A typology of graziers’ land management strategies and its importance for sustainability in the Bowen-Broken catchment

Iris Bohnet, Elaine Harding, Karl Haug, and Brian Roberts
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For further information contact:
Dr Iris Bohnet
CSIRO Sustainable Ecosystems Atherton
Ph: (07) 4091 8826
iris.bohnet@csiro.au

or the CSIRO Communications Unit on:
Ph: (02) 6246 4565
Fax: (02) 6246 4564

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Abbreviations

ABS     Australian Bureau of Statistics
BMP     Best Management Practice
CSIRO   Commonwealth Scientific and Industrial Research Organisation
DNRW    Department of Natural Resources and Water
DPI&F   Department of Primary Industries and Fisheries
FNQ     Far North Queensland
GBR     Great Barrier Reef
LGA     Local Government Area
NRM     Natural Resources Management
OESR    Office of Economic and Statistical Research
RCS     Resources Consulting Services
WfHC    Water for a Healthy Country

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1 Introduction

1.1 Management strategies for sustainable grazing

Within the Burdekin catchment, the Bowen-Broken sub-catchment has been identified as a major contributor of sediment and nutrients that enter into the Great Barrier Reef (GBR) lagoon (Prosser et al. 2001; Brodie et al. 2003; O’Reagain et al. 2005). Loss of sediment and nutrients not only affects livestock production, future productivity and profitability of grazing properties, but also impacts upon the long-term economic, social and ecological sustainability of the Great Barrier Reef lagoon and reef catchments.

The condition of the land is the primary factor directly influencing the loss of sediment and nutrients (Stafford Smith et al. 2000) into riverine systems which ultimately flow into the GBR. Graziers monitor changes in the health of their properties through observation and therefore their management responses to changing land conditions can lead either to improved or degraded states of health in the future (Landsberg et al. 1998). Ideally, the relationship between the land and the land manager is a positive one: where both can thrive through the conscious and timely decision-making processes that the manager has implemented. A system of land management is therefore key to a successful land-grazier relationship, and although the particulars of any individual approach may vary spatially and temporally, there are likely to be consistent value systems and socio-economic factors which guide the development of a specific typology of land management (Emtage et al. 2006). By understanding these unique types of land management, and the factors which may lead to their development, government agencies and research organisations can more clearly apprehend differences in land management strategies and thus effectively tailor their extension and incentive programs to meet those needs (Emtage et al. 2006).

Land condition on grazing properties has been defined as ‘the capacity of grazing land to respond to rain and produce useful forage” (Ash et al. 2005). In particular, healthy land condition generally contains good coverage of native ‘3P’ grasses to ensure that water is captured effectively, while poor land condition is often indicated by a sparse cover of grasses, low water retention, high amounts of runoff and reduced forage growth (Ash et al. 2005). The term ‘3P’ describes those native species that are “perennial, productive and palatable” (Ash et al. 2005). Pasture utilization or “the percentage of pasture growth in a year that is consumed by cattle” is an important aspect of maintaining good land condition. An example from the ECOGRAZE study (Ash et al. 2005) demonstrates this measure:

Assume there is a stocking rate of one adult cow (450 kg) to 10 ha of land. This animal will eat approximately 3,000 kg of dry forage per year. The amount consumed per ha is therefore 300 kg dry forage per year. If we now assume that the pasture produces, on average, 1,500 kg / ha of dry forage per year, then pasture utilisation is: 300 / 1,500 = 20%.

Thus, land condition is a product of how pasture utilisation interacts with the existing characteristics of the soil, grass species and cover, slope and amount and seasonality of rainfall (Stafford Smith et al. 2000)

Although the concept of ‘sustainable’ grazing land is not easily defined outside an individual property’s context, there are several core elements that have been shown to allow for the continued long-term health of the land (Ash et al. 2005):

- The current best management practice system utilises continuous stocking at 25% utilization rates or early wet season spelling followed by 50% utilization rates;
- To achieve efficient use of the pasture, the maximum paddock size should not be more than about 2000 ha;
• Distance to water should not be more than about 2 km;
• Rotational grazing systems that incorporate wet season spelling can provide an improved overall pasture condition and be more profitable than continuous grazing strategies.

The overall stocking rate, type of rotational system, and use of wet-season spelling are therefore three key features of most sustainable land management strategies, with the first factor having a strong influence on general land condition (Roberts 1972; Ash et al. 2005). Because these factors are inter-related and there is no single rule which can be applied to every property, it is necessary to directly measure the land condition in order to properly assess if the management approach leads to sustainable outcomes for the environment. Notwithstanding that, stocking rates of 5-16 ha/head are generally recommended, assuming that sufficient water is available for the cattle to be evenly distributed throughout the paddock (Ash et al. 2005). Although continuous and rotational grazing systems may have similar impacts on land condition when distance to water is not a major factor, one of the primary reasons for rotational grazing is to minimise the intensive disturbance that can occur from continuous grazing of paddocks (Ash et al. 2005). Additionally, rotational grazing which provides some wet season spelling for every paddock can improve pasture biomass and species composition (Ash et al. 2005).

Maintaining an adequate cover of grasses throughout the year is more likely to lead to improved infiltration rates and reduced run-off of sediments and nutrients (Gordon and Nelson 2007).

To manage a sustainable land condition, graziers must develop strategies to maintain pasture quality and quantity, while minimising risk and unexpected expenditure outlays (Landsberg 1998). Often, they learn about improvements to land management systems through a diverse range of sources, including their own experimentation, through neighbours, field days, government extension programs, and published information (Kilpatrick et al. 1999). However, their capacity to seek and integrate new approaches to land management is strongly influenced by their socio-economic status and a dynamic set of beliefs, values and attitudes (Emtage et al. 2006). Therefore, designing outreach and incentive programs that target the needs of graziers must first consider their differing approaches to learning (Kilpatrick et al. 1999) and the socio-economic constraints which may limit their capacity for information delivery and attitudinal and behavioural change (Emtage et al. 2006).

Regional studies examining the types of land management strategies used within an industry may therefore provide insights into the variety of outreach and educational approaches necessary to improve sustainability outcomes (Emtage et al. 2006). The classification into types is often based upon a combination of physical and economic, social and psychological variables (especially attitudes and values) that are gained through surveys and in discussions with landholders. In Australia, research investigating the categories of land managers within a sector has become more common, with studies across different sectors (agroforestry, grazing, crops) describing some similarities among these categories (Emtage et al. 2006). In particular, the following socio-economic factors (Emtage et al. 2006) have been indicated as providing consistent differentiation among land management styles:

• Landholding: economic characteristics, size and productivity
• Off-farm income
• Family history: ownership, size, time in life-cycle
• Education level
• Attitudes towards government and biodiversity conservation

Thus, the examination of these factors within a regional group or landholder sector can aid in classifying a diversity of management approaches. The data collected from such
surveys can often reveal a set of consistent socio-economic factors that, if linked to underlying values and attitudes, can assist in developing a profile of landholder types to guide improvements in outreach and incentive programs.

Recent studies in the Burdekin catchment have identified that graziers are interested in obtaining better access to information and that on-property demonstrations of existing research are generally effective outreach tools (Greiner et al. 2007). Although Greiner’s study (2007) sought to identify motivations and constraints to uptake Best-Management-Practices across grazing and sugar-cane lands, it did not fully examine the existing land management strategies or their linked socio-economic drivers in relation to improvements in educational outreach and land improvement incentive strategies.

1.2 Scope of the research

This research project addresses this gap by working in partnership with graziers and government in the Bowen-Broken catchment to assess the existing types of grazing management strategies and clarify the socio-economic factors which may underpin these types. It builds on existing work carried out by CSIRO (Greiner et al. 2003; Bartley et al. 2004; Ash et al. 2005;), Greening Australia (2004) and River Consulting (Greiner and Lankester 2006; Greiner et al. 2007).

The overall aims of the project are to:

- enhance understanding of the constraints graziers face in changing to more sustainable grazing systems;
- develop proposals that contribute to the building of more resilient grazing communities through efficient and permanent grazing systems and creation of alternative wealth streams.

Specific objectives of the project are to:

1. provide a typology of graziers’ approaches to land management;
2. understand graziers’ current social and economic situation and the potential influence these have on land management strategies;
3. identify graziers’ aspirations and motivations to maintain and achieve a sustainable business (including impediments to change to more sustainable systems);
4. provide opportunities for graziers to discuss potential income streams and explore viable long-term land practices;
5. develop strategies with graziers to address the potential risks and uncertainties with the adoption of changes in land management practices and alternative income streams; and
6. learn from successful graziers who have changed their land management practices and who have made use of alternative income streams for economic and environmental benefit.

