Better beef and reef

Staged framework for property investment that supports pastoralists improving herd management and infrastructure

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Final project report

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Contents

Executive summary

The Australian Government Department of Environment (DoE) commissioned the Queensland Department of Agriculture and Fisheries (DAF) to identify key management practices that could be adopted by beef producers in the Fitzroy and Burdekin river catchments adjoining the Great Barrier Reef (GBR), to improve their profitability and reduce their impact on the reef. The DoE also required DAF to recommend how more beef producers in these catchments could be encouraged to adopt better management practices.

The major activities of this project were a beef producer workshop in Townsville, a beef industry stakeholder workshop in Rockhampton, a 'Focus is on People' webinar, and review of relevant literature.

Best management practices for the extensive beef grazing industry are well known and thoroughly documented. The Grazing Best Management Practices (Grazing BMP) program contains 157 industry standards drawn from decades of research and development. These standards cover the entire grazing enterprise and are grouped under the modules of soil health, grazing land management, animal production, animal health and welfare, and people and business.

Some grazing land and herd best practices could be considered more important than others. A reliable supply of good quality drinking water for cattle, fence and water point locations that facilitate even grazing distribution, vaccinations, appropriate genetics, and matching cattle numbers with the long-term safe carrying capacity of the land are prerequisites for higher-level management. The most important higher-level practices are: adjustments of stocking rates to align cattle numbers with variable feed supply; and controlled mating for more effective and efficient herd production. Other higher-level practices are: sub-division of large paddocks, pasture spelling; segregation and targeted management of cattle classes; early weaning; and culling poor performing female cattle for cash flow and reduction of stocking rates in dry years.

McLean *et al.* (2014) reported variation in management practices between beef businesses in northern Australia. The superior financial performance of the top 25% of producers was due to herd management practices that produced higher reproductive rates, lower mortality rates, and higher sale weights, all at lower costs. Apart from the economies of scale provided by large properties, poor performance in much of the industry appears due to poor business and herd management practices. Further, McCosker and Barbi (2014) surveyed 394 beef properties in reef catchments to determine adoption rates of grazing land management practices that improve reef water quality. They rated the land management practices of almost 60% of beef producers in reef catchments as poor to very poor.

Participants of workshops in Townsville and Rockhampton were of the opinion that while industry best practices are well known, many beef producers are not motivated to adopt them. Hence, the challenge is to increase adoption rates of well-known best practices. The beef producers at Townsville favoured increased communication from trusted sources as the methods most likely to encourage other beef producers to adopt best practices. They said that personal relationships with trusted people, personal interactions with successful people, personal invitations to events, promotion by industry champions, and advice from respected professional people were most likely to motivate other beef producers to adopt best practices.

It was assumed that the majority of beef producers in reef catchments would adopt best practices to improve herd and business performance if approached in this way. However, this may not be the case. For this reason, participants of the Rockhampton

stakeholder workshop recommended that reef Research, Development and Extension (RD&E) programs should modify existing approaches. They suggested that best practices may be attractive to more beef producers if they were more aligned with lifestyle rather than business topics. Additionally, reef RD&E programs could target districts and properties which have the greatest impact on the GBR. In this respect, if beef producers will not come to reef RD&E programs, the programs will go to them.

Barson *et al.* (2014) estimated that 50% of the total anthropogenic sediments exported to the GBR from grazing lands came from the Burdekin and 30% from the Fitzroy Natural Resource Management (NRM) regions, and as such, they are high priorities for investment. Similarly, some management units within these sub-catchments deliver disproportionately large amounts of sediment to the reef lagoon. Bartley *et al.* (2014) found that within the Burdekin sub-catchment, the Bowen and the Upper and Lower Burdekin management units appear to be the dominant source of the fine silts and clays which pose the greatest risk to coral reefs. Furthermore, it is possible that remote-sensing could identify properties that have persistent low ground cover, leading to higher rates of erosion and soil loss. Targeting the properties that most impact the reef, however, has counter-productive potential to the development of effective relationships between beef producers and reef RD&E programs. It is recommended that reef RD&E programs target management units rather than properties believed to be disproportionate sources of pollutants.

Reef RD&E programs could target the larger beef properties within reef catchment management units. Producers who own or manage large properties appear to more readily adopt best practices than do producers from small- and medium-sized properties. While there may be fewer large properties, they make up a larger proportion of the landscape. Providing the characteristics of these properties are relevant, reef RD&E programs may be more effective and cost-efficient if they targeted beef producers who have large properties.

Reef RD&E programs should also cater for the different characteristics of beef producers. Rogers (2003) suggested that only 20% of any population, the innovators and early adopters, readily adopt new technologies. In comparison, the 60% of the population who are early and late majorities and the 20% who are laggards, take much longer or never adopt the technology. It is likely that it is the innovators and early adopters who are the main clients of current reef RD&E programs. Like beef producers at the Townsville workshop, they constantly seek information on how to improve their performance, and therefore readily engage with RD&E programs.

However, as in other populations of people, many beef producers do not seek information on land, herd and business management. For these reasons, they are not motivated to attend formal workshops which transfer information and skills on better herd and business management. This is consistent with Robinson (2009), who said that for a particular technology, the membership of each segment of people is static, and thus innovations only spread when they evolve to meet the needs of successive segments. Accordingly, participants of the Rockhampton workshop recommended reef RD&E programs focus more on people and their needs and less on information-transfer. They should adapt their best practices to make them more relevant to the personal goals of beef producers. Healthy land and pastures they are proud of, high quality and more valuable cattle, a happy and successful family, and more time to enjoy what they have built are themes that may motivate more beef producers to adopt best practices.

Robinson (2009) suggested that when designing extension activities it is critical to know the percentage of the population who have already adopted the innovation. That figure tells you which segment to target next, and provides insight into how best

to design projects and pitch communications to them. Strong face-to-face support is needed to help innovators and early adopters trial, refine and validate new practices. Innovators and early adopters should be promoted as industry leaders, and some recruited and trained as peer educators. When working with the early majority, Robinson (2009) recommends offering give-aways or competitions to stimulate interest, using mainstream advertising and media stories featuring endorsements from credible, respected, similar people, lowering the entry-cost, redesigning to maximise ease and simplicity, simplifying application forms and instructions, and providing strong customer service. To work with the late majority, focus on promoting social norms rather than just product benefits. They will want to hear that plenty of other conservative people like themselves think it's normal or indispensable. Keep refining the product to increase convenience and reduce costs, and emphasise the risks of being left behind.

