
- Families consisting of a two-parent family with dependent offspring, and income greater than $77,999 (%)
- Families consisting of a couple only, and with income greater than $62,399 (%)
- Families consisting of a single parent with dependent offspring, with income greater than $31,199 (%)
- Mortgage greater than $1,300 per month (%)
- Rent greater than $249 per week (%)

weight between 0 and 0.2

- Households purchasing dwelling (%)
- Households owning dwelling (%)
- Dwellings with 3 or more motor cars (%)
- Average number bedrooms per person

weight between -0.2 and 0

- Households in improvised dwellings (%)
- Households renting (government authority) (%)
- Households renting (non-government authority) (%)
- Dwellings with 1 or no bedrooms (%)
- Rent less than $74 per week (%)
- Families consisting of a single parent with dependent offspring, with income less than $15,600 (%)

weight between -0.3 and -0.2

- Families consisting of a couple only, and with income less than $15,600 (%)
- Families with family structure other than two parent or single parent with dependent offspring or consisting of a couple only, and income less than $26,000 (%)
- Families consisting of a two-parent family with dependent offspring, and income less than $26,000 (%)
- Dwellings with no motorcars (%)

weight between -0.2 and 0

- Households purchasing dwelling (%)
- Households owning dwelling (%)
- Dwellings with 3 or more motor cars (%)
- Average number bedrooms per person

weight between -0 and 0

- Households in improvised dwellings (%)
- Households renting (government authority) (%)
- Households renting (non-government authority) (%)
- Dwellings with 1 or no bedrooms (%)
- Rent less than $74 per week (%)
- Families consisting of a single parent with dependent offspring, with income less than $15,600 (%)

weight between -0.3 and -0.2

- Families consisting of a couple only, and with income less than $15,600 (%)
- Families with family structure other than two parent or single parent with dependent offspring or consisting of a couple only, and income less than $26,000 (%)
- Families consisting of a two-parent family with dependent offspring, and income less than $26,000 (%)
- Dwellings with no motorcars (%)

weight between -0.2 and 0

- Households purchasing dwelling (%)
- Households owning dwelling (%)
- Dwellings with 3 or more motor cars (%)
- Average number bedrooms per person

weight between -0 and 0

- Households in improvised dwellings (%)
- Households renting (government authority) (%)
- Households renting (non-government authority) (%)
- Dwellings with 1 or no bedrooms (%)
- Rent less than $74 per week (%)
- Families consisting of a single parent with dependent offspring, with income less than $15,600 (%)

weight between -0.3 and -0.2

- Families consisting of a couple only, and with income less than $15,600 (%)
- Families with family structure other than two parent or single parent with dependent offspring or consisting of a couple only, and income less than $26,000 (%)
- Families consisting of a two-parent family with dependent offspring, and income less than $26,000 (%)
- Dwellings with no motorcars (%)

weight between -0.2 and 0

- Households purchasing dwelling (%)
- Households owning dwelling (%)
- Dwellings with 3 or more motor cars (%)
- Average number bedrooms per person

weight between -0 and 0

- Households in improvised dwellings (%)
- Households renting (government authority) (%)
- Households renting (non-government authority) (%)
- Dwellings with 1 or no bedrooms (%)
- Rent less than $74 per week (%)
- Families consisting of a single parent with dependent offspring, with income less than $15,600 (%)

weight between -0.3 and -0.2

- Families consisting of a couple only, and with income less than $15,600 (%)
- Families with family structure other than two parent or single parent with dependent offspring or consisting of a couple only, and income less than $26,000 (%)
- Families consisting of a two-parent family with dependent offspring, and income less than $26,000 (%)
- Dwellings with no motorcars (%)

weight between -0.2 and 0

- Households purchasing dwelling (%)
- Households owning dwelling (%)
- Dwellings with 3 or more motor cars (%)
- Average number bedrooms per person

weight between -0 and 0

- Households in improvised dwellings (%)
- Households renting (government authority) (%)
- Households renting (non-government authority) (%)
- Dwellings with 1 or no bedrooms (%)
- Rent less than $74 per week (%)
- Families consisting of a single parent with dependent offspring, with income less than $15,600 (%)

weight between -0.3 and -0.2

- Families consisting of a couple only, and with income less than $15,600 (%)
- Families with family structure other than two parent or single parent with dependent offspring or consisting of a couple only, and income less than $26,000 (%)
- Families consisting of a two-parent family with dependent offspring, and income less than $26,000 (%)
- Dwellings with no motorcars (%)

weight between -0.2 and 0

- Households purchasing dwelling (%)
- Households owning dwelling (%)
- Dwellings with 3 or more motor cars (%)
- Average number bedrooms per person

weight between -0 and 0

- Households in improvised dwellings (%)
- Households renting (government authority) (%)
- Households renting (non-government authority) (%)
- Dwellings with 1 or no bedrooms (%)
- Rent less than $74 per week (%)
- Families consisting of a single parent with dependent offspring, with income less than $15,600 (%)

weight between -0.3 and -0.2

- Families consisting of a couple only, and with income less than $15,600 (%)
- Families with family structure other than two parent or single parent with dependent offspring or consisting of a couple only, and income less than $26,000 (%)
- Families consisting of a two-parent family with dependent offspring, and income less than $26,000 (%)
- Dwellings with no motorcars (%)