This report addresses research objectives 1, 2, and 3 listed above. The results presented provide an in-depth portrait of graziers’ management strategies and how their current social and economic situation, as well as their aspirations and motivations, may influence their capacity to achieve a sustainable business. The study does not attempt to identify if landholders are achieving sustainable environmental, social and economic outcomes, but rather it assumes that there are particular elements of a land management strategy (such as wet season spelling) that may enhance the likelihood of achieving such outcomes.
The results also provide important input into SEPIA (Single Entity Policy Impact Analysis), an agent-based model through which policy options can be tested. To reduce uncertainty in the model, this research project developed a typology of graziers that provided detailed information for the SEPIA project (Smajgl et al. 2007).
2 Research approach

2.1 A conceptual model of the relationship between grazier and grazing land

To gain an increased understanding of graziers’ relationship to their land and their capacity to achieve a sustainable business, it was necessary to develop a theoretical foundation for the project. It was considered important to first identify the key socio-economic factors that may influence graziers’ land management systems, and based on those key factors, to develop groupings or a typology of graziers in the Bowen-Broken catchment. This understanding is useful for developing targeted strategies (i.e. policies, incentive schemes, education programmes, tax rebates, and other government initiatives) that are tailored to address the needs of different groups of graziers with the aim of improved environmental, social and economic outcomes for grazier, catchment and reef communities.

Using a systems approach, a conceptual model of the relationship between grazier and grazing land was developed (Figure 1) with key factors such as age, family history and income to debt ratios and core values impacting on the grazier’s perceptions and actions. In this model, graziers play a crucial role in the grazing landscape, as they are part of the biosphere, but as reflecting and acting beings they can set themselves apart from the grazing landscape (Tress and Tress, 2001). The grazier-land relationship is therefore composed of both material and perceptual realities as illustrated by the arrow directions.

Figure 1. Conceptual model of the dynamic relationship between grazier and grazing land.
Graziers perceive the grazing land through a filter of beliefs and values, which are generally influenced by their socio-economic status, cultural background and individual experiences (Abel et al. 1998; Tress and Tress, 2001). They create, through thinking and reflecting, mental images about the grazing land and how, in practice, activities such as management decisions taken by them impact upon the grazing land. Thus, their land management system evolves in response to the interactions of their internal view of the land with their knowledge, values and current socio-economic situation all providing a context for their decision-making processes, as indicated in the time arrow in Figure 1.

2.2 Study area

The Bowen-Broken catchment is located in the Dry Tropics of North Queensland. It is a large sized sub-catchment of the Burdekin catchment which covers an area of approximately 9,500 square kilometres (Figure 2). The catchment is hilly in places (Figure 3) with grano-diorite, basalt and sedimentary soils, and sodic soils on river banks (O’Reagain et al. 2005). Many areas are overgrazed with low vegetation cover (O’Reagain et al. 2005).

![Burdekin River Catchment](image_url)

Figure 2. Burdekin river catchment, showing the location of the Bowen-Broken sub-catchment with major towns and roads (Source: Bartley et al. 2004).

The Leichhardt range separates the Bowen-Broken catchment from the remainder of the Burdekin catchment to the west (DND, 1972). The Clarke and Connors Ranges separate the Bowen-Broken from the coastal catchments to the east, while the Denham Range separates it from its southern boundary. The landforms found within the catchment are relatively complex due to variations in the underlying geology and geomorphology (Burdekin Project Committee, 1976). Dissected and gently undulating plateaus, high plains and igneous intrusions are prominent along the Connors Range with tertiary basalts and minor sediments pocketing the western side of the range and the southern hills and tablelands. Gently undulating hills and ridges and level to gently undulating plains and lowlands dominate the lower catchment, particularly along the Bowen River section.
Figure 3. Bowen-Broken catchment showing elevation values ranging from 80m to 1080m above sea level (Source: Bohnet 2006).

The dominant land use in the Bowen-Broken catchment is grazing on native pastures (Figure 4), comprising more than 75% of the catchment land use. Other land uses are production forestry and very small pockets of vegetable and cereal crops. In contrast, the coastal areas of the shire – outside the Bowen-Broken catchment – are dominated by crop production.

The eastern ranges are mostly rainforest with areas of wet sclerophyll in high rainfall zones, while the western and lower parts of the catchment are much drier with open woodlands and grasslands dominating.
The Bowen Shire Local Government Area (LGA) covers a substantial part of the Bowen-Broken catchment (Figure 3); small parts of the catchment are located in Burdekin, Mirani and Nebo Shire, bordering shires are Belyando, Dalrymple, Whitsunday and Mackay.

Although this project deals with the geographical area covered by the catchment boundaries of the Bowen and Broken Rivers, data on the population, economics and other statistical data relevant to this project are based on and presented for the LGA of Bowen Shire.

The total area of Bowen Shire is 21,177 square kilometres. The shire has a population of around 13,700 people with approximately 9,000 people living in the coastal town of Bowen, and 4,700 in the outlying rural region including Collinsville, an old mining town (OESR, 2005). Bowen is the administrative centre of the shire and Collinsville is the only other major township. About 750 persons or 5.5% of the shire population stated that they were of Aboriginal or Torres Strait Islander origin.

The total gross value of agricultural production in the Bowen Shire for the 1998-99 financial year was AU$159.1 million, representing 2.5% of the Queensland total. Crops comprised 78.2% of the regional total, while livestock disposals comprised 20.9% and livestock products 0.9% of the regional total.
3 Research design and methods

3.1 Research design

The research is conducted through three major research phases which include desktop studies, field studies and communication. The three phases include:

- Phase I – Planning and building research partnerships;
- Phase II – Learning from the case study;
- Phase III – Reflecting, synthesising and sharing key findings.

The relations between the phases and details of each are presented in Figure 5.

![Adaptive research cycle](image)

Figure 5. Adaptive research cycle.

3.2 Methods

As the aim of the investigation to date was to gain new and deeper insights into the land management strategies used and how the particular social and economic situation of graziers may influence their land management strategies, a qualitative approach was adopted (Silverman, 2000). This methodological approach is based on the principle of openness and flexibility, which was a requirement as the project also developed grazing agents for input into SEPIA (Smajgl et al. 2007).

A literature review was carried out to provide background and context to the research (Bohnet, 2006). Meetings were held with researchers and extension providers who are familiar with the Bowen-Broken catchment and who could suggest a wide range of graziers to contact for this research. Relevant maps, including a land use/land cover map, topography and rainfall, as well as a grazing properties map, were developed before interview schedules and land assessments were designed. The following section focuses on the design of the qualitative interview schedule and the land assessment as they were
the central methods used to gain understanding of graziers' decision-making about land management and to develop a typology of grazing agents for the SEPIA model.

3.2.1 Design of the qualitative interview schedule

From the range of qualitative interview techniques available, the ‘semi-structured interview’ was chosen because it is well suited for situations where the same information needs to be captured in all interviews. For example, the information needs for the SEPIA model were quite specific and following a checklist of reminders or themes would have not been sufficient. Nevertheless, the interview questions were open-ended and allowed new insights to emerge during the study. This was important to gain a better understanding of the social and economic situation of graziers and how that relates to their management approach. This information was equally important for the SEPIA project; however, quantitative data were required for model input and this was not undertaken in this study. The interviews conducted consisted of the following parts (Appendix 1):

- The first set of questions focused on land use and management strategies. They included a number of detailed questions regarding herd and grazing land management, which were essential for categorising management types.
- The second part of the interview covered the history of the grazing property and the grazier, landscape changes and values held by the grazier in relation to their land. These questions provided insights into the relationship between grazier and grazing land, which provided socio-economic information for clarifying a typology of graziers and grazing agents.
- In part three, the interviewees were asked about the economics of their business and if governments should stimulate change through incentive or other payments.
- The last set of questions was about graziers’ future aims and aspirations as related to the property. These questions also provided more general information used to develop a typology of graziers.

3.2.2 Design of the land assessment field record sheet

To supplement the qualitative interview data, the team decided to carry out land assessments (Countryside Commission, 1993) of the land managed by each of the interviewees (Appendix 2). The aim of the assessments was to gain a deeper contextual understanding of the interview data and to collect another data set for triangulation. In the land assessment, which was in essence farm tours led by the grazier or grazing couple, the focus was on the built and natural environment, land use and management practices and areas that the graziers felt important to look at during the assessment. These tours were also of great value as they provided the research team with additional information about the property, but more importantly, they provided insights into the values and attitudes of the interviewees (Abel et al. 1998).