Adoption of best practices by beef producers is a socio-cultural activity. For most, adoption or rejection of new practices is strongly influenced by their family, the community in which they live and the networks in which they operate. Initially, beef producers have much uncertainty about adopting a new practice, and often only other beef producers they know personally and trust can give them credible reassurances about it. Similarly, trusted people in wider networks, and especially opinion leaders and industry champions, have a positive influence on adoption decisions. While advertising and media stories spread information about innovations, it is peer-peer conversations that spread adoption. As an innovation spreads from the early adopters to the majority audience, face-to-face communication becomes more essential to the decision to adopt. Over time, face-to-face communication is more influential than mass media. RD&E providers, therefore, need to exert their influence at the community level if they are to spread the adoption of industry best practices beyond the 20% of the population. At this level, it is critical that they are highly trusted, credible and legitimate providers of information.

Change agents may be more effective if they align their interventions with the behaviours associated with the adoption of best practices by beef producers. Beal and Bohlen (1957) and later Pannell *et al.* (2006) claimed that adoption of management practices is a learning process that can be broken into a number of stages. Adoption begins when beef producers become aware of a new practice and its potential value to them and their enterprise. Effective extension programs use multiple methods to make producers aware of new practices. This involves multiple extension channels, multiple deliverers of the message, and harnessing peer pressure.

Pannell *et al.* (2006) recommend that industry best practices need to have high relative advantage, where their value to a beef producer is high and obvious. When a beef producer perceives a new practice has high value, they may trial it on a small scale. Hence, the new practice should have high trialability. Even at a small scale, the new practice should generate easily observable results quickly. This helps alleviate any doubts the beef producer has about the application of the practice under their conditions, and helps them acquire the skills needed to apply the practice effectively and efficiently on a wider scale. If the results of the trial are positive, then the practice may be implemented more broadly. In reality, the adoption process is never completed, and instead is continuously reviewed and revised as new information is obtained or circumstances change.

Adoption of new practices could be made easier and more compelling by providing beef producers with a framework or pathway, an Enterprise Improvement Pathway (EIP), which guides the implementation of practices. Three potential EIPs were identified in this project. The Grazing BMP program is an obvious candidate. It has been developed and endorsed by beef producers, an industry organisation, NRM

bodies and the Queensland Government. The program is also seeking supply chain and community recognition of Grazing BMP, using a certification and audit assurance system. This has potential to be a powerful driver of beef producer participation. Management practices that improve reef water quality are part of the Grazing BMP certification and assurance system, and hence accreditation to this standard could be a requirement for the flow of incentives from reef RD&E programs to beef producers. A potential weakness of Grazing BMP is that it has a high number of industry standards that are not necessarily high priority practices for individual beef producers, other members of supply chains, and other industry stakeholders.

Alternatively, reef programs could develop a simple reef-dedicated EIP. This identifies a sequence of a smaller number of prerequisite and higher-level best practices for implementation on a beef property, providing structure for the adoption of best practices, and more easily demonstrating the links between better herd management, higher profitability, and improved reef water quality. Consideration could be given to development of a reef conservation label that would be the public face for this adoption pathway, and to gain support for this from other stakeholders.

The third EIP, a basic continuous improvement cycle of plan, do, check and act, is closely aligned with beef producer actions and decisions associated with adopting best practices, and importantly, provides processes for selecting, implementing, monitoring and improving management practices. This continuous improvement cycle is well suited to achieving the goals of beef businesses and their clients.

Finally, social marketing, with its principles, strategic planning approaches, and its focus on changing behaviour, provides a reef RD&E framework for increasing the adoption of best practices by beef producers. Social marketing is a systematic and planned process, characterised by consumer orientation, segmentation and targeting, and extensive customer research to ensure that interventions are believable, relevant and motivating. Other factors, such as partnerships with key allies, stakeholder engagement, and monitoring and evaluation, are also important components of social marketing. It is capable of incorporating the key elements of adoption described in this report, including adoption behaviour and the factors which influence this behaviour. Social marketing is ideally suited to increasing best management practice adoption due to its emphasis on changing voluntary behaviour through initiatives delivered at the community level.

This report reconciles the literature on best management practice adoption with the views of beef producers and RD&E providers on the most effective means to achieve sustainable management of grazing land in river catchments adjoining the Great Barrier Reef.

1. Introduction

The 2013 Scientific Consensus Statement (Brodie *et al.* 2013) of land use impacts on water quality of the GBR noted that coral cover declined from around 50% in the 1960s to 14% in 2013. There are several causes of this decline, including cyclones, sediments and nutrients of terrestrial origin, coral bleaching and coral disease.

The decline of marine water quality associated with terrestrial runoff from adjacent catchments, particularly nitrogen and fine sediments, is a major cause of the current poor state of the GBR marine ecosystem (Brodie *et al.* 2013). Compared to pre-European conditions, modelled mean annual river loads to the GBR lagoon have increased 3.2 to 5.5-fold for total suspended solids, 2.0 to 5.7-fold for total nitrogen and 2.5 to 8.9-fold for total phosphorus. Inshore sediment levels are consistently well above the water quality guidelines, and are a cause of the poor and declining condition of several components of the inner reef ecosystem (Brodie *et al.* 2013).

The main land uses contributing pollutant loads are rangeland grazing for sediment, and rangeland grazing and sugarcane farming for total nitrogen and total phosphorus (Brodie *et al.* 2013). Barson *et al.* (2014) estimated that the grazing industry contributes around 45% of the average annual anthropogenic loads of total suspended solids (TSS), 43% of particulate phosphate (PP) and 45% of particulate nitrogen (PN) delivered to the GBR lagoon. Much of the total anthropogenic TSS, PP and PN exported to the GBR from grazing lands comes from the Burdekin (50, 45 and 46% respectively) and Fitzroy (30, 25 and 15% respectively) natural resource management (NRM) regions. Consequently, it is the Burdekin and Fitzroy regions which are the focus of this Better Beef and Reef project.

Broad-acre cattle grazing is the dominant land use by area in both the Burdekin and Fitzroy regions. In the Fitzroy, 3666 graziers manage 81% of the regions 135,753 km^2, while in the Burdekin, 983 graziers manage 96% of the regions 126,880 km^2 (Queensland Government 2011). However, sediment erosion processes, particularly in grazing lands, are the main sources of sediments and particulate nitrogen and phosphorus. Sediment erosion by water begins when raindrops fall on bare soil and dislodge soil particles (Department of Environment and Resource Management 2011). McIvor (2012) wrote that rain which falls on the soil surface either enters the soil (infiltration) or runs off. Run-off occurs when rainfall rate is greater than soil infiltration rate, which is determined by soil porosity, soil moisture, rainfall intensity and ground cover. There is a close relationship between ground cover and infiltration. Generally, as ground cover increases, infiltration increases. Pasture is a major source of ground cover and is strongly influenced by grazing.