weight between -0.2 and 0

- Households purchasing dwelling (%)
- Households owning dwelling (%)
- Dwellings with 3 or more motor cars (%)
- Average number bedrooms per person

weight between -0 and 0

- Households in improvised dwellings (%)
- Households renting (government authority) (%)
- Households renting (non-government authority) (%)
- Dwellings with 1 or no bedrooms (%)
- Rent less than $74 per week (%)
- Families consisting of a single parent with dependent offspring, with income less than $15,600 (%)

weight between -0.3 and -0.2

- Families consisting of a couple only, and with income less than $15,600 (%)
- Families with family structure other than two parent or single parent with dependent offspring or consisting of a couple only, and income less than $26,000 (%)
- Families consisting of a two-parent family with dependent offspring, and income less than $26,000 (%)
- Dwellings with no motorcars (%)

weight between -0.2 and 0

- Households purchasing dwelling (%)
- Households owning dwelling (%)
- Dwellings with 3 or more motor cars (%)
- Average number bedrooms per person

weight between -0 and 0

- Households in improvised dwellings (%)
- Households renting (government authority) (%)
- Households renting (non-government authority) (%)
- Dwellings with 1 or no bedrooms (%)
- Rent less than $74 per week (%)
- Families consisting of a single parent with dependent offspring, with income less than $15,600 (%)

weight between -0.3 and -0.2

- Families consisting of a couple only, and with income less than $15,600 (%)
- Families with family structure other than two parent or single parent with dependent offspring or consisting of a couple only, and income less than $26,000 (%)
- Families consisting of a two-parent family with dependent offspring, and income less than $26,000 (%)
- Dwellings with no motorcars (%)

weight between -0.2 and 0

- Households purchasing dwelling (%)
- Households owning dwelling (%)
- Dwellings with 3 or more motor cars (%)
- Average number bedrooms per person

weight between -0 and 0

- Households in improvised dwellings (%)
- Households renting (government authority) (%)
- Households renting (non-government authority) (%)
- Dwellings with 1 or no bedrooms (%)
- Rent less than $74 per week (%)
- Families consisting of a single parent with dependent offspring, with income less than $15,600 (%)

weight between -0.3 and -0.2

- Families consisting of a couple only, and with income less than $15,600 (%)
- Families with family structure other than two parent or single parent with dependent offspring or consisting of a couple only, and income less than $26,000 (%)
- Families consisting of a two-parent family with dependent offspring, and income less than $26,000 (%)
- Dwellings with no motorcars (%)
Index of Education and Occupation

weight between 0.2 and 0.4
- Employed Males classified as ‘Professionals’ (%)
- Employed Females classified as ‘Professionals’ (%)
- Persons aged 15 and over at CAE or university (%)

weight between 0 and 0.2
- Employed Males classified as ‘Associate Professionals’ (%)
- Employed Females classified as ‘Advanced Clerical & Social Workers’ (%)
- Employed Males classified as ‘Advanced Clerical & Social Workers’ (%)
- Employed Males classified as Intermediate Clerical, Sales & Service Workers’ (%)

weight between -0.2 and 0
- Employed Females classified as ‘Tradespersons’ (%)
- Employed Males classified as ‘Tradespersons’ (%)
- Employed Females classified as ‘Elementary Clerical, Sales & Service Workers’ (%)
- Employed Females classified as ‘Intermediate Production & Transport Workers’ (%)

weight between -0.4 and -0.2
- Employed Males classified as ‘Intermediate Production & Transport Workers’ (%)
- Employed Females classified as ‘Labourer & Related Workers’ (%)
- Employed Males classified as ‘Labourer & Related Workers’ (%)
- Males (in labour force) unemployed (%)
- Females (in labour force) unemployed (%)
- Persons aged 15 and over who left school at or under 15 years of age (%)
- Persons aged 15 and over with no qualifications (%)
**Appendix 2B: Methodological issues with SEIFA**

To allow for easy recognition of high and low scores, the raw index scores the SEIFA are standardized. Each index has a mean of 1000 and a standard deviation of 100 across all CDs in Australia. In practice, this means that around 95% of index scores are between 800 and 1200. This standardisation allows for easy geographical comparisons and relative assessment of a particular community in relation to a chosen reference point. At the same time the method poses a problem for longitudinal comparison in that the absolute SEIFA values are not comparable between census years. Longitudinal comparisons are restricted to the relative score of an index in relation to determined percentiles.

The indices, like all summary measures, have some limitations. These limitations are explained in ABS – Information Paper – 1996 Census of Population and Housing, Socio-Economic Indices for Areas. Catalogue 2039.0.

- Firstly, the indices contain only limited aspects of wealth. While income and expenditure are represented, aspects such as inherited wealth, savings, indebtedness, and property values are not included. These aspects were not included, as details on them were not collected by the Census. This affects the Index of Economic Resources more seriously than the other indices.

- Secondly, family structure (number of income earners, number of parents, number of dependents, etc.) is not strongly represented in the indices though it does appear to some extent in the Index of Economic Resources. As a consequence, the indices will perform relatively poorly at distinguishing between different family types directly.

- Thirdly, access to infrastructure such as schools, community services, shops and transport are not represented by the indices. These variables are considered to be integral to the concept of advantage or disadvantage. For example, rapidly growing outer suburban areas may suffer from a locational disadvantage situation rather than a socio-economic disadvantage.