3.2.3 Analysis

All interviews were tape-recorded with the consent of the interviewees and transcribed verbatim. This database was supplemented with data gathered during the land assessments and landscape photographs taken during the station visit. This database was analysed according to Glaser and Strauss’ Grounded Theory (Strauss and Corbin, 1996). They maintain that the text should be encoded only with themes arising from the data, but since it was clear that specific information was collected as input into SEPIA, some of the codes (categories) were predefined. Nevertheless, most of the codes were derived from the data. ATLAS.ti (Muhr, 1997), a qualitative software package, was used to analyse and code the data on the computer.
As a first step (open coding), the full text of the first interview was screened and codes attached to clear statements regarding the research questions. Similar statements were assigned the same codes, which were defined primarily according to the empirical data as well as to the research questions. Land assessment and photos were used as supporting information and for triangulation. Subsequent interviews were then analysed in the same way with established codes being revised and new codes developed according to the empirical findings.

In a second step (axial coding) the inter-relationship between codes (known as nodes) was investigated, based on the data from all interviews, land assessments and photographs. The nodes identify common patterns in the data and explain the inter-relationships between the codes. The key codes and nodes on which the inter-relationships are based were then examined and revised by the research team until a consistent set of themes could be found in the data.

In a final step (selective coding) the text and landscape photographs were screened again, but only to further underpin the differences between groups of graziers identified.

### 3.2.4 Selection of graziers for the interview

Taking a qualitative approach, the main aim was to gain insights into the subject through in-depth analysis rather than statistical quantification. A large and representative sample size was therefore not required, so only a small number of individuals were interviewed. The interviewees were purposefully sampled, in contrast to random stratification, based on expert opinion provided by researchers and extension staff familiar with the catchment and its graziers (Bohnet, 2006) and by geographical stratification of the sample (Figure 6), e.g. stations bordering the Bowen River, bordering the Broken River, stations located in close proximity to Collinsville, and stations located in hilly terrain.

![Figure 6](image_url)
Besides including graziers from different age and gender groups, graziers who manage their properties using different approaches were included in the sample. Agricultural extension personnel with expertise in the area recommended graziers who they thought might be willing to participate in the research (Laing, Nelson, Torenbeck; pers. comm. 2005, 2006). In addition, a snowballing technique, where an interviewee suggests other potential interviewees, was also used to gain access to as many different graziers as possible. This sampling procedure was repeated until no new information could be gained from the interviews.

In 2006, 9 in-depth interviews and land assessments with a total of 13 graziers were carried out at their stations. Their characteristics are shown in Table 1. On four of the nine properties visited, the interview was carried out with the grazing couple (husband and wife/partner) who jointly manage their property and make decisions regarding land management. The characteristics of the grazing properties are presented in Table 2. Six informal, less detailed, interviews were carried out over the phone with graziers who were not available during the two rounds of field research, giving a final sample size of 19 respondents. The information gathered from the six informal interviews was mainly used for validation of the in-depth interviews and land assessments carried out on site.

Table 1. Broad characteristics of the interviewees.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>8</td>
</tr>
<tr>
<td>Female</td>
<td>5</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
</tr>
<tr>
<td>30 – 40</td>
<td>6</td>
</tr>
<tr>
<td>41 – 50</td>
<td>3</td>
</tr>
<tr>
<td>51 – 60</td>
<td>4</td>
</tr>
<tr>
<td><strong>Broad occupational status</strong></td>
<td></td>
</tr>
<tr>
<td>Agricultural qualification; have been a farmer/grazier all his/her life</td>
<td>10</td>
</tr>
<tr>
<td>Qualification related to agriculture, e.g. accounting</td>
<td>3</td>
</tr>
<tr>
<td><strong>Length of time lived in the Bowen-Broken catchment</strong></td>
<td></td>
</tr>
<tr>
<td>&lt; 5</td>
<td>3</td>
</tr>
<tr>
<td>5 – 10</td>
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</tr>
<tr>
<td>11 – 15</td>
<td>1</td>
</tr>
<tr>
<td>&gt; 16</td>
<td>6</td>
</tr>
<tr>
<td>Whole life</td>
<td>3</td>
</tr>
</tbody>
</table>
Table 2. Characteristics of the grazing properties visited for the research.

<table>
<thead>
<tr>
<th>Geographical location of property in catchment</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bowen river frontage</td>
<td>4</td>
</tr>
<tr>
<td>Broken river frontage</td>
<td>2</td>
</tr>
<tr>
<td>Bogie river frontage (outside Bowen-Broken catchment boundary)</td>
<td>1</td>
</tr>
<tr>
<td>No main river frontage</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Property size</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10,000 ha</td>
<td>1</td>
</tr>
<tr>
<td>10,000 ha – 20,000 ha</td>
<td>5</td>
</tr>
<tr>
<td>&gt; 20,000 ha</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Land tenure</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freehold (family owned grazing property)</td>
<td>7</td>
</tr>
<tr>
<td>Perpetual grazing lease (family owned)</td>
<td>1</td>
</tr>
<tr>
<td>30 year grazing lease</td>
<td>1</td>
</tr>
</tbody>
</table>
4 Results

4.1 Groups of graziers in the Bowen-Broken catchment

Based mainly on their land management characteristics, four distinct groups of graziers emerged. These groups are described below and the main differences between the groups are summarised in Tables 3, 4 and 5. Selected quotations are used to illustrate the findings, and, in the interest of readability, not all interviewees are quoted on every aspect. However, the results are based on the analysis of all interviews according to common practice in qualitative studies.

4.1.1 Group 1: Cell graziers

Group 1 consists of graziers whose land management strategy is characterised by short rotations and spelling in small paddocks with moderate cattle levels. The long-term goal of this group is to not only have a small but a large or the whole property under a cell grazing system. They are generally middle-aged with a high level of investment in their property and have a relatively well developed land ethic.

“We call ourselves grass farmers rather than cow farmers; put the focus back on the grass and look after it, rather than looking after the cow. … The focus is on looking after the grass and environment, and therefore if the grass is really healthy and there’s no gaps in it, there isn’t really anywhere for those weeds to come in.” [interviewee 1]

This statement indicates that making money for short-term economic gains may not be the highest priority for these graziers, but that other factors are not only relevant but may have a higher priority. To graziers in Group 1 the long-term sustainability of their land seems to come first.

“We could probably run our stock without being detrimental to the environment. Maybe we’re wrong, but that’s our aim…and make more money.” [interviewee 2]

Graziers in this group are younger than the average farmer (45 years) and have undertaken courses with Resource Consulting Services (RCS). The RCS website says “RCS can assist you to create a productive and profitable grazing business. Our group of dedicated, experienced hands-on staff will work with you individually or within a management team to assist you to analyse the current situation, develop options, implement and manage your grazing business” (Resource Consulting Services, 2002). Half of the property managed by interviewee 1 and 2 is under a cell grazing system where high numbers of cattle are kept for short periods of time in a paddock which then gets a rest from grazing for several months. It is the aim of the managers to convert the whole property to a time-controlled cell grazing system. However, infrastructure costs, i.e. fencing and establishment of watering points, are high.

“I can’t remember off the top of my head, probably about $250,000 to finish, putting the same basic water development over on this half of the property. I’m investigating every scheme that’s out there at the moment that can help me get there …” [interviewee 1]

According to the philosophy of graziers that are part of Group 1, the system is managed highly intensively and provides environmental, aesthetic and economic benefits for graziers and the wider community through the provision of a continuous groundcover, erosion control, reduced off-property impacts, and other benefits. However, establishment costs are high and it may not be feasible to establish this system where water is not available, topography is steep or undulating, and soils are of poor quality (Ash et al 2005).
Table 3. Property and management characteristics distinguishing grazier’s management strategies in the Bowen-Broken catchment.

<table>
<thead>
<tr>
<th>Grazing Management Strategy</th>
<th>Cell</th>
<th>Rotational</th>
<th>Continuous</th>
<th>Heavy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Paddock Size [ha]</td>
<td>311</td>
<td>536 - 2,778</td>
<td>2,125</td>
<td>2,000</td>
</tr>
<tr>
<td>Initial Stocking rate [ha/animal]</td>
<td>12</td>
<td>13 - 29</td>
<td>8 - 10</td>
<td>6</td>
</tr>
<tr>
<td>Stocking rate changes</td>
<td>Dynamic</td>
<td>Dynamic</td>
<td>None (except forced by drought)</td>
<td>None</td>
</tr>
<tr>
<td>Rotation</td>
<td>Short term</td>
<td>Medium term</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Property Improvement in $ for infrastructure (fencing, watering points)</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
<td>None</td>
</tr>
<tr>
<td>Wet season spelling</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Supplementary Feeding</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Table 4. Social and economic characteristics of the four distinct groups of graziers in the Bowen-Broken catchment.