McIvor (2012) concluded that substantial areas of the Burdekin are considered to be in poor condition, and thus prone to erosion. Land condition has been classified by Chilcott *et al.* (2003) according to four broad categories, being A (best), B, C and D (worst). These are briefly described in Table 1.

A large number of metrics and tools have been employed to document rangeland health/condition (e.g. Tongway and Hindley 2004, Watson *et al.* 2007, Bastin *et al.* 2012), but recent work in the Burdekin and Fitzroy has focussed on two main tools, the ABCD land condition frame work (Chilcott *et al.* 2003) and satellite derived assessments of ground cover (Scarth *et al.* 2006, 2010). Two studies (Karfs *et al.* 2009, Beutel *et al.* 2014), which have looked specifically at aggregated ABCD assessment data across the Burdekin and Fitzroy, correlate reasonably well. Evidence to date suggests that in the Burdekin and Fitzroy regions, approximately 20% (53,000 km^2) of the grazing lands are in C condition, and another 5%

(13,000 km^2) is in D condition (Beutel *et al.* 2014). This is a substantial area of land losing sediments and nutrients to the reef lagoon.

Table 1. Description of ABCD land condition categories (FutureBeef 2012).

Condition	Description
A	• Good coverage of perennial grasses dominated by those species considered to be 3P grasses for that land type; little bare ground. • Few weeds and no significant infestations. • Good soil condition: no erosion, good surface condition. • No sign, or only early signs, of woodland thickening.
B	B condition has at least one or more of the following features, but otherwise is similar to A condition: • Some decline of 3P grasses; increase in other species (less favoured grasses, weeds) and/or bare ground (more than 30% but less than 60%). • Some decline in soil condition; some signs of previous erosion and/or current susceptibility to erosion is a concern. • Some thickening in density of woody plants.
C	C condition has one or more of the following features, but otherwise is similar to B condition: • General decline of 3P grasses; large amounts of less favoured species and/or bare ground (more than 60%). • Obvious signs of past erosion and/or current susceptibility to erosion is high. • General thickening in density of woody plants.
D	D condition has one or more of the following features: • General lack of any perennial grasses or forbs. • Severe erosion or scalding, resulting in hostile environment for plant growth. • Thickets of woody plants cover most of area.

The FutureBeef website (2012) states that Land condition determines the capacity of grazing land to produce useful forage. Therefore, land condition is also directly related to carrying capacity, livestock production and profitability of a grazing enterprise. In the Burdekin and Fitzroy catchments, poor land condition is responsible for a decline in the productivity of the beef industry, as cattle numbers on C and D condition land are more than 50% lower than they would be if land was in A condition. Assuming that the average stocking rate in these catchments is approximately 10 head/km^2 (Gowan *et al.* 2012), this loss in carrying capacity is in the order of 330,000 head (53,000 km^2 x 5 head/km^2).

The Queensland beef industry, the largest of all states and territories, has an annual gross farm gate value of approximately $3 billion (McGowan *et al.* 2012). In the Burdekin, the gross value of meat cattle production in 2010-11 was $396 million, and in the Fitzroy it was $672 million (Barson *et al.* 2014). As such, beef cattle production is the most widespread and valuable agricultural industry in these two regions. While the financial viability of beef properties in the Fitzroy and Burdekin is unknown, this is likely to be similar to other beef properties in northern Australia (all of Queensland and the Northern Territory, and the northern part of Western Australia).

The Northern Beef Report 2013 (McLean *et al.* 2014) found that the majority of beef businesses in northern Australia have not been economically sustainable over the

period 2001 to 2012. Excluding land value changes, return on assets has averaged less than 1% across the industry over the last 12 years. Whilst profits before financing are largely unchanged, after financing, performance is deteriorating due to increased debt. Martin *et al.* (2013) drew similar conclusions from their analysis of the financial performance of beef cattle producing farms in northern Australia. They wrote, 'despite low interest rates, high farm debt from borrowing for farm investment over the past 15 years, together with accumulated business losses, has resulted in a high proportion of farm receipts being needed to meet interest payments'. Not surprisingly, McLean *et al. (*2014) found that the majority of northern beef producers are not generating profits sufficient to fund current and future liabilities (Figure 1). Profit after interest is decreasing, and is mostly negative, as a result of increasing debt with no increase in profits. Martin *et al.* (2013) reported that small (<400 cattle) and medium (<1600 cattle) beef properties consistently had small or negative annual profits, which is a concern for the industry given that these properties make up 75% of all beef properties in northern Australia.

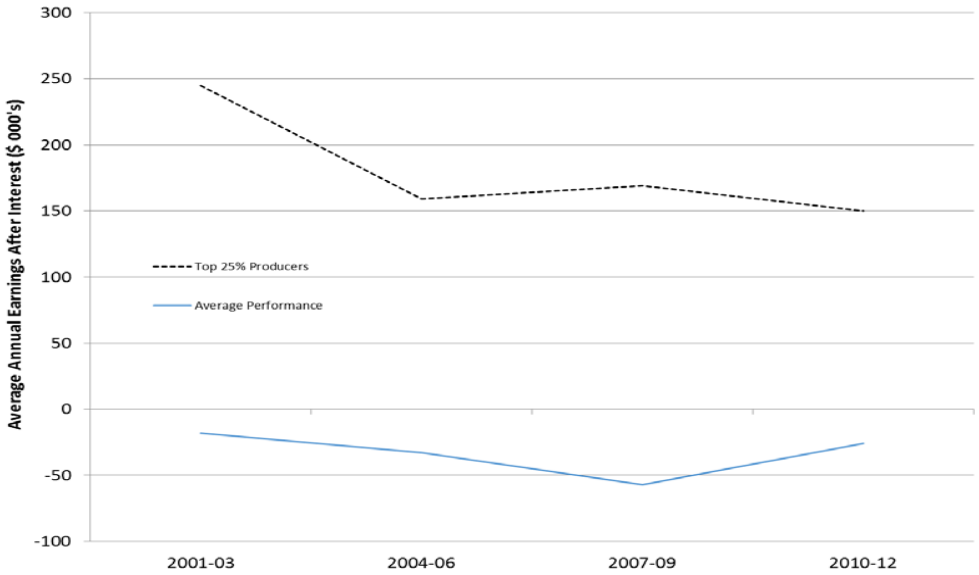

Figure 1. Changes in earnings after interest over time (source McLean *et al.* 2014)

Also related to the economic performance of beef businesses is health and wellbeing of beef producers, their families and their cattle. Paton (2014) wrote that families and communities suffering widespread drought in central and western Queensland are experiencing loss of livelihood and facing challenges of loss of lifestyle and identity. Impacts associated with this include increasing debt and bankruptcy, reduced spending on family and property, high workloads for entire families, social isolation, marital and intergeneration stress and negative health impacts.