The SEIFA are available for a wide range of geographic areas from small areas, such as collection district (an area made up of approximately 200 households), postal areas, local government areas and statistical local areas, to large areas, such as statistical subdivisions.

It is important to remember that comparison can only be made within an index, i.e. between areas described by a single index, not between different indices. Therefore, we can compare the region according to ‘Urban Advantage’ between the urban areas, but it is meaningless to compare these values directly with those of ‘Rural Advantage’.

It is equally important to bear in mind comparisons of indices between census years is not possible by comparing the absolute index values. Rather such longitudinal comparisons are restricted to comparisons between given percentiles. For example, a SLA may have improved from being in the bottom 10 percent for ‘Education and Occupation’ in the last census to being in the 25-50 percentile for the current census.
Appendix 2C: SEIFA indices for LGAs in the Burdekin Region

Table A2C-9.4: Rural Index of Relative Socio-Economic Advantage for the shires within the Burdekin Catchment
(Source: ABS – SEIFA 1996; reference values for Australia at percentiles 10, 25, 50, 75 and 90 %. Values for SLAs at CD level and for SD at SLA level)

<table>
<thead>
<tr>
<th>LGA value</th>
<th>Reference values for LGAs for Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>Belyando (S)</td>
<td>884</td>
</tr>
<tr>
<td>Bowen (S)</td>
<td>878</td>
</tr>
<tr>
<td>Burdekin (S)</td>
<td>925</td>
</tr>
<tr>
<td>Charters Towers (C)</td>
<td>905</td>
</tr>
<tr>
<td>Dalrymple (S)</td>
<td>955</td>
</tr>
<tr>
<td>Jericho (S)</td>
<td>861</td>
</tr>
<tr>
<td>Mirani (S)</td>
<td>884</td>
</tr>
<tr>
<td>Nebo (S)</td>
<td>922</td>
</tr>
</tbody>
</table>

Table A2C -9.5: Urban Index of Relative Socio-Economic Advantage for the Burdekin Region
(Source: ABS – SEIFA 1996; reference values for Australia at percentiles 10, 25 ,50 ,75 and 90 %. Values for SLAs at CD level and for SD at SLA level)

<table>
<thead>
<tr>
<th>LGA value</th>
<th>Reference values for LGAs for Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>Belyando (S)</td>
<td>984</td>
</tr>
<tr>
<td>Bowen (S)</td>
<td>909</td>
</tr>
<tr>
<td>Burdekin (S)</td>
<td>958</td>
</tr>
<tr>
<td>Charters Towers (C)</td>
<td>954</td>
</tr>
<tr>
<td>Dalrymple (S)</td>
<td>954</td>
</tr>
<tr>
<td>Jericho (S)</td>
<td></td>
</tr>
<tr>
<td>Mirani (S)</td>
<td></td>
</tr>
<tr>
<td>Nebo (S)</td>
<td>882</td>
</tr>
</tbody>
</table>
Table A2C -9.6: Index of Relative Socio-Economic Disadvantage for the Burdekin Region and Shires
(Source: ABS – SEIFA 1996; reference values for Australia at percentiles 10,25,50,75 and 90. Values for SLAs at CD level and for SD at SLA level)

<table>
<thead>
<tr>
<th>LGA value</th>
<th>Reference values for LGAs for Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>Belyando (S)</td>
<td>984</td>
</tr>
<tr>
<td>Bowen (S)</td>
<td>906</td>
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<tr>
<td>Burdekin (S)</td>
<td>986</td>
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<td>Charters Towers (C)</td>
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<td>Dalrymple (S)</td>
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<tr>
<td>Jericho (S)</td>
<td>929</td>
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<tr>
<td>Mirani (S)</td>
<td>965</td>
</tr>
<tr>
<td>Nebo (S)</td>
<td>974</td>
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</tbody>
</table>

Table A2C -9.7: Index of Economic Resources for the Burdekin Region and Shires
(Source: ABS – SEIFA 1996; reference values for Australia at percentiles 10,25,50,75 and 90)

<table>
<thead>
<tr>
<th>LGA value</th>
<th>Reference values for LGAs for Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10%</td>
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<td>Belyando (S)</td>
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<td>Bowen (S)</td>
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<tr>
<td>Burdekin (S)</td>
<td>998</td>
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<tr>
<td>Charters Towers (C)</td>
<td>962</td>
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<tr>
<td>Dalrymple (S)</td>
<td>945</td>
</tr>
<tr>
<td>Jericho (S)</td>
<td>945</td>
</tr>
<tr>
<td>Mirani (S)</td>
<td>968</td>
</tr>
<tr>
<td>Nebo (S)</td>
<td>935</td>
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</tbody>
</table>

Table A2C -9.8: Index of Education and Occupation for the Burdekin Region and Shires
(Source: ABS – SEIFA 1996; reference values for Australia at percentiles 10,25,50,75 and 90)

<table>
<thead>
<tr>
<th>LGA value</th>
<th>Reference values for LGAs for Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10%</td>
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<tr>
<td>Belyando (S)</td>
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</tr>
<tr>
<td>Bowen (S)</td>
<td>848</td>
</tr>
<tr>
<td>Burdekin (S)</td>
<td>907</td>
</tr>
<tr>
<td>Charters Towers (C)</td>
<td>952</td>
</tr>
<tr>
<td>Dalrymple (S)</td>
<td>887</td>
</tr>
<tr>
<td>Jericho (S)</td>
<td>880</td>
</tr>
<tr>
<td>Mirani (S)</td>
<td>896</td>
</tr>
<tr>
<td>Nebo (S)</td>
<td>879</td>
</tr>
</tbody>
</table>
Appendix 3: Measures of economic activity
(Source: Encyclopædia Britannica)

There are basically two ways of measuring national economic activity: as the money value of the total production of goods and services during a given period (usually a year) or as the total of incomes derived from economic activity after allowance has been made for capital consumption.