<table>
<thead>
<tr>
<th>Grazing Management Strategy</th>
<th>Cell</th>
<th>Rotational</th>
<th>Continuous</th>
<th>Heavy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of main manager</td>
<td>≤ 40</td>
<td>≤30 to ≥ 55</td>
<td>≥ 55</td>
<td>NA ♦</td>
</tr>
<tr>
<td>Family history</td>
<td>Station in family for generations</td>
<td>Station part of “multimillion $” family business</td>
<td>Station in family for one or two generations</td>
<td>Mining company</td>
</tr>
<tr>
<td>Information sources</td>
<td>RCS*</td>
<td>RCS*</td>
<td>None</td>
<td>Mining company</td>
</tr>
<tr>
<td>Participation in incentive schemes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Income</td>
<td>On-farm, cattle agistment</td>
<td>On-farm, off-farm businesses and from other family businesses</td>
<td>On-farm</td>
<td>On-farm, mining</td>
</tr>
<tr>
<td>Business strategy</td>
<td>Focus on detail on-farm and on-farm diversification</td>
<td>Diversification on-farm and off-farm, growing businesses</td>
<td>Business as useful, exiting industry</td>
<td>Driven by mining interests</td>
</tr>
<tr>
<td>Debt level</td>
<td>Low</td>
<td>High</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

* Resource Consulting Services ♦ Properties owned by mining companies
Table 5. Personal values, motivations and perceptions characterising the four distinct groups of graziers in the Bowen-Broken catchment.

<table>
<thead>
<tr>
<th>Grazing Management Strategy</th>
<th>Cell</th>
<th>Rotational</th>
<th>Continuous</th>
<th>Heavy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value/s related to business</td>
<td>Environment, grass cover</td>
<td>Grass cover</td>
<td>Freedom of choice</td>
<td>Mining interest</td>
</tr>
<tr>
<td>Motivations of being a grazier</td>
<td>Land management for future generations</td>
<td>Land management for further generations – running a ‘successful’ business</td>
<td>Independence</td>
<td>NA</td>
</tr>
<tr>
<td>Business motivations</td>
<td>Handing over sophisticated grazing business to next generation</td>
<td>Handing over growing businesses to next generation</td>
<td>Improving grazing business to hand over to next generation or to sell</td>
<td>Prospect of mining</td>
</tr>
<tr>
<td>Perception of incentive schemes</td>
<td>Provide win/win for the environment and the grazier</td>
<td>Useful if they can provide benefits for graziers</td>
<td>Sceptical due to a lack of success or infringement of independence</td>
<td>NA</td>
</tr>
<tr>
<td>Perception of what the main issues are</td>
<td>Water availability, environmental flow of the rivers</td>
<td>Water availability, environmental flow of the rivers</td>
<td>Water availability, environmental flow of the rivers</td>
<td>Water availability</td>
</tr>
</tbody>
</table>

Government financial support to establish this system appears capable of motivating graziers who are interested in splitting up paddocks in order to reduce grazing pressures and create a more even groundcover across the property.

Besides the distinctive management strategy that graziers of Group 1 employ, a further defining feature of this group is their focus on-farm. Instead of ‘getting bigger’ by acquiring a further station or farm, or diversifying/supplementing the farm income with off-farm income, graziers of Group 1 focus on land management and how to achieve greater efficiencies in the system, such as through a cell grazing system. However, on-farm diversification also takes place; for example, interviewee 1 agists cattle for other graziers who are unable to keep their stock on their properties due to a lack of grass and/or water.

Debt levels of graziers in Group 1 are relatively low due to the focus of activity and investment on one property.

4.1.2 Group 2: Rotational graziers

Group 2 is the most diverse group of graziers identified in the Bowen-Broken catchment. All graziers in this group use a rotational grazing system that provides some rest to the pastures from grazing, achieved through wet season spelling. However, graziers in this group may rotate over longer periods and in larger-sized paddocks. Rotational graziers also have a relatively well developed land ethic, similar to graziers of Group 1.

“The land is what I’m passionate about, the long term sustainability of the land. … This raises a few eyebrows with a few graziers, but to me the cattle or the camels or the sheep or whatever you want to use, are just a tool that we use to turn the grass into money. … Cattle come and go, the land goes on forever.” [Interviewee 6]

Similar to graziers of Group 1, most graziers in this group have set up a cell grazing system on their property. However, this has occurred only in relatively small sections of
their properties (approximately 10%), where soil type, topography and water availability, provided the opportunity to set up a cell grazing system. On one of the properties, mining has already commenced or is close to commencing in the area where the grazier has established his cell grazing system. The grazier described the situation as follows:

“We’ve made big investments in infrastructure to set that up. … There’s 43 paddocks in the rotation.” … “What they’re [the mining company] taking is a bit over 10% of the whole property but this is where all the infrastructure is and this is the developed and intensively managed part of the property. It’s like a motor car with the engine taken out of it. You’ve still most of the motor car but the important part is not there.” [interviewee 6]

This is not an exception. On other properties, particularly those close to the township of Collinsville, mining companies are also prospecting for coal or have proven coal reserves in areas where graziers have set up infrastructure for more intensive management. Despite the fact that graziers are losing their most valuable grazing land they are not in a position to oppose mining and are limited to negotiating compensation levels.

“We’ve said we’re not trying to stop the mine but we just want fair compensation for the 20 years that we’ve put in. And the value of grazing land has escalated quite high in recent times.” [interviewee 6]

To address this threat and other uncertainties such as drought, climate change, water supply, cattle prices, and others, graziers of Group 2 have diversified their incomes in a number of ways. Interviewee 6 stated:

“… we’ve purchased an off-farm business that my wife does the administration work and runs it from home virtually, does the bill paying and wages. And I can go where the pressure is. So if they’re busy at the business I can go there and help two or three days a week, or if we’re busy on the farm I can have that flexibility. I’ve got the systems in place in both … ” [interviewee 6]

Other stations visited in the course of this study belong to big family farm businesses which provide a number of different income streams and have an increased flexibility through multiple properties. For example, interviewee 3 runs two farming enterprises with his brother and, in addition, earns some off-farm income.

“My brother and I are fairly young. We took on a very heavy debt load. We decided to expand in the sugar cane industry. The sugar industry was suffering really badly so we had to make a decision to either get out altogether or try and get our economy size up.” [interviewee 3]

In contrast to the mixed farming enterprise run by interviewee 3, interviewees 4, 5, 6 and 7 indicated that their grazing properties are part of bigger family-owned grazing operations which provides them far greater flexibility. For example, cattle can be moved between properties, and some properties may be used mainly for breeding, whereas other properties are mainly used for fattening. Some of the family-owned grazing operations are all located within the Bowen-Broken catchment, which has the advantage that animals, stock feed and labour can be moved between properties easily and with low cost. In some instances, family-owned operations have one property in the Bowen-Broken catchment and one or two properties in other regions, for example on Cape York or in the Fitzroy Basin. This has the advantage that cattle are sold within the family business and market price and drought fluctuations can be better combated.

In contrast to Group 1, graziers in Group 2 focus on a greater number of on-farm and off-farm activities. Similar to Group 1, most graziers in Group 2 attended courses with RCS and use these networks if they need advice. They are keen to run successful enterprises and make use of the diverse income streams provided by their businesses. Some have received grants through an incentive scheme provided by Greening Australia in 2004, which offered subsidies of a range of on-ground projects, including installation of riparian
fencing to prevent riverbank erosion and water infrastructure to lessen grazing pressure (Greening Australia, 2004).

Graziers in this group include young successors (under 30 years of age), young grazing families (between 30-40 years of age), and grazing couples in their 40s and early 50s. They all carry heavy debt loads, when compared with graziers of Group 1.

4.1.3 Group 3: Continuous graziers

This is a distinct group of graziers who could be described as not having changed their grazing management practices much over time. These older graziers, in clear contrast to graziers in Groups 1 or 2, do not rotate their animals on farm in order to allow paddocks to rest for part or all of a wet season.

The investment which these graziers, with a continuous grazing system, have made on their properties over the years is significantly lower per unit area than that of Group 1 and 2. Subsequently, their economic situation differs significantly when compared to Group 1 and 2.

“We’ve got no debts at all so we can carry on like that. We’re finding with these dry years our cattle are doing very well. They’re heavier, they’re growing better because we’ve got less [cattle] … it’s quite successful, we’re making just as much money now as possibly we did in the good years when we had all the cattle, the prices were down …” [interviewee 13]

Their economic situation allowed them to adjust their stocking rate to the drought situation. However, it appears that they may not have had any other choice (Figure 7, 8).