Rural and Remote Communities Australia (2008) wrote that public infrastructure and service closures, and the restructuring of farming businesses, resulted in further economic uncertainty. This contributes to population decline, which in turn makes it difficult for rural communities to sustain services and businesses. This creates a cycle of decline, unemployment and out-migration, particularly among young people.

Under these circumstances it is not surprising that Polain *et al.* (2011) found older farmers felt an overwhelming sense of loss. This included a loss of: profitability and professional success; community status; physical well-being and comfort; the ability to participate in the modern world; and above all, relationships (partners, children and friends moving away). They also interpreted government compliance requirements as evidence that the community and government had lost trust in famers.

Durante and McCartney (2014) reported symptoms of stress in the farming communities of central Queensland and the Darling Downs. They wrote, as it becomes more difficult to make a living from agriculture, combined with the increasing difficulty in attracting and retaining affordable labour, producers are being forced to work longer hours, making it difficult for them to maintain healthy work/life balances. This had an impact on psychological health, health of marriages and physical health. Depression was identified as an important emerging issue and was strongly linked to financial pressure, unpredictable weather, geographic isolation, lack of 'down time' and unexpected events. It played a significant role in production decisions and farm life generally, with marriage breakdowns and even suicides perceived to be directly linked to financially unsuccessful agricultural enterprises. Furthermore, it serves as an indicator of how primary producers are faring, and the social sustainability of agriculture. Similarly, a survey of cattle producers in northern Queensland found that 54% of respondents wanted to access counselling for mental health/depression (Nason 2014).

It is clear that beef producers operate within an industry which is highly vulnerable due to climate variability and extremes, fluctuating market prices, increasing costs and difficult global trading conditions. Much of this is beyond the control of beef producers and has potential to be stressful. While the extensive beef industry is vulnerable and thus prone to change, Marshall *et al.* (2014) found that 84% of beef producers in northern Australia had poor capacity to cope with change. This was largely due to a lack of strategic skills, inability to manage risk and weak networks.

The DoE recognises that halting the decline in the health of the GBR is more complex than simply changing grazing land management practices. The anthropogenic and natural systems of the coastal beef industry are strongly interdependent, where the economic viability of beef enterprises, the health and wellbeing of beef producers, the condition of land, and the condition of the GBR are closely intertwined. For this reason, significant improvement in any one component is only possible when the whole system improves.

The DoE commissioned the DAF in June 2014 to develop a staged framework for investment that supports pastoralists improving herd management and infrastructure. This Better Beef and Reef project has two main outputs.

The first, an Enterprise Improvement Pathway, will identify the industry best practices that beef producers in the Fitzroy and Burdekin reef catchments could implement over an extended period of time to improve their management, leading to higher profitability, better land condition, and reduced impact on the reef. The second output is identification of how industry service providers and other stakeholders could encourage more cattle producers to adopt best practices.

The importance of second output increased considerably following the beef producer and beef industry stakeholder workshops that were run early in this project. Participants of these workshops strongly believed that the availability of industry best practice was not limiting adoption of these by beef producers. Instead, generally low adoption rates of industry best practice was due to a number of other barriers.

The premise of this Better Beef and Reef project is that better cattle herd performance due to better management and better land condition will improve both the profitability of cattle properties and the quality of water entering the reef lagoon.

2. Methods

There were four major activities undertaken in this Better Beef and Reef project.

The first activity was a review of literature to identify grazing industry best practice that could reduce the amount of sediment and nutrients entering the reef lagoon, the current rates of adoption of these practices by beef producers in reef catchments, and the types of extension activities currently used to promote adoption. This first project report, titled 'Review of improved herd and grazing land management practices and stakeholder actions that support adoption,' was completed on 16 June 2014. The main findings of this review have been incorporated into the results section of this final project report.

The second activity was a beef producer workshop held in Townsville on 16-17 July 2014. The purpose of the workshop was for beef producers to identify:

- the key management practices that improve both profitability and land condition for beef enterprises
- how to achieve greater industry uptake of key practices.

Beef producers from 14 cattle businesses in central and northern Queensland met in Townsville to identify the practices that were critical to the success of their businesses, and to recommend how more beef producers could be encouraged to adopt these.

The third activity was an industry stakeholder workshop held in Rockhampton on 20 and 21 August 2014. The objectives of this workshop were to:

- identify the target beef producers and high priority for improving practices and performance
- describe the critical best management practices for beef producers to adopt
- determine how more beef producers can be encouraged to adopt these practices.

Forty-two people from 18 organisations (a bank, three consultant companies, nine government agencies, two natural resource management groups, and three industry organisations) attended this workshop.

The fourth activity was a webinar on 16 October 2014, titled 'The focus is on people.' The purpose of this webinar was to provide information on segments of beef producer populations, the implications of this for RD&E, and to outline social science methodologies that could be used to improve the practices and performance of beef producers.

This final project report then completed the descriptions of grazing industry best practice and the RD&E services required to increase adoption by beef producers, using the main findings from the three forums of the Better Beef and Reef project and relevant literature.

3. Results

The full reports for the beef producer workshop held in Townsville and the beef industry stakeholder workshop held in Rockhampton are provided in the Appendices (Appendix 1 and Appendix 2 respectively). The 'Focus is on People' webinar and literature review are reported below.

3.1 Beef producer workshop

The profitability and sustainability of beef properties in the reef catchments of Queensland can be improved through the adoption of industry best practices. To this end, beef producers from 14 cattle businesses in central and northern Queensland met in Townsville in June 2014 to identify the practices that were critical to the success of their businesses, and to recommend how more beef producers could be encouraged to adopt these (Pahl *et al.* 2014a, Appendix 1).