The most commonly used indicator of national output is the gross national product (GNP), which is a measure of the total market value of currently produced finished goods and the value of services rendered. Because national output includes goods and services that are highly diverse in nature and some that are not in fact placed on the market, the determination of market value is difficult and somewhat imprecise. Nonetheless, the use of a common basis of valuation makes it possible to obtain a total that fairly represents the level of output of a country. The rule that only currently produced goods and services should be counted ensures that only production occurring in the course of a given year is included and that any transaction in which money changes hands but no good or service does so in return (so-called transfer payments, e.g., unemployment or social-security payments, gifts) is excluded. The rule that only finished or final goods must be counted is necessary to avoid double or triple counting of raw materials, intermediate products, and final products. For example, the value of automobiles already includes the value of the steel, glass, rubber, and other components that have been used to make them.

National income may be derived from the GNP by making allowances for certain non-income costs included in the GNP, mainly the costs of indirect taxes, subsidies, and the consumption of fixed capital (depreciation). National income thus calculated represents the aggregate income of the owners of the factors of production; it is the sum of wages, salaries, profits, interest, dividends, rent, and so on.

The data accumulated for calculating the GNP and national income may be manipulated in a number of ways to show various relationships in the economy. Common uses of the data include: breakdowns of the GNP or the closely related gross domestic product (GDP) according to types of product or according to functional stages in its generation; breakdowns of national income by type of income; and analyses of the sources of financing (depreciation; savings by individuals, corporations, or institutions; and national deficits). The GNP is identical to GDP except that the latter does not include the income accruing to a nation's residents from investments abroad (minus the income earned in the domestic economy accruing to non-nationals from abroad).

In practice, statisticians face a number of difficulties and complications in computing the national product and income. Although there is a wealth of information available from
regular production returns made by companies, from value-added tax figures, from income and corporation tax returns, and from other reports relating to incomes or expenditures, they are all incomplete, subject to errors, and based on different definitions and valuation methods. Statisticians have developed various techniques for estimating and adjusting so as to improve the quality of the figures. Much indirect evidence is used to close gaps in data. Margins of error that accompany published calculations are themselves subject to error. Thus simple comparisons of, for example, one nation's reported national product and income with another's may be misleading. National accounting remains an inexact science, but it constitutes an invaluable tool for economic planners and government budget makers.
Appendix 4: Survey cover sheet, letter and questionnaire
Burdekin Catchment

Landholder Survey

2002

Your experience matters

Your opinion counts

Photographs by CSIRO, DPI, NR&M and Les Searle
Dear Landholder,

The Burdekin Dry Tropics Board has commissioned the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to undertake a socio-economic assessment of the Burdekin catchment. The Board is charged with implementing the National Action Plan on Salinity and Water Quality (NAP) in the Burdekin Catchment. In this function, we will deliver funding to regional communities in years to come from sources such as the NAP and National Heritage Trust. The study we have asked CSIRO to conduct will assist us in identifying priority investment areas.

As part of the study, CSIRO will be conducting a strategic survey of approximately 100 landholders across the entire Burdekin catchment. The specific aims of the survey are

1) to identify key barriers to changes in land and water management and
2) to learn what strategies property managers think could overcome these impediments.

The survey provides an important avenue for your input into the NAP process.

I ask you to kindly participate in the study. If you complete the survey, you will go in the draw for a prize to the value of $200. It is a voucher to be spent at a business of your choice. Your participation will help maximize the relevance of the survey results for the decision making of the Board.

The survey will be conducted by telephone but a copy is provided to you with this letter in preparation for the interview. A member of the CSIRO research team will ring you during the next couple of weeks to arrange a day and time that is convenient for you to answer the questions over the phone. Please read the survey (you might wish to fill it in) and have your copy ready for the interview. The interview will take approximately 30 minutes to complete.

Data obtained in this survey is treated as strictly confidential. Data will be collated and analysed by CSIRO researchers only. Results obtained from the data will be released in aggregate form only. The results will be reported to the Board and will be publicly available.

Should you have any queries about the study, please do not hesitate to contact the project leader: Dr Romy Greiner, CSIRO, Davies Laboratory, PMB Aitkenvale, Townsville QLD 4814, ph 4753 8630, fax 4753 8650, email: romy.greiner@csiro.au.

On behalf of the Burdekin Dry Tropics Board I thank you very much for your time and collaboration!

Yours sincerely,

Kirk Smith
Chair, Burdekin Dry Tropics Board

29 July 2002
1. **How many properties do you (the property manager) manage?** ……… property/properties
   
   Please note: If you operate more than one property, please answer the following questions for the entirety of your properties.

2. **What is the approximate(combined) size of your property?** Please indicate the area measure you use.
   