“Fortunately at the moment I’m in the position where I don’t need that many cattle and I think that’s - as far as the country is concerned that’s the best decision I’ve made, to run less cattle. … No matter what seasons come now, I’m never going to go back to where I was.” [interviewee 11]

Because graziers of Group 3 had not invested in the infrastructure required for a rotational or cell grazing system, they had less opportunity to spell any paddocks over the wet season or parts of the year. These properties have been continuously grazed for over a century. This does not mean that they have necessarily been overgrazing, however, it is not surprising that soil conditions in areas that are used by cattle permanently, e.g. in close proximity to dams, rivers, and other watering points, are deteriorating and localised soil erosion appears to warrant attention on some properties (Figure 8).

Graziers of Group 3 are generally over 55 years of age and may not have been exposed to new grazing management techniques. Most of them have not used any agricultural extension services for years nor participated in any RCS courses. In addition, they have not applied for any funding for property planning or drought assistance.

“We find if you go into any government assistance - I shouldn’t say it, but it’s never really successful. It’s very hard to get into. We used to try and get drought relief and you’d be filling in forms and trying to say this and trying to say that, no that doesn’t work. So we got that way we never bothered with any assistance. We don’t get the fuel, we pay for our fuel, we pay for everything we’ve got. We never get any assistance because it’s always too complicated and it’s never really us, I suppose.” [interviewee 13]

“I don’t know; I’m suspicious of the government; I wouldn’t want them coming and checking …. there’s so much red tape to go through …. too much hassle and the less government people on your property the better, that’s what we think anyway.” [interviewee 9]
What Group 3 has in common with Groups 1 and 2 is the fact that graziers are also interested in improving the overall value of their properties.

“In fact, I’m doing more improvements now … , being able to afford to do them is another thing too, you know. You’d like to do a lot of things, but if you haven’t got the money to do it you can’t. At the moment I’ve got a bit of spare money and I just built a new yard, replaced the old yard up there, fixed another one up out here. Just to try and keep the facilities in good working order.” [interviewee 11]
4.1.4 Group 4: Heavy continuous grazing

The main characteristic of Group 4 is that these stations are owned by mining companies. Grazing managers are employed by the mining companies to carry out the day to day activities on these stations and are guided in their management by the mining company.

“… property was bought solely because of its mining interests.” [interviewee 12]

Despite some similarities between Groups 3 and 4 (e.g. low to no investment in property), Group 4 differs in many significant ways from the other three groups of graziers. In terms of management, Group 4 is the only group that does not supplementary feed their cattle. However, the more significant difference is the distinction in values that drive the land management decisions: the values and interests of this group are not primarily related to a pastoral enterprise but to mining. Therefore, land management information is provided by the mining sector and not the grazing industry. This is a major difference between Group 4 and all other groups.

The income of these managers is not directly linked to the management strategies carried out by these managers. They receive a salary paid by the mining company whose interest is primarily coal. Therefore, no investment is made to improve grazing management on these properties beyond the day to day activities. Investment relates primarily to setting up the infrastructure required to run a mine.

Mining companies strategically purchase cattle stations with major coal deposits and carry on pastoral activities in the short to medium term until the mining operation starts. This has the advantage for these companies that no negotiations on compensation are required and mining can commence without being delayed.

Similar to Group 2, stations owned by mining companies also make use of the opportunity to flexibly supply other properties with cattle.

“We breed to sell and also to supply other company properties … See we’ve got properties up in Borroloola, Saxby out near Julia Creek, at Mt Isa and all that.” [interviewee 12]

A further difference related to Group 4 is the requirement of the Mining Act for companies to return mined land to a slope and topsoil depth approximating the original land condition suitable for its original land use, in this case grazing.

4.2 Social and economic factors influencing graziers’ land management strategies

Besides the management related factors which characterise the four groups of graziers, a number of additional factors have been identified that may influence graziers’ land management strategies. These factors do not specifically relate to a particular group, but appear to be key decision triggers for graziers generally.

4.2.1 Economic factors

Despite the unexpected finding that economic factors are not the dominant driver for some graziers’ decision-making in this study, grazing properties are business operations and managers are expected to make a return on capital, financial and human resources. Economic theory suggests that graziers may be motivated to implement change to achieve triple-bottom-line sustainability in their businesses as long as private benefits received from the change are equal to the private costs they incur from doing so (Greiner et al. 2007). This research seems to confirm that graziers who have changed their management practices with the aim of achieving greater triple-bottom-line sustainability,
have made use of incentive schemes to help pay for the infrastructure costs involved in setting up cell grazing or rotational grazing systems or to establish additional watering points.

4.2.2 Incentives as a motivator to change practice

Besides recognition of the contribution of riparian areas to biodiversity, cultural and recreational values (Jackson, 2005; Bohnet et al. 2007), the capacity of riparian areas to improve water quality has also been identified (e.g. Roth et al. 2002). Fencing riparian areas to exclude cattle is a means of preventing riverbank erosion and reducing sediment reaching the sea (e.g. Prosser et al. 2001). Water quality has been one of the main concerns triggering this research. However, despite these recognised benefits, graziers in this study seem unwilling to permanently exclude cattle from riparian areas for a number of reasons. For the graziers interviewed for this study, the benefits do not outweigh the costs, even if 50% of the infrastructure costs are covered by financial incentives. As one grazier put it:

“There’s incentives to go say 50/50, we’ll pay 50% of the polypipe and the pump and the tank, but then we’ve still got to put it [infrastructure] in, we’ve still got to pay for all the petrol, electricity, we’ve still got to check it every second or third day. To be honest, there’s more of a benefit environmentally than there is for us. … there’s a big advantage to have open water like that [Bowen River] because I don’t need to check the cattle that often.” [interviewee 3]

Some graziers in this study (Group 1 and 2) have established so-called watering lines, which are paddocks along the river. Cattle can be excluded from the watering lines during the wet season or when required but are generally part of the grazing system. To achieve a change in this practice, i.e. exclude cattle from riparian areas permanently, further incentives would be required.

“I can see the benefits for everybody to get cattle off that riverbank permanently. I think there are massive benefits, but the thing is there’s a benefit for just as much if not more for downstream people, the environment, the community. So therefore that cost needs to be well and truly shared.” [interviewee 3]

This statement supports the view that economic factors and incentives may not be sufficient motivators to change practice, but it seems that some graziers would be prepared to put up with some practical inconvenience but only as long as they receive financial compensation for it.

4.2.3 Perceptions of issues and their importance

It appears that all graziers interviewed agree, in principle, that the quality and quantity of ground cover is a crucial factor of land management, not only because it reduces off-property impacts such as soil erosion and increased run-off to the sea, but mainly because it can lead to better beef production.

“Well when we bought the place we worked it out on the DPI carrying capacity and then sort of done our own grass budget and things were improving - you could see it improving all the time. It’s improved ten-fold since we’ve been here just from light stocking.” [interviewee 4]

Nevertheless, ground cover does not seem to be the key decision-driver at all times (Figure 7, 8). Previous research has shown correlations between debt load and vegetation cover (Greiner et al. 2007), suggesting graziers may have been forced to heavily graze or over-graze their properties because of financial commitments. This may be true for some of the grazing properties visited; however, as the graziers with the highest debt load are
part of bigger operations and have diversified their incomes, they would be expected to have more financial flexibility than others.

Some graziers who also acknowledged the importance of ground cover seem to have a different perception of the problem. Climate change has been named as the number one issue by some graziers:

“A lot of the years in the late 60s and 70s there was fairly good rainfall. Then the 80s started to get drier, then the 90s got drier and the 2000s seems to be worse. So I don’t know why it’s getting so dry …” [interviewee 13]

Considering pasture condition, it appears that stock reduction has only occurred in recent years on some properties. It seems clear that a long term recovery plan for some properties would be beneficial.