There was unanimous agreement that a beef enterprise must be run as a business. Too many beef producers regard themselves as producers of livestock only, and do not run their enterprises as a business. To run the enterprise as a business, it is important to clearly define business and personal goals and continually review business performance to ensure these goals are being met. Planning, budgeting, use of performance indicators, benchmarking, quarterly economic analyses, and seeking professional business guidance were very important to the success of a business.

There is no one 'silver bullet' management practice that can make a business successful. Instead, there are a number of business, livestock, herd and land management practices that need to be implemented together as a system (holistic management). Key management practices include fundamental actions such as: regular vaccinations; supply of ample quality and quantity water; record keeping; optimising stock access to pastures using fence and water point locations; education of stock; and knowing the carrying capacity of land. Other critical management practices were: forage budgeting; cattle and cash budgets; controlled mating; cross-breeding; and a structured annual program of stock management (calving, mustering, weaning, husbandry, culling and nutrition). It is also critical to compare property performance with benchmarks for highest industry performance, identify weak areas that need to be improved, and then act on these in a timely manner.

Given the highly dynamic nature of the industry, there was unanimous agreement that beef producers should be continually seeking new ideas and advice from people within and external to their industry. Running a successful beef business requires continual learning and improvement. In this respect, it is important to network with successful beef and other businesses and be open-minded to advice and opportunities. There is an ongoing need to access inspiration and advice from networks of other successful professional people, such as accountants, solicitors, bankers, consultants, agents and RD&E providers.

Workshop participants were of the opinion that while critical industry management practices have been well known for many years, many beef producers have not been motivated to adopt them. The challenge is to increase adoption rates of well-known and readily available industry best practice, rather than develop more best practices.

The producers who attended this workshop identified the following factors as being important to improving their management practices and outcomes. These were:

- long-term relationships with trusted advisors
- looking over the fence and seeing successful results
- respected people who endorsed practices or technologies
- learning from outside your sector, such as the grains industry.

Personal relationships with agency staff that were built up over a period of time were needed before beef producers could trust their advice. Rapid turnover of staff in some regions meant that producers did not get to know agency staff and the staff did not develop sufficient understanding and experience of the industry.

Personal traits were the dominant reason why the 14 producers at this workshop adopted critical management practices. These appear to be: confidence; a desire for continuous improvement personally and in their business; having vision; being open-minded; being determined to succeed no matter what; being curious and looking outside of their properties and business for inspiration and ideas; enjoying a challenge; wanting to leave a legacy and having drive. These traits belong to people who know what good performance is, are determined to achieve it, continually seek out and adopt better ways of doing things, and exert control over their business.

The personal relationships also played a role in adoption of new practices. These producers surrounded themselves with successful peers and successful professional people from whom they constantly sought information and advice.

The producers at the workshop were then asked if there were any other triggers that could encourage other beef producers to adopt critical management practices. They said that personal relationships with trusted people, personal interactions with successful people, personal invitations to events and promotion by industry champions, and advice from respected professional people were most likely to motivate other beef producers to change their practices. Working in projects, having other people review their business, undertaking training courses, and employing consultants were important activities.

Communication featured highly in the discussions of triggers that can prompt adoption of improved practices. There was considerable interest in using television to promote better practices and advertise training courses. It was mentioned that more consideration be given to communicating via social media such as Facebook. Other more traditional forms of communication using newspapers such as the *Queensland Country Life* were also important. Continual prompting by agency staff and other service providers of important practices and important decision times often helped commence and continue new practices. However, it is critical that beef producers know and trust service providers, and that the service providers have a very good understanding of the industry.

Training was also regarded as an important trigger for the adoption of best practices. It was generally considered that more beef producers need to access training courses, and that subsidies are likely to increase the numbers of producers attending courses. Getting more beef producers to training workshops through the provision of subsidies was important for them to find their own light-bulb moments. Resource Consulting Services (RCS 2014) have observed that attendance of producers at their very well-known training courses has dropped 50% since subsidies were withdrawn. Personal invitations to training courses or related activities from trusted neighbours, industry champions or agency staff were much more likely to result in them attending training courses, and were much more effective than email invitations.

At this workshop there was also value placed on incentive payments for on-ground works, such as for fences and water points, as a means of encouraging beef producers to open their minds to new practices and to help improve their performance. McKenzie-Mohr and Smith (1999) also noted that government incentives can make new practices more attractive to producers. This is consistent with McCartney and Durante (2013) who reported that landholders were generally supportive of incentives, advocating them as a key means of increasing or hastening

adoption of improved practices. Coutts (2011) also identified incentive payments as a significant driver of change for graziers.

3.2 Beef industry stakeholder workshop

Forty-two people from 18 service-provider organisations attended this workshop in Rockhampton in August 2014 (Pahl *et al.* 2014b, Appendix 2). Initial workshop discussions focused on the need for more targeted delivery of RD&E services. It was suggested that programs target the locations that will give the greatest improvement in reef water quality. For example, the Bowen Bogie, East Burdekin and Dawson sub-catchments, which export disproportionately high amounts of sediments, could receive more attention from RD&E service providers.

Other suggestions for targeted RD&E were existing groups and networks, beef producers who do not have strategic management skills and who need help to develop these, and graziers who are most likely to be receptive. The Rockhampton workshop also heard that the Better Beef program of the Victorian Department of Environment and Primary Industries (BetterBeef Network 2014) decided to target larger properties, those that had over 100 head of cattle, as it was these properties that could most contribute to the Victorian State Governments goal to double productivity. While these properties represented only 30% of the total number of beef farms in the state, they produced 80% of the beef. In general terms, as herd size increased, so did the proportion of beef producers with aspirations and capacity to increase their productivity and/or expand the scale of their operations.

The Rockhampton workshop identified management practices that are most likely to improve the performance of beef enterprises in reef catchments. These included:

- Having knowledge of appropriate long-term stocking rates and matching annual stocking rates to variable annual forage supply underpins many decisions. Doing this helps ensure that a good quantity and quality of feed is available for cattle, as it is important to keep condition on both cattle and country.

- The fertility, growth and survival of cattle are dependent on good nutrition, and this needs to be supplied predominantly by pasture. Forage budgeting, involving measuring the amount of forage available for consumption at the end of the pasture growing season and adjusting stock numbers accordingly, is important in this respect. The performance of cattle will be very poor if pasture supply is limited during the dry season. For example, end of dry season body condition of breeding cows is a key management factor that is closely related with pregnancy rates. Running out of feed at the end of the dry season also results in low ground cover, making land vulnerable to erosion when the wet season commences.