   Size .................................................. hectares  acres  square km  square miles

3. **In what part(s) of the Burdekin catchment is the property located?**
   
   □ 1 Upper Burdekin
   □ 2 Belyando-Suttor
   □ 3 Bowen-Broken
   □ 4 Lower Burdekin
   □ 5 outside catchment

4. **What is the town closest to your property?** If you do your grocery shopping and business dealings somewhere else, please provide town(s) and approximate distance.
   
   Town - closest ................................................................. Distance ...................... (kilometres)
   Town – grocery shopping ................................................. Distance ...................... (kilometres)
   Town – business dealings ................................................ Distance ...................... (kilometres)

5. **What is the average annual rainfall on your property?** Please indicate what measure you use.
   
   Average annual rainfall ................................ millimetres  inches  points

6. **What enterprises do you have on your property?** Please indicate ‘average’ size of enterprises.
   Please tick appropriate box(es) and specify size of enterprises and additional information as requested.
   
   □A grazing  □1 cattle  → ...........head → .........breeders .........calves .........steers .......bulls
   □2 sheep  → .........head
   □3 horses  → .........head
   □4 ........... → .........head (please indicate other livestock)
   (comments on grazing enterprise)

   □B cropping  □1 dryland crops  → .........hectares  
   major crop(s) ...........................................................
   □2 irrigated crops  → .........hectares  
   major crop(s) ...........................................................
   annual water consumption ......... Megalitres
   water source(s) □ ground water □ river □ property dam
   □3 fallow  → .........hectares
   (comments on cropping enterprise)

   □C tourism (please specify, for example: property stay – 10 cabins; or: access to property by tour operator) ,
   ........................................................................................................................................

   □D Other (please specify, for example: tree plantation - 50 ha; or: contract work – 20 days per year)
   ........................................................................................................................................

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7. **How are management decisions made on the property?**
   - □ 1 by owner/manager alone
   - □ 2 by owner/manager in consultation with other family member(s)
   - □ 3 by owner/manager in consultation with (non-family) staff
   - □ 4 by owner/manager with outside help/influence
   - □ 5 other (please specify) __________________________________________________________

8. **How is the property operated?**
   - □ 1 owner operated
   - □ 2 manager operated – owner residing in QLD
   - □ 3 manager operated – owner residing elsewhere
   - □ 4 other (please specify) __________________________________________________________

9. **How many people are working on the property full time and part time (including contract)?**
   **How many are family members (including yourself)?**
   - In total: Full time .......... Part time ......... Persons → How many full-time staff would that be? ........
   - Family: Full time .......... Part time ......... Persons → How many full-time staff would that be? ........

10. **What tenure is the property under?**
    - □ 1 freehold
    - □ 2 leasehold
    - □ 3 other (please specify) __________________________________________________________

11. **Does native title exist over (part of) your property or has a native title claim been made?**
    - native title exists □ 1 yes □ 2 no
    - claim made □ 1 yes □ 2 no

12. **Are you - or a family or staff member – a member of the following group(s) or associations?**
    - self □ A family/staff □ B
    - □ 1 .......... AgForce
    - □ 2 .......... local Landcare/catchment group
    - □ 3 .......... local Best Practice/Better Business group
    - □ 4 .......... land management society
    - □ 5 .......... breed or animal society
    - □ 6 .......... marketing or commodity group (eg. CANEGROWERS)
    - □ 7 .......... local service club (e.g. APEX, Lions, Rotary, RSL)
    - □ 8 .......... rural fire brigade
    - □ 9 .......... local government
    - □ 10 .......... rural women’s organisation
    - □ 11 .......... church group
    - □ 12 .......... other (please specify) __________________________________________________________

13. **What is your age?**
    - □ 1 less than 30 years old
    - □ 2 30-39 years
    - □ 3 40-49 years
    - □ 4 50-59 years
    - □ 5 60-69 years
    - □ 6 70 years and older

14. **How many years have you run the property? .......... years**
15. **How important are the following sources of information for management decisions on your property?**

*Please rate on a scale from 1 to 5, where*

- “1” indicates that the source is irrelevant for how you run your property and
- “5” indicates that the source is extremely important and has a strong influence on how you manage your property.

*Please tick one box per line. Please provide and rate additional sources at bottom of the table.*

<table>
<thead>
<tr>
<th></th>
<th>completely irrelevant</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>extremely important</th>
</tr>
</thead>
</table>

a. School education ...........................................□...□□□□□
b. University/Tafe training ...................................□...□□□□□
c. Additional training ..............................................□...□□□□□
d. Family members ...................................................□...□□□□□
e. Other (neighbouring) properties ..............................□...□□□□□
f. Trial and error ....................................................□...□□□□□
g. QLD Dept. of Primary Industries ................................□...□□□□□
h. QLD Dept. of Natural Resources .................................□...□□□□□
i. Other QLD government agencies .................................□...□□□□□
j. Scientific research reports .....................................□...□□□□□
k. Industry magazines ..............................................□...□□□□□
l. Industry consultants ............................................□...□□□□□
m. Business advisors (accountant) .................................□...□□□□□
n. Landcare group ....................................................□...□□□□□
o. Internet ......................................................................□...□□□□□
p. TV, radio, newspaper .............................................□...□□□□□
q. Field days .............................................................□...□□□□□
r. Other (*specify*) .....................................................□...□□□□□
s. Other (*specify*) .....................................................□...□□□□□

16. **What papers, TV stations, radio stations to you read/see/tune into regularly? (please specify)**

Newspapers........................................................................................................................................