Besides climate change, water availability rather than water quality has also been identified by some graziers as the number one issue of concern:

“There’s just going to be more and more and more pressure put on this river. … When Eungella dam was built the Collinsville mine owned one mine, it’s now being used by 36 mines.” [interviewee 9]

“They came out with a boat and GPS and depth measure, and they said, on your present usage, you’ve got two weeks of water left. I said, that’s great, what do I tell the four families with 4,000 cows to do then? Anyway, it rained and it saved us.” [interviewee 8]

“The single biggest thing on this place… there’s that many test holes all over here and just no water … because they’re [mining company] still drilling now, I said if you find water let us know and if it’s enough and it’s in the right place we’ll use it. Water is the big thing. We’ve got no hassles with pests, really … That river for some reason, people said it’s never dried up in so many years, last year it nearly dried up, it stopped running totally. … We nearly had to buy water to bath in, and this year if we hadn’t have had that rain the other day, I reckon in six to eight weeks we’d have been in the same situation, and that will stretch it out a bit further. But whether it can - and then you know, if it rains again, it will stretch a bit further. While it’s running, and I guess this year the same thing, it doesn’t really matter, but they’ve been taking a hell of a lot of water for that pipeline. A lot of water. Unreal. But you know, while it’s running it doesn’t really matter, as soon as it stops you’re in trouble.” [interviewee 11]

4.2.4 Knowledge and education

Knowledge and education are two of the relevant factors influencing graziers’ decision-making. Many of the younger graziers interviewed are undertaking courses relevant to improve management practices.

“I think the most important thing is education to the people. Like coming from down in central Qld, and a lot of places down there are pretty well grassed up and we’ve been through dry times just like they have up here. Education to the people on grass management seems to be really lacking around this immediate area I reckon. There’s a lot of flogged out country - that country you’ve seen coming in. Very badly eroded. I know it has had a bit to do with the dry but … the people have been - from what I hear around the traps - they’ve been feeding cattle and losing them they’ve been feeding them that much - they can’t feed them enough to keep them alive…”

“We’ve been seeing a lot of Black Speargrass and Forest Mitchell grass coming back through in amongst all that. It’s improved a lot but it’s not as good as it
could be. … We get excited when we drive past there now - ‘oh, look’. It gives a bit of satisfaction.” [interviewee 5]

4.2.5 Uncertainty of grazing continuity

Many properties in the Bowen-Broken catchment are owned by mining companies which graze cattle in the short to medium term until mining starts. On many other properties, mining companies are also prospecting, which leaves graziers with the uncertainly of what might happen on their land in the longer term.

“We’ve got a freeholding lease, but it’s got all these special conditions and one of the special conditions is that the government retains the minerals and the petroleum … so we own all the gravel, all the soil on the top…” [interviewee 6]

Another grazier pointed out on a property map that a mining company is prospecting all over their property.

“They’re [mining company] out there drilling. They’re in spell now and drilling, this one here - they’re drilling all this…” [interviewee 7]

It remains unclear from this study whether grazing pressure and erosion are more prevalent on land that is going to be mined in the future.
5 Discussion

5.1 Typology of graziers

The four groups of graziers identified in this research seem to have varied abilities, skills, resources, motivations and values (Tables 4 and 5) and operate in varied locations in the Bowen-Broken catchment with specific bio-physical characteristics and constraints. Therefore it is not surprising that they apply different grazing management strategies that are characterised by particular socio-economic constraints and social values.

One of the research aims of this study was to gain an understanding of graziers’ relationship to the land they manage. Grouping the graziers into four distinct groups allowed the research team to provide an overall indication of the social and economic situation of the groups in the Bowen-Broken catchment (Table 4). Distinguishing groups of graziers in the Bowen-Broken catchment also provided an opportunity to demonstrate that not all graziers in the catchment manage their properties similarly. While this is not unexpected, creating a typology or identifying groups of graziers is a way of reducing complexity so that underlying drivers of these types might be clarified.

Identifying distinct groups of graziers, as well as common factors important to graziers’ decision-making, sets the scene for discussing the implications for designing more practical measures that may enhance graziers’ decision-making in order to maintain or achieve a sustainable grazing business.

Many graziers interviewed for this research have already started to improve their land management according to their future aims and aspirations, and within the scope of their personal abilities. For example, graziers of Groups 1 and 2 had begun to diversify their businesses on-farm and/or off-farm, while some are attempting to improve the ground cover on their properties by mechanically ripping the soil (Figure 9). Others are controlling weeds by using camels and goats and a few have de-stocked their properties to reduce grazing pressures. However, it may take many years to recover heavily utilised pastures where plant species have been lost (Figure 7) and in some cases the use of machinery may be necessary to restore degraded grazing lands (Figure 8). Graziers of Group 3 who have reduced their stocking rates may notice that stock management changes alone may be insufficient to restore the pasture ecosystem. Surface-breaking and seeding implements such as the ‘crocodile’ may be useful in creating the conditions necessary for pasture recovery (Roberts, pers. comm. 2007). In other cases, logs or stone-packs on the contour may contribute to runoff control. Eventually, stocking rates which allow sufficient spelling in the growing season will be the key to sustainable grazing (Ash et al. 2005). These practices should be mandated for all graziers, including graziers of Group 4.

The main messages from this analysis of factors common across the different grazing groups are:

1. Economic factors are important to some degree. To motivate graziers to change their management practices substantially, compensation payments may be required;

2. Financial incentives can provide the best option to maintain or achieve a sustainable grazing system. The analysis also showed that without incentives certain practices will not be carried out if graziers consider them not worth the effort, too costly, or impracticable. Therefore, different practices will need to have different incentive structures;

3. Major impediments to change are the differences between graziers in their perception of what the problem is and how it can be resolved. Water supply, rather than water quality is a high priority for graziers. Therefore knowledge and
education seem crucial, particularly how knowledge is transferred and information about incentives is communicated. That includes private and public contributions and benefits from the long and short term outcomes provides by the incentive;

4. Uncertainty of the future use of many paddocks is currently perceived as an impediment to carrying out ‘responsible’ grazing management practices.

Figure 9.  Top: Ripper; Middle: Sealed soil surface that prevents infiltration; Bottom: Same area worked with ripper to allow water infiltration.
5.1.1 Suitability of the conceptual model

This research was based on the assumption that graziers’ decision-making regarding the management of their properties is based on social and economic factors as well as personal values and attitudes. In the conceptual model of the relationship between grazier and grazing land (Figure 1) graziers’ decision-making is based on their perceptions about how the grazing system functions in terms of the relationship between management actions and on-ground change over time. Research on grazing, crop and mixed farms by Pannell et al. (2006) confirms that the adoption of a conservation practice, i.e. a decision to change a practice, depends principally on whether landholders expect that the practice will help them achieve their goals, which may include economic, social and environmental goals. They further conclude that adoption of a practice is influenced by the characteristics and circumstances of the landholder, which is also shown in the conceptual model (Figure 1).

5.1.2 Suitability of the methods

From the results, it appears that using a qualitative approach and an applied methodological procedure was a suitable way of exploring the social and economic situation of graziers in the Bowen-Broken catchment. It was possible to identify a wide range of factors that influence graziers’ social and economic situation. It also helped to assess the different strategies taken by the different graziers to maintain or achieve a sustainable grazing system based on their different values. Carrying out land assessments (field inspections) together with the graziers was also useful for data triangulation and provided a better understanding of the meaning of what was discussed during the interview. This would not have been possible if only a quantitative approach was used.

In order to cover a wide range of different situations, grazing properties in different locations within the Bowen-Broken catchment were selected for this investigation. The selection was based on geographic and bio-physical characteristics as well as on recommendations from agricultural extension personnel. It emerged in the course of the study that the recommendations from agricultural extension personnel were not the only way to find graziers with very different characteristics. The additional use of a snowballing technique provided the diversity of graziers sought for this study and included graziers who have not been in contact with agricultural extension personal or researchers for a long time.

While the recorded data were analysed according to Grounded Theory developed by Glaser and Strauss (Strauss and Corbin, 1996), this approach needed to be modified to allow some of the codes to be predefined rather than derived directly from the data. In line with the thinking of Schenk et al. (2007) it is the opinion of the research team that the exclusion of all previous knowledge is a conceptual weakness of Grounded Theory. Grounded Theory was helpful, however, in analysing the data and discovering new findings which may not have been discovered using a different approach.

Despite the relatively small sample size, it was possible to develop a typology of graziers’ land management strategies in the Bowen-Broken catchment. The sampling techniques used to identify interviewees and the results from the 9 in-depth and 6 informal interviews provided confidence in developing the typology. When compared with quantitative studies, the sample size, in terms of covering the geographical area of the Bowen-Broken catchment, was relatively high, covering almost 50% of the catchment area, as some graziers/land managers were able to speak for more than one enterprise in the catchment.
6 Conclusions and Recommendations

This study of grazing land management strategies in the Bowen-Broken catchment identified that four broad groups of graziers exist that have some overlapping, but also unique features. Although some groups, such as the cell and rotational graziers, may utilise elements of sustainable land management strategies, the overall land condition of each group was not evaluated, and therefore it can not be concluded that a particular strategy is achieving superior results over other approaches. However, the study results do indicate that outreach and incentive programs are utilised by some groups and not others, and that existing and new initiatives may need to consider the following factors in order to reach a specific target audience:

1. The categories of cell and rotational graziers already practice some aspects of Best Management Practice (BMP) and obtain new information from Resources Consulting Services (RCS). Therefore any new information or outreach projects could be developed in conjunction with RCS.