- Targeted supplementary feeding can be very useful, in nutrient deficient country, and particularly during low-rainfall years, but should always be viewed as a supplement to the natural pasture diet. Protein supplements during the dry season and phosphorous supplements during the wet season can significantly improve cattle growth and fertility.

- Knowledge of commencement of the pasture growing season is also very important. This equates to the date in 70% of years when 50mm of rain falls in three days. This is critical for the time of mating cows and maintaining their body condition. Controlled mating to align periods of high nutritional demand with periods of best feed availability is best practice. It means that calving occurs during the early part of the wet season when forage quantity and quality are high. It also creates even lines of cattle to make marketing and management easier, enables identification of non-productive cows, assists with pasture management,

and reduces the need for supplementary feeding. Weaning calves early also helps maintain cow condition, particularly in years of low rainfall.

- Possession of an adequate number of paddocks and water points assists stock management. Paddocks fenced to land type with ample water points will be grazed more evenly, reducing the occurrence of over-grazed areas with low ground cover. An adequate number of paddocks is necessary for segregating classes of cattle and managing them with regard to their specific needs. It also makes it easier to rest and regenerate pastures during the wet season.

- Having the cattle breed that is suited to the tropical environment is important. Ideally, the genetic make-up of cattle should enable them to survive, breed and grow in the environment with minimal assistance. Brahman cattle genetics are the basis for this, but well-managed cross-breeding can help produce a carcass that is more highly valued by markets. The regular use of vaccines for well-known diseases in animals is essential.

The workshop then spent considerable time discussing how more beef producers could be encouraged to adopt industry best practices. Participants were largely of the opinion that extension practices need to be changed if wider adoption of beef industry best practice was to occur. For example, many RD&E service providers mistakenly believe that the provision of information (transfer of technology) will motivate beef producers to change their practices. However, if beef producers are unaware of poor performance and/or not interested in improving it, then information on industry benchmarks and best practices will not appeal to them. As with any community, beef producers vary greatly in their motivations, values, performance, needs and capabilities. Similarly, beef businesses are highly variable in their characteristics. A better understanding of beef producers and beef properties would enable extension programs to become more targeted and more cost-effective.

Many beef producers who currently access RD&E services are the early adopters of new practices. They are hungry for information that helps them improve their performance. In contrast, slow or non-adopters of best practices, perhaps the majority of the industry, are not strongly motivated to improve their performance. They are less hungry for information on how to improve their productivity and profitability, and are instead motivated by other personal values.

There is a need to identify what will stimulate the interest of people who currently do not seek information and align messages with their value system. Family, lifestyle and connection with the land may be the most important motivation. It is necessary to build relationships with beef producers and communities to understand the drivers of their behaviour, and align the extension of industry best practices with these.

Similarly, commercial advertising is often successful because it has emotional hooks that align with people's values, triggering a response and the desire for more information about the product or service. RD&E agency staff are generally reluctant to appeal to a producer's emotional values, and instead strive to be an 'honest broker' of information. Commercial advertising recognises that few people seek products or services without being prompted, and that the best way to do this is to align the product or service with the emotional values of the individual. As such, advertising of a product or service may portray values such as freedom, status and happiness, in a way that engenders confidence and trust in the providers.

Workshop participants were asked 'what do we need to do differently'? Pitching industry best practice in the best light, taking time to develop the pitch, and aligning the values of beef producers with extension messages were mentioned. Also

mentioned was to focus more on women in the industry, and to lengthen the time frame for engagement.

The final session of the workshop wrapped up with each person identifying the one thing they thought would most improve the effectiveness of extension activities. The responses that were different to those recorded above were:

- producers are our clients and we need to target their needs not ours
- focus less on the information and practices, and more on people
- provide opportunities for personal development as a pathway for the adoption industry best practices
- focus our messages on where graziers want to be in the future, and make change a positive concept
- focus on the next generation that will drive change in the industry
- use long-term or enduring group work
- take a whole-of service provider network approach to improving the practices and performance of beef producers
- build networks and encourage beef producers to operate within these
- use commercial advertising companies in the design of communication and extension programs
- use mass-media such as television, but then local media to target a particular area
- use a range of messages or values in a single presentation/promotion, even if people do not see all of them
- make extension messages timely, e.g. promote forage budgeting at the end of the wet season, or align messages with the phases of drought.

Workshop participants in Rockhampton expressed considerable interest in using social science research to inform the development of extension programs.

3.3 'The focus is on people' webinar

'The focus is on people' webinar on 16 October 2014 was a follow-on activity from the stakeholder workshop in Rockhampton. The purpose of this webinar was to discuss social science insights that could be used to improve the practices and performance of beef producers. Presentations were provided by Bruce Howie from C-Qual Agritelligence, Fiona McCartney from the Queensland Department of Science, Information Technology and Innovation, and Nadine Marshall from CSIRO.

Bruce Howie provided insights into the characteristics of the people who make up the segments of Rogers (2003) technology adoption curve. He proposed that the innovators and early adopters have a strong appetite for information, and can be characterised by: testing; innovating; being inquisitive; embracing change; questioning; shaping the future; and being attracted by what is interesting. In contrast, the early and late majorities are much less interested in information. They are characterised by: being esteem driven; avoid social risk; want to belong; display symbols of success; conform to community paradigms and frameworks; and rely on trusted channels and evidence. Bruce proposed that because of their characteristics, the innovators and early adopters are always seeking information, making it easy for traditional extension programs to engage with them. However, the early and late majorities are much more difficult to engage with through traditional extension programs because they are much less interested in information.

Bruce Howie also offered advice for people who wished to communicate with early and late majority producers. He referred to a review of science literature undertaken by Carmen Lawrence. She concluded that much of the scientific literature connected poorly with the general community. Carmen Lawrence was quoted as saying:

'When the language is stripped bare of emotion it is also stripped of power'.

Bruce proposes that innovations and technologies need to be 'sold' to the early and late majorities. As such, communication with these producers will need to use sales and marketing methods to appeal to their values, feelings and emotions. Bruce provided a list of the values and interests of primary producers including: sense of well-being; community; self-esteem; pride in self; pride in industry; love of land; care for environment; provide for family; reputation; perception of peers; and recognition.