Weekly papers/magazines/newsletters..................................................................................................

Radio stations......................................................................................................................................

TV stations........................................................................................................................................
17. Which of the following property management practices do you follow or have you implemented? Please tick one box per line. You may add and rate additional activities if applicable.

<table>
<thead>
<tr>
<th>YES across whole area</th>
<th>YES on part area</th>
<th>NO not applicable on my property area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Grazing management**

- a. Regular pasture monitoring (e.g. species, yield, …) ...........................................
- b. Regular stock monitoring (e.g. performance, condition, …) ...................................
- c. Spelling paddocks regularly (e.g. rotational, wet spelling, …) ..............................
- d. Stock numbers adjusted to pasture condition ........................................................
- e. Complementary stock feeding ...............................................................................
- f. Planting fodder crops .........................................................................................
- g. Subdivisional fencing ..........................................................................................
- h. Cell grazing ...........................................................................................................
- Other (please specify) ..............................................................................................

**Crop management**

- i. Fallow for soil water storage ................................................................................
- j. Break crops ...........................................................................................................
- k. Green trash blanketing ........................................................................................
- l. Conservation tillage .............................................................................................
- Other (please specify) ..............................................................................................
- Other (please specify) ..............................................................................................

**Pest and weed management**

- m. Control woody weeds with fire ..............................................................................
- n. Control (woody) weeds mechanically ...................................................................
- o. Chemical weed control ..........................................................................................
- p. Integrated or biological pest control ......................................................................
- q. Control feral animals (goats, rabbits, pigs etc) ......................................................
- r. Control native animals (kangaroos, wallabies, etc) ..............................................
- Other (please specify) ..............................................................................................
- Other (please specify) ..............................................................................................

**Soil and water management**

- s. Contour banks ........................................................................................................
- t. Monitor total water consumption ...........................................................................
- u. Monitor water consumption on area basis .............................................................
- v. Control water flow from artesian bores ..................................................................
- w. Additional stock waterpoints ................................................................................
- x. Increase efficiency of irrigation practices .............................................................
- y. Artificial wetland(s) ..............................................................................................
- Other (please specify) ..............................................................................................
- Other (please specify) ..............................................................................................

**Environmental management**

- z. Plant and/or fence off riparian vegetation ............................................................
- aa. Fence off remnant vegetation for conservation ...................................................
- bb. Plant (native + local) vegetation for conservation ...............................................  
- cc. Keep some areas deliberately remote from water points .......................................
- Other (please specify) ..............................................................................................
- Other (please specify) ..............................................................................................
18. Do you think the following actions could provide economic and/or environmental benefits for your property?

Economic improvement includes higher cash flow or reduced economic risk.
Environmental improvement includes prevention of erosion and salinity, higher biodiversity, etc.
Please rate in each case the economical and the environmental benefits – provide one tick each to left and right of the line.

<table>
<thead>
<tr>
<th>Economic benefit</th>
<th>YES</th>
<th>YES</th>
<th>NO</th>
<th>YES</th>
<th>YES</th>
<th>NO</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic benefit</td>
<td>large</td>
<td>small</td>
<td></td>
<td>Environmental benefit</td>
<td>large</td>
<td>small</td>
<td></td>
</tr>
<tr>
<td>Economic benefit</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>Environmental benefit</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Economic benefit</td>
<td></td>
<td></td>
<td></td>
<td>7</td>
<td>8</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

a... Enterprise diversification (eg. tourism) ...........................................□1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
b... Continuous stocking at reduced pasture utilisation ...... □1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
c... Rotational grazing system ...................................................□1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
d... Wet season spelling ...........................................................□1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
e... Adjust stocking rate to carrying capacity
(land type, pasture condition) ...................................................□1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
f... Fence and manage land according to land type ........ □1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
g... Add new off-stream stock watering points .................. □1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
h... Establish additional riparian buffer zones .............. □1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
i... Fence off existing (and new) riparian buffer zones ...... □1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
j... Plant new or extend existing riparian buffer zones ...... □1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
k... Fence off remnant vegetation
(other than riparian) ...............................................................□1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
l... Clear native trees ...............................................................□1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
m... Use fire as management tool ................................................□1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
n... Control weeds (woody and other) .................................. □1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
o... Control introduced pest animals ...................................... □1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
p... Control native pest animals .................................................. □1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
q... Fence off marginal grazing land ........................................ □1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
r... Revegetate marginal cropping land ................................. □1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
s... Establish artificial wetlands .............................................. □1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
t... Increase efficiency of irrigation practices ..................... □1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
u... Improve crop rotations ........................................................□1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
v... Improve crop management ................................................... □1 .... □2 .... □3 ........ □4 .... □5 □6 .... □9
Other (please specify) .............................................................. □1 .... □2 .... □3 ........ □4 .... □5 □6
19. To what degree do the following factors constrain you in implementing actions to achieve environmental improvements?

Please rate the following points on a scale from 1 to 5, where
“1” indicates that this is not a constraint, factor or consideration
“5” indicates that this is a very important constraint or factor which effectively stops you from changing the way you manage your property.