2. The continuous grazing group is generally older and more conservative in nature and therefore may require exposure to new approaches through field days and by direct and repeated contact by extension officers. It may be useful to consider having a sponsored ‘trial’ on one of these properties to allow for potential uptake of new methods already in use by neighbouring properties.

3. The heavy grazing group consists of stations owned by mining companies who bought these grazing properties because of their mining potential. It may be necessary to request that the mining companies develop and follow a ‘grazing code of practice’.

4. Protection of rivers through fencing may require a clear and accessible financial incentive program to offset initial installation and ongoing maintenance costs.

Further, it is recommended that:

1. Organisations with a responsibility and an interest in sustainable grazing management practices meet with graziers in the Bowen-Broken catchment. The aims of the meeting are to provide graziers with up-to-date information on:
   - sustainable grazing management,
   - incentive schemes that graziers in the catchment can access,
   - activities taking place in the area,

   and to collaboratively workshop and agree on priority actions, responsibilities and funding opportunities.

2. That a detailed Implementation Plan be developed by a Designated Action Group for submission to the Burdekin Dry Tropics NRM Board.
References


Appendices

Appendix 1  Semi-structured interview schedule (graziers)

Semi-structured interview schedule (graziers)

Interviewee ID:
Date of interview:
Length of interview:

A. Land use and management strategies (Background information on the land/land use and management/perception of official advice)

1. What kind of grazing enterprise do you have?

2. What is the size of your grazing enterprise (in hectares)?
   2.a Is it in your ownership – are you a leaseholder?
   2.b If you are a leaseholder – what is your role in farm-decision making and how long are these leases?
   2.c Could you mark the land under your ownership and/or management control in this map, the land you lease, etc?
   2.d Have you bought or sold, rented or let any land in the past (land can be marked on the map)?
   2.e What is the price of land per cattle/beast area (per ha)?
   2.f What is considered a viable family unit (father, mother and one married son) in the area (based on native pastures)?

3. What percentage of your property is under native pasture, improved pasture, open forest, thinned open forest, etc. (native pasture/ha; improved pasture/ha; open forest/ha; remnant vegetation/ha; etc.)?
   3.a For what purposes do you use the different land use types (eg breeding, fattening, nature conservation)

4. Could you put the different land use types on the map?

5. What is the size of your herd?
   5.a What is your herd composition (eg breeders, store cattle, fattening cattle)?
      • Why did you choose this composition?
   5.b How do you manage your herd (eg target age, target weight, stocking rate)?
      • What are your age and target weight? (weight for age)
   5.c Do you manage your different herds differently (heifers, breeders and bullocks)?
      • If yes, how?
   5.d What general stocking rates to you aim for?
      • Is there a difference in stocking rate relating to land type?

6. How do you manage your grazing land – do you follow any industry codes or guidelines?
   6.a If you are certified organic – when and why did you convert/change your farming system?
   6.b How do you manage your pastures?
      • What improved pasture species do you grow (only applicable if improved pastures are grown)?
• What proportion of your fodder is made up by legumes?
• What is the carrying capacity of these improved pastures (e.g. 3-5 times higher than native pastures)?
• How often do you replant your pastures (only applicable if improved pastures)?
• What type, if any, of fertiliser do you apply?
  How much per ha (total amount per ha per year)?
• Do you use any pesticides/herbicides?
  If yes, what type and how much (per type total amount per ha per year)?
• Do you have any ungrazed areas on your property?
  If yes, how are they used?
  Do these areas have a particular value?
• How many paddocks do you have and how many different herds graze them?
• How do you decide when to move the herd to another paddock and how do you choose the paddock where you move the herd to?
  Do you have a general rule of thumb when to move the animals?
• How many watering points do you have per paddock?
  How far are they apart?
• Do you have waterways fenced off?
  If yes, how do you manage these areas?
• Do you control regrowth?
  If yes, how often do you control regrowth and how?
  If regrowth is controlled by burning, how do you spell the area afterwards?
• Do you supplement feed your cattle?
  If yes, when, what type and how much (per head per year)?
• Do you also make hay?

(The following questions 6.c – 6.d are only asked if applicable)
6.c Orchard/s – how do you manage it/them?
• When did you plant the orchard/s?
• What is a typical yield level (tons per ha per year)?
• What varieties do you grow (traditional/modern varieties)?
• Do you use fertilisers/pesticides/herbicides/fungicides (per type total amount per ha per year)?
  If yes, what type/s, for what and how much (amount per ha per year) of each do you use and when?
• Do you have uncultivated grass strips/rough grassland margins around your orchard/s?
  If yes, how wide are they and how do you manage them?
  Why do you leave these margins?

6.d Woodlots/timber plantations/farm forests – how do you manage it/them?
• When did you plant it/Them?
• What is the tree density (number of trees per ha)?
• What species have you planted?
• What type, if any, of fertiliser do you apply?
  How much per ha (total amount per ha per year)?
• Do you use any pesticides/herbicides/fungicides?
  If yes, what type and how much (per type total amount per ha per year)?
• Did you receive any grants to plant the trees?
  If yes, who were the grants from?
• Do you have a long-term management / harvesting plan?
  If yes, what for and how much (amount per ha)?

6.e Do you manage parts of your property as part of a woodland network structure?
• If yes, could you mark the area/s on the map?
• Are these areas fenced off?
• If yes, how are they managed?

6.f Have you abandoned any of your land?
• If yes, why? (fields/areas can be marked in the map)
• What are you doing on this land?
• Do you think that abandoning land has some benefit for the environment/landscape?
• If yes, in what ways?
7. How are the soils classified on your land?
   7.a Is there a relationship between soil quality and your management regime?

8. Did you carry out any changes on the land (drained marshy ground, converted native pastures, cleared native vegetation, replanted trees and/or riparian strips - orchards, changed grazing intensity, created a wetland, started a B & B, etc)?
   8.a What were the main reasons for these changes (eg to increase the area of productive land, remove a fire hazard, combat land degradation, etc)?
   8.b Did you receive advice before carrying out any of these changes?
       • If yes, was the information that you received adequate for your needs?

9. Have you used any of the agricultural extension services in the past?
   9.a If yes, which-ones?
       • For what reasons?
       • Do you find them useful?

10. Do you manage land under a voluntary conservation agreement?
    10.a If yes, who is the agreement with?
       • How long is the agreement for?
       • Is it beneficial, unsatisfactory, crucial, etc?
       • If yes, in what ways?

11. Are you managing any reserves?
    11.a If yes, are the reserves recognised by any organisation officially?
       • What sort of agreement you are having (eg management agreement) and for how long?
       • How do you manage them (if at all)?
       • If yes, do you receive grants to carry out these management practices?
       • Are these areas fenced-off?
       • Is it beneficial, unsatisfactory, crucial, etc?
       • If yes, in what ways?
    11.b Are there endangered plant and/or animal species on your property?

12. Do you have a whole farm plan (a map of the farmland including a list of actions to be taken over the next few years)?
    12.a If yes, why?
       • Who helped you develop it?
       • Is this plan part of an overall catchment/landscape plan?
       • Is it useful and have you managed to implement some aspects of it (eg replanting trees, fencing of bushland, soil treatments, minimum tillage, etc)?

13. Have you attended a farm-planning workshop?
    13.a If yes, why?
       • Was it useful?

14. How are your farming practices constrained by physical factors (soil quality, water, slope, climate, etc)?

15. How are your farming practices constrained by biological factors (weeds, diseases, etc)?

16. How labour intensive are your management practices throughout the year/seasons (eg mustering, sorting animals, maintenance work, feeding, fencing, etc)?
    16.a What is the division of labour between the people doing farm work?
    16.b Do you contract seasonal workers as well?
16.c Do you ever face a shortage in labour availability?
   • If so, when in the year?
16.d Did the labour intensity change over the last few years?
   • If yes, how and why?
   • Did this effect your enterprise?
   • If yes, how?

17. What farming machinery is on the farm?
   17.a What sort of activities can you carry out yourself?
   17.b Which operations (eg muster, fencing) do you contract out?

B. History (Background to grazing continuity / landscape changes and values)

1. How many years have you been living here?
   1.a Did you inherit this grazing property/business?
   1.b If yes, for how long has it been in your family?
   1.c If no, when and under which circumstances did you take over this property?
   1.d How many people live on the property?
   1.e How many are family members?
   1.f How many of them work on the property and for how many days per week?
   1.g How many of them work off-farm?
   • What do they do and for how many days per week?