Fiona McCartney identified a wide range of factors that influence farm decision making and hence the adoption of best practices. This included economic factors such as: personal financial capacity (equity, debt); increasing costs; commodity prices; labour constraints; supply chains; and economies of scale. Personal factors were: purpose and goals for farming; attitudes and entrenched beliefs; succession; health (mental, physical); knowledge and skills; and demographics (e.g. age, education level). Other important factors were community expectations, social networks and government influence (e.g. regulations). Fiona also noted that it is a combination of factors, rather than any single factor, that influences decision making and behaviour, and this makes farm decision making a highly complex process.

Fiona then noted aspects that should be considered when designing extension programs. Attention was drawn to two acronyms which identify aspects associated with behavioural change.

The first was MINDSPACE (2014).

Messenger	We are heavily influenced by who communicates information
Incentives	Our responses to incentives are shaped by predictable mental shortcuts such as strongly avoiding losses
Norms	We are strongly influenced by what others do
Defaults	We 'go with the flow' of pre-set options
Salience	Our attention is drawn to what is novel and relevant
Priming	Our acts are often influenced by sub-conscious cues
Affect	Emotional associations powerfully shape our actions
Commitments	We seek to be consistent with our public promises, and reciprocate acts
Ego	We act in ways that make us feel better about ourselves

The second was EAST (2014).

Easy	Harness the power of defaults. Reduce the 'hassle factor' of taking up a service. Simplify messages.
Attractive	Attract attention. Design rewards and sanctions for maximum effect.
Social	Show that most people perform the desired behaviour. Use the power of networks. Encourage people to make a commitment to others.
Timely	Prompt people when they are likely to be most receptive. Behaviour is generally easier to change when habits are already disrupted, such as around major life events. Consider the immediate costs and benefits. Help people plan their response to events.

Nadine Marshall proposed that instead of focusing on increasing productivity we should focus more on helping producers adapt to changing conditions. CSIRO found that only 15% of northern beef producers are able to cope with current challenges, while 85% are vulnerable to change and need help to understand what will make them successful. Factors that promote success are:

- networks
- business approaches
- diversification
- local knowledge
- environmental awareness
- use of technology.

Ideas for focusing on people are:

- encourage individuals to experiment, be innovative, creative, share learnings, reflect, be brave and think differently
- encourage people through events, networks, extension, workshops, women, kids, media, stories, festivals, NRM organisations, consultants
- provide scenarios of the future
- create an interest in the future
- encourage skills to meet the future
- facilitate new networks
- redefine education around life skills.

3.4 Review of best management practice

Literature was reviewed for the purpose of identifying beef grazing industry best management practices. While the beef industry has been a low-input and low-management primary industry sector, there is pressure to increase management effort. This is being driven by declining terms of trade, where costs are increasing and prices received for beef are stable or declining. Additionally, there has been a steady increase in the requirements associated with beef production, such as has occurred with:

- Government environmental regulations
- occupational health and safety (OH&S)
- food safety
- supply chain specifications for quality
- animal welfare
- chemical use and recording
- stock movements
- finance requirements
- insurance requirements.

Management practices that consistently achieve results superior to those achieved by other means are often called industry best management practices. These best management practices for the beef industry differ spatially and temporally, yet the likelihood of success is high for achieving better outcomes and leading to improvements in economic performance, land condition and reef water quality.

The 2013 Scientific Consensus Statement by Brodie *et al.* (2013) affirmed that improved land management practices are known to reduce the runoff of suspended sediments and nutrients at the paddock scale. For example, in grazing lands, sediment loads can be reduced by setting stocking rates that maintain ground vegetation cover and biomass (particularly during droughts and at the end of the dry

season), and by managing stock access to riparian, frontage country and wetlands, and degraded areas that are rilled, scalded or gullied.

Similarly, McIvor (2012) noted that the cattle industry has placed emphasis on practices that improve herd performance, such as controlled mating, greater segregation of animals for mating and nutrition, and early weaning.

There has been considerable effort over several decades to develop best practices for the extensive beef grazing industry. Understanding the resource base and achieving sustainable use of it was the initial focus. Some fundamental best practices arose from this work, including: identification of objective safe carrying capacities; annual adjustments in stocking rate at the end of the wet season, forage budgeting; pasture spelling and burning. In more recent times there has been an increasing focus on best practices for herd management and business management.

Of particular interest to this project are recommended industry practices that improve both herd performance and the sustainability of cattle enterprises. The confluence of these two areas of management has the potential to improve both the cattle industry and the GBR. For example, culling cows that are not pregnant or will calve in the dry season can be good for both cash flow and for reducing stocking rates. Pregnancy testing and foetal aging can be used to identify dry cows or cows mated at the wrong time. These cows have low production potential and can be sold, while the cows that will calve at the correct time and be more likely to rear a calf, will be retained.

As part of the Northern Grazing Systems project, McIvor (2010) formulated a number of grazing land management principles and guidelines based on an extensive literature review. This review covered property infrastructure (fences and waters), stocking rates, pasture spelling and prescribed burning. These principles and guidelines inform the implementation of practices on beef properties, although the exact nature of these practices may vary with the characteristics of properties.

The principles and guidelines formulated by McIvor (2010) are listed under the headings of property infrastructure, stocking rate management, pasture spelling and prescribed burning. However, these are preceded by what may be regarded as practices which are fundamental or prerequisite to these higher level practices.

3.4.1 Prerequisite practices

Fordyce *et al.* (2013) wrote that management practices have a hierarchy of importance. The efficacy of any practice is enhanced by effective implementation of more fundamental or prerequisite practices. The most important and most basic practices are to provide adequate feed to readily satisfy voluntary feed intake, provide ready access to clean water and to have cattle under control. If these conditions are not met, then many higher-order practices may not be achievable.

Before anything else, it is necessary to keep cattle where you want them. Fences need to be of a type and condition that keep cattle within paddock boundaries. Holroyd and Fordyce (2001) emphasise the importance of being able to control the location of cattle. Effective cattle control is being able to segregate different classes of cattle, keeping them where you want them and being able to recover them when you want at a minimum cost and effort. It allows for more effective implementation of other husbandry and management practices. Important segregation groups are: cull females; small weaners; older weaners; heifers; first-calf cows; mature cows; immature and cull bulls and steers. Possession of a sufficient number of paddocks is an important prerequisite for the segregation and management of cattle classes.

It is important to keep cattle healthy. A continuous supply of good quality drinking water is essential, no matter how long the dry season or drought. Keeping cattle healthy also requires vaccinations for a range of diseases (botulism and reproductive) and treatments for a range of internal and external parasites.