Please tick one box per line. You may provide and rate additional constraints at bottom of the table.

<table>
<thead>
<tr>
<th>Not a factor or constraint</th>
<th>Very important factor or constraint</th>
<th>Don’t know</th>
<th>Not applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Operational and financial constraints

a. Not enough time

b. Not enough staff or labour

c. Lack of skills on property

d. High initial capital cost involved

e. High ongoing effort or costs

f. Loss of productive capacity of property

and income

g. Low returns on investment

h. Lack of government incentives

Knowledge constraints

i. Lack of scientific evidence that there is a link between property management and environmental outcomes

j. Not enough information on what is best and how to improve management practices

Uncertainty

k. Variable climatic conditions and drought

l. Uncertainty about future of property

m. Uncertainty about future of industry

n. Uncertainty about tenure

o. Uncertainty associated with native title

Other constraints

p. Lack of broader community support

q. Lack of local leadership

Other (specify)

Other (specify)

Attitude

r. My property is in good shape. There is no environmental improvement required.

s. No-one else seems to care, so why me?

Other (specify)
The following two questions take a **whole-of-catchment perspective**.
Please provide your considered assessment on the basis of your own experience, what you know from neighbours and other properties, and your knowledge about the catchment.

### 20. Do you think environmental outcomes for the Burdekin catchment could be achieved by the widespread adoption of the following activities?
Please tick one box per line and add and rate additional activities if applicable.

<table>
<thead>
<tr>
<th></th>
<th>YES large benefit</th>
<th>YES small benefit</th>
<th>NO</th>
<th>don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

- a. Enterprise diversification (eg. tourism) ...........................................................
- b. Continuous stocking at reduced pasture utilisation ...........................................
- c. Rotational grazing .........................................................................................
- d. Wet season spelling ......................................................................................
- e. Adjust stocking rate to carrying capacity .....................................................
- f. Fence and manage land according to land type ..............................................
- g. Add off-stream stock watering points ................................................................
- h. Establish additional riparian buffer zones ....................................................
- i. Fence existing (and new) riparian buffer zones ............................................
- j. Fence off remnant vegetation (other than riparian) ........................................
- k. Clear native trees and shrubs .........................................................................
- l. Use of fire as management tool ........................................................................
- m. Control weeds (woody and other) ...................................................................
- n. Control feral pest animals ..............................................................................
- o. Control native pest animals ............................................................................
- p. Fence off marginal grazing land ......................................................................
- q. Revegetate marginal cropping land ................................................................
- r. Establish artificial wetlands ............................................................................
- s. Increase efficiency of irrigation practices .......................................................  
- t. Improve crop rotations ......................................................................................
- u. Improve crop management ................................................................................

Other (please specify) ..............................................................................................
21. **How do you rate the effectiveness of the following policies and programs to encourage the widespread adoption of measures to achieve environmental improvements in the Burdekin catchment?**

*Please rate the following options on a scale from 1 to 5, where

1 = completely ineffective (i.e. complete waste of effort and money)

5 = extremely effective (i.e. would work well)*

*Please tick one box per line. Please provide and rate additional options at bottom of the table.*

<table>
<thead>
<tr>
<th>Option</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education, Extension, Development</td>
<td></td>
</tr>
<tr>
<td>a. More state government extension</td>
<td></td>
</tr>
<tr>
<td>b. Better access to existing data/information</td>
<td></td>
</tr>
<tr>
<td>c. Better environmental education at school</td>
<td></td>
</tr>
<tr>
<td>d. Offer courses in book/record keeping</td>
<td></td>
</tr>
<tr>
<td>e. Technical and applied management courses</td>
<td></td>
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<tr>
<td>f. Environmental management courses</td>
<td></td>
</tr>
<tr>
<td>g. On-property demonstration sites</td>
<td></td>
</tr>
<tr>
<td>h. More research</td>
<td></td>
</tr>
<tr>
<td>Voluntary and/or industry measures</td>
<td></td>
</tr>
<tr>
<td>i. Voluntary codes of conduct</td>
<td></td>
</tr>
<tr>
<td>j. Accreditation of land managers</td>
<td></td>
</tr>
<tr>
<td>k. Community involvement in work</td>
<td></td>
</tr>
<tr>
<td>l. Property management plans</td>
<td></td>
</tr>
<tr>
<td>m. Effective co-operative arrangements between individual properties on a voluntary basis</td>
<td></td>
</tr>
<tr>
<td>n. Conservation credit system for properties (eg. carbon credits or credits reflecting the conservation status of the property with respect to land, water, biodiversity. This can be used, for example, as a marketing tool)</td>
<td></td>
</tr>
<tr>
<td>Financial incentives</td>
<td></td>
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<tr>
<td>o. More funding for Landcare projects</td>
<td></td>
</tr>
<tr>
<td>p. Income tax incentives for landholders/managers (for example: expenses in relation to conservation works are fully tax deductible in that year)</td>
<td></td>
</tr>
<tr>
<td>q. Costsharing arrangements not related to Landcare (for example: government pays for structural works and landholder provides labour)</td>
<td></td>
</tr>
<tr>
<td>r. Rate and lease payment reductions for on-property conservation areas including riparian buffer zones</td>
<td></td>
</tr>
<tr>
<td>s. Debt-for-conservation swaps (debt is written off in exchange for conservation works)</td>
<td></td>
</tr>
<tr>
<td>Regulation</td>
<td></td>
</tr>
<tr>
<td>t. Increased government regulation</td>
<td></td>
</tr>
<tr>
<td>u. Cross-compliance (for example: conservation work as condition for lease renewal)</td>
<td></td>
</tr>
<tr>
<td>v. Conversion of leasehold to freehold</td>
<td></td>
</tr>
<tr>
<td>Other – please specify</td>
<td></td>
</tr>
<tr>
<td>w.</td>
<td></td>
</tr>
<tr>
<td>x.</td>
<td></td>
</tr>
</tbody>
</table>
22. **If new research was to be initiated, what priorities would you give to...? Please rate from 1 to 4.**
   - □ 1 …improved production and profit
   - □ 2 …reduced environmental impact
   - □ 3 …better understanding of catchment as a whole (water, industries, community, and how they relate)
   - □ 4 …other (Please specify)……………………………………..