2. Do you expect to have a successor who will continue to run the grazing business after you retire?

3. How old are you?
   3.a Where did you grow up (if not on this property)?

4. Do you come from a grazier’s family?
   4.a If not, how did you get into farming/grazing?
   4.b Do you have any agricultural qualifications?
   4.c Have you been in another occupation before?

5. Can you tell something about the history of this property and its surrounding (the various stages of clearing and land use/management changes)?
   5.a Time of foundation?

6. Can you describe the main changes regarding the use and management of this area?
   6.a What have been the main implications of these changes?

7. Are there any sites of historical importance on your land?
   7.a If yes, have you received any advice of how to treat these sites?

8. Are there any cultural-historical or natural elements on the farm/in the surrounding? (eg water holes)
   8.a Do they still have their ‘original’ function?
   8.b Do you integrate these elements in your farm management?
   8.c If yes, how?
   8.d If not, do you manage them – to what extent?
   8.e Do they have any value for you?
8.f If yes, which values?
8.g If not, why not?
8.h Do you think these landscape elements are threatened?
8.i If yes, do you think these threats are related to agriculture?

9. What kind of attitude is there towards nature/landscape conservation in this area – in general?
   9.a Has this attitude changed in the last few years?
   9.b If yes, what do you think this has been in response to?
   9.c Has your own perception changed?
   9.d If yes, why and how?

C. Socio-economic circumstances

1. Where do you sell your cattle (eg feed lots, life exports, local meatworks) – different products (eg breeders, store cattle, fattening cattle)?
   1.a What price do you receive for your products?
   1.b How much did the price for your different products vary over the last 5 to 10 years?
   1.c Why have there been these large changes (eg global market)?
      • How many cattle/different products do you typically sell (heads per year) and when (eg what time in the year)?
   1.d What would be a reasonable price for your products to cover your costs?

2. Does your farm satisfy any recreational/tourist needs (camping on farm, farm shop, B & B, etc)?
   2.a If yes, what and how long have these activities been operating?

3. Do you have any other (off-farm) income sources (stock market, investments, tourism, others, etc)?
   3.a If yes, what are these other sources?
   3.b What is the distribution of your income (i. on-farm income from farming and other activities, ii. off-farm employment, and iii. other off-farm income sources)?
   3.c Have these proportions changed over the last few years?

4. What are the main difficulties graziers face in this area (eg global markets, agricultural policies, climate change, scale of farm, etc)

5. Is there co-operation amongst graziers in this area?
   5.a If yes, what sort of co-operation?
   5.b Are there farmer organisations/interest groups active in your area?
   5.c If yes, what activities do they have?
   5.d Are you involved in any of these activities?
      • If yes, why?
      • If no, why not?

6. Do you think that state/federal/local government policy could or should support graziers to improve environmental conditions on farms (eg through financial incentive/agri-environmental schemes for revegetation projects/fencing on farms, schemes for the protection of native vegetation on farms, tax rebates, etc)?
   6.a In general?
   6.b In this area?
• If yes, what kind of support would be useful and for what kind of activities?
• Would you respond to this kind of support (e.g., would you apply for funding)?

7. Do you think that state/federal/local government policy could or should stimulate land management (e.g., wet season spelling, fencing off different land types, off-stream watering points, adjusting stocking rates to pasture conditions, weed control) and land use change (e.g., crop diversification) through financial incentives and/or policy interventions (e.g., water restrictions)?
   7.a In general?
   7.b In this area?
   • If yes, what kind of support/policy interventions would be useful and for what kind of activities?
   • Would you respond to this kind of support (e.g., would you apply for funding)?

D. Future

1. What kind of future plans do you have regarding the use and management of your property?
   1.a Any big changes (e.g., fencing off rivers and creeks, planting of riparian vegetation, fencing off different land types, use fire as a management tool, wet season spelling)?
   1.b If yes, what are the reasons for these changes?
   1.c Can you imagine to change your land management practices in the future (e.g., fencing off rivers and creeks, planting of riparian vegetation, fencing off different land types, use fire as a management tool, wet season spelling, cooperative grazing enterprises that share profit)?
   1.d If yes, why and how (e.g., with the help of contractors, employing seasonal staff, etc)?
   1.e If not, why not?
   1.f What would induce you to change your land use and management practices (e.g., if there were opportunities for income generation, incentive schemes, other graziers who have changed)?
   1.g How do you think these changes will/would affect your enterprise/the landscape of the area?
   1.h With your experience and local knowledge, do you think that a certain percentage of any property in this area should be left in an uncleared state?
   1.i If yes, why?
   1.j If not, why not?
   1.k Can you imagine converting your farming system from conventional to organic?
   1.l If yes, why?
   1.m If not, why not?
   1.n How do you think these changes will/would affect your enterprise/the landscape of the area?

2. What are the most important aims of your work now/in the future (e.g., having a good lifestyle, making money out of farming, providing opportunities for children to take over farm)?

3. What are the main driving forces influencing your decision-making (e.g., agricultural market, succession of farm, looking after the ‘health’ of the place, creating a nice place to live, stewardship of the land)?
   3.a Is the mining industry influencing the decisions you are making on your property?

4. How do you see the future of this area?
   4.a In what direction do you hope this area will develop?
   4.b What would be ‘the ideal prognosis’?
   4.c Can you think of any circumstances under which you would consider giving up running your grazing enterprise?

Thank you very much for your time and co-operation. The information that you have provided will be treated strictly confidential and no individual farmer will be identifiable in any report or documentation of the project.
Appendix 2  Land assessment of grazing property

Land assessment – field record sheet

Bowen-Broken catchment

Viewpoint No:     Location:     Date:

Panoramic Photo Nos:

Geology:

Topography:
flat   plain   valley
undulating   rolling lowland   gorge
rolling   scarp / cliffs   broad valley
steep   hills / rocks   narrow valley

Dominant land cover/land use and landscape elements:

<table>
<thead>
<tr>
<th>BUILDINGS</th>
<th>HERITAGE</th>
<th>LAND USE/LAND COVER</th>
<th>HYDROLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>farm building</td>
<td>historic farm house</td>
<td>native vegetation (including trees)</td>
<td>Bowen River</td>
</tr>
<tr>
<td>shed</td>
<td>stock route</td>
<td>improved pasture</td>
<td>Broken River</td>
</tr>
<tr>
<td>water tank</td>
<td>rest area</td>
<td>cell grazing</td>
<td>permanent creek</td>
</tr>
<tr>
<td>pipeline</td>
<td>indigenous cultural site</td>
<td>rotational grazing</td>
<td>seasonal creek</td>
</tr>
<tr>
<td>windmill</td>
<td>geological site</td>
<td>cattle agistment</td>
<td>gully</td>
</tr>
<tr>
<td></td>
<td></td>
<td>eucalyptus scattered in landscape</td>
<td>dam</td>
</tr>
<tr>
<td></td>
<td></td>
<td>single shade trees</td>
<td>watering point</td>
</tr>
<tr>
<td></td>
<td></td>
<td>weed invested paddocks</td>
<td>reservoir</td>
</tr>
</tbody>
</table>

Brief description: (including main elements, features, attractors and detractors)

Key characteristics/distinctive features and why they are important:

Condition:

Visual assessment criteria:

<table>
<thead>
<tr>
<th>SCALE:</th>
<th>intimate</th>
<th>small</th>
<th>medium</th>
<th>large</th>
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<tbody>
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</tr>
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<td>COMPLEXITY:</td>
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<td>diverse</td>
<td>complex</td>
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<tr>
<td>UNITY:</td>
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<td>interrupted</td>
<td>fragmented</td>
<td>chaotic</td>
</tr>
<tr>
<td>FORM (3 DIMENSIONAL)</td>
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<td>angular</td>
<td>curved</td>
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</tr>
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</table>

Perception:

<table>
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<tr>
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<th>bland</th>
<th>interesting</th>
<th>challenging</th>
<th>inspiring</th>
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</thead>
<tbody>
<tr>
<td>TRANQUILLITY:</td>
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<td>remote</td>
<td>vacant</td>
<td>peaceful</td>
<td>busy</td>
</tr>
<tr>
<td>PLEASURE:</td>
<td>unpleasant</td>
<td>pleasant</td>
<td>attractive</td>
<td>beautiful</td>
<td></td>
</tr>
</tbody>
</table>

Additional comments: (Note evidence of pollution, erosion, bare or disturbed ground, condition of historical features, new planting, restoration work)