23. **What formal education have you completed?**
   - □ 1 Primary school
   - □ 2 High School
   - □ 3 University
   - □ 4 TAFE
   - □ 5 Other (Please specify)……………………………………..

24. **What formal education have other family members/staff who work on the property completed?**
   - □ 1 Primary school
   - □ 2 High School
   - □ 3 University
   - □ 4 TAFE
   - □ 5 Other: (Please specify)……………………………………..
   - □ 6 Not applicable

25. **What property-relevant training have you (property manager) completed in the past five years?**
   Please specify.
   1) …………………………………………………………….
   2) …………………………………………………………….
   3) …………………………………………………………….

26. **What property-relevant training have other family members/staff completed in the past five years?**
   Please specify.
   1) …………………………………………………………….
   2) …………………………………………………………….
   3) …………………………………………………………….

27. **Is there a property management plan in place?**
   - □ 1 yes
   - □ 2 currently in process of establishing an PMP
   - □ 3 no

28. **Is there an environmental management plan in place?**
   - □ 1 yes
   - □ 2 currently in process of establishing an EMP
   - □ 3 no
29. In what category would you place your total annual income last financial year?
This includes on-property and off-property income for your household, i.e. you and your partner(s), after expenses but before tax.

☐ 1  negative
☐ 2  $ 1 to $20,000
☐ 3  $ 20,001 to $50,000
☐ 4  $ 50,001 to $100,000
☐ 5  $ 100,001 to $250,000
☐ 6  $ 250,001 to $500,000
☐ 7  $ 500,001 and above
☐ 0  don’t know
☐ 9  prefer not to specify

30. According to your best estimate, what proportion (per cent) of this income would come from the following sources?

…….% pastoral activities (cattle, sheep, other livestock)
…….% agriculture (dryland and irrigation cropping)
…….% off-property employment (from eg. full or part time employment, contract work)
…….% off-property investment
…….% other activities on the property (eg. tourism, forestry, mining)
…….% other (please specify)……………………………………

31. What share of your property is under mortgage? ………….%

32. How do you rate the medium to long-term profitability of the property?

☐ 1  very good
☐ 2  good
☐ 3  satisfactory
☐ 4  marginal
☐ 5  not sustainable
☐ 0  don’t know
☐ 9  prefer not to specify

33. Is there a succession plan in place for the property?

☐ 1  yes - son or daughter likely to take over
☐ 2  yes - other family member likely to take over
☐ 3  yes - other (please specify)……………………………………………………………………
☐ 4  no - current owner/manager will stay on for foreseeable future
☐ 5  no - property/lease to be sold in foreseeable future
☐ 6  no - lease expires in foreseeable future and will not be renewed
☐ 7  no - other (please specify)……………………………………………………………………

34. Are you aware of environmental threats that occur on your property but that are caused elsewhere? (an example would be dryland salinity in the Murray Valley caused by upstream tree clearing)
…...……………………………………………………………………
…...……………………………………………………………………
…...……………………………………………………………………
35. Is there anything that you would like to say in relation to this survey, the Burdekin catchment, the Burdekin Dry Tropics Board, or in general?

........................................................................................................................................................................
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Thank you very much indeed for your time and collaboration!

Would you like to receive further information on the project, in addition to information you will receive through the Burdekin Dry Tropics Board.

□ yes please provide email address ..................................................................................................................

□ no
Appendix 5: Perceived environmental benefits of NRM activities at the sub-catchment scale

Upper Burdekin

Score for economic benefit  
(0 = none; 2 = large)

Score for on-site environmental benefit  
(0 = none; 2 = large)

Mean score for catchment wide environmental benefit  
(0 = none; 2 = large)

Mean score for on-site environmental benefit  
(0 = none; 2 = large)
Score for economic benefit
(0 = none; 2 = large)

Score for on-site environmental benefit
(0 = none; 2 = large)

Mean score for catchment wide environmental benefit
(0 = none; 2 = large)

Mean score for on-site environmental benefit
(0 = none; 2 = large)
Social and Economic Issues of NRM in the Burdekin Dry Tropics Region

Score for economic benefit
(0 = none; 2 = large)

Score for on-site environmental benefit
(0 = none; 2 = large)

Mean score for catchment wide environmental benefit
(0 = none; 2 = large)

Mean score for on-site environmental benefit
(0 = none; 2 = large)