The other major requirement for keeping cattle healthy and productive is a continual supply of forage from pasture. In this respect, setting appropriate stocking rates is essential. If forage supply does not meet the maintenance requirements of cattle, then they will lose weight to the point where their welfare is compromised. To ensure that forage is always available for cattle it is necessary to know the carrying capacity of each paddock and set stocking rates accordingly. The carrying capacity depends on a combination of its size, land type, land condition, and tree cover. The area of land available for grazing is largely that within a 2 km radius from water points, and therefore may not be the whole paddock. The task of working out carrying capacities is made a lot easier by the possession of a property map and natural resource inventory. This should include:

- actual fence line locations
- measured paddock areas
- actual water point locations
- grazing circles around water points
- land types based on grazing land types for region
- measured land type areas
- measured areas of land condition, based on ABCD land condition ratings
- locations of vulnerable/sensitive land types (including frontages and wetlands).

(Source: Kevin McCosker, Reef Plan Water Quality Risk Framework for Grazing)

A fixed or set stocking strategy (relatively constant from year-to-year) is generally easier to manage and least risky. As stocking rates do not vary much over periods of high and low rainfall, set stocking rates need to be conservative if they are not to result in overgrazing in the majority of years.

Estimates of appropriate conservative set stocking rates can be sourced in two ways. First, given the information listed above, local experience and/or local knowledge will often indicate how many adult cattle may be carried in each paddock. Where possible, it is also advisable to seek calculated carrying capacities from industry or agency advisors. They will calculate the long-term average annual amount of pasture produced in each paddock, and the number of adult cattle that this can support.

In respect to managing stocking rates, the Reef Plan Water Quality Risk Framework for Grazing, recommend keeping records of annual cattle weights by classes. Records and analysis of stock numbers allow more effective planning and management of stocking rate. Records should be kept of:

- numbers of cattle in each paddock during the year and every time there is a change in cattle number in a paddock; digitally or in a paddock book
- Adult Equivalents (AE) used to account for effects of animal class and size/age when comparing stocking rates for different mobs or different paddocks.

While a conservative set stocking strategy may be appropriate for most seasons, there will always be a few years every decade when drought or near-drought conditions prevail. Therefore, there will be some years when forage availability does not meet maintenance requirements of cattle, resulting in weight loss, reduced breeding performance, land degradation and even animal mortality. At these times it is necessary to reduce stocking rates, using a pre-determined strategy that sets out how and when this will unfold. A strategy is made possible through controlled mating, pregnancy testing, segregation of cattle classes, and rules for culling stock.

Having breeds that suit the tropical environment also helps keep cattle healthy. Brahman cattle (Bos indicus) genetics are the basis for this, but well-managed cross-breeding with British breeds (Bos taurus) helps produce a carcass more highly valued by markets. Holroyd and Fordyce (2001) wrote that in the dry tropics of northern Australia, the appropriate genotype is a balance between suitable productive traits for particular markets (e.g. growth rate, meat quality) and adaptive traits such as parasite resistance and heat tolerance, where these are somewhat mutually exclusive. It is a question of finding the right genotype for the particular environment, management system and target market. In the dry tropics, 50-75% Bos indicus is ideal. In the more benign environments of the reef catchments, it is likely that 50% or even lower content of B. indicus genotype would be appropriate.

Judicious supplementary feeding is useful for maintaining the health and productivity of cattle, particularly in nutrient deficient country, and particularly during low-rainfall years. However, this should always be viewed as a supplement to the natural pasture diet. Protein supplements during the dry season and phosphorous supplements during the wet season can significantly improve cattle growth and fertility.

Fordyce *et al.* (2013) wrote that in their experience in northern Australia, a very low proportion of beef producers keep sufficient records to enable calculation of current production, herd performance, and business performance. To enable diagnostics of why performance and production are not reaching desirable levels, and to enhance the ability to produce basic herd performance data, a supporting 'paddock' record system is advisable. Paddock records should include:

- diary entries for events of significance that are not recorded elsewhere, e.g. water delivery, pasture management, cattle sickness and injury, cattle treatments
- a record of cattle movements to maintain a clear understanding of herd structure, numbers and whereabouts
- reproductive assessment
- regular (e.g. water run) pasture assessment
- diagnostic tests (e.g. NIR) from the environment or animals
- routine weather recording

It is also important to keep good monthly and annual records of variable and fixed costs, labour costs, total kilograms of beef produced, and income received. This will enable some key performance indicators to be calculated, such as the cost of producing a kilogram of beef divided by the price received for a kilogram of beef sold. It will also enable completion of basic accounting practices, being the use of a cash-flow statement, profit and loss statement, and balance sheet.

In summary, the prerequisite practices for beef properties are:

- continual supply of good quality drinking water
- vaccinations for disease and treatments for parasites
- genetics that are an appropriate mix for the environment and markets
- fences that control the movement of cattle
- conservative, relatively constant stocking rates aligned with long-term safe carrying capacity
- map and inventory of the properties main infrastructure and natural resources
- judicious supplementary feeding
- record keeping and analysis
- basic accounting practices (use of cash-flow statement, profit and loss statement, and balance sheet).

3.4.2 Property infrastructure

The related principle defined by McIvor (2010) is 'use fences (paddocks) and water points to manipulate grazing distribution'. The associated guidelines are:

- Smaller paddocks and additional water points can achieve more effective use of pastures, i.e. reduce the proportion of the paddock that experiences little grazing. For the more intensive regions in the eastern part of northern Australia, it is likely that paddocks of 20 km^2 with two water points are sufficient from the perspective of optimising grazing distribution. Smaller paddocks may still benefit from sub-division where cattle show a strong preference for land types within a paddock.
- To minimise the development of large sacrifice areas around water points, the number of head per water point should be limited to no more than 300.
- Smaller paddocks and additional water points do not overcome uneven utilisation by cattle at the plant community or patch scales. Other methods are needed to improve evenness of utilisation at these scales (e.g. fire, careful selection of water point locations).
- Fencing and water points can be used to help protect preferred land types and sensitive areas from overgrazing. Fencing to separate markedly different land types is an important strategy for controlling grazing pressure on preferred land types, and to get more effective use of all pasture resources on a property. It can be a practical option in some situations and should be considered where property development is planned.

While cattle will walk up to 10 km from water, most of the grazing, up to 80%, occurs within 2 km of water (MLA 2014). Hence, to encourage more even grazing of paddocks, locate water points so that they are no more than 4 km apart.

McIvor (2010) also noted that:

- The evenness of grazing in paddocks is improved if water points are sited away from fences.
- To protect sensitive areas, riparian/frontage country should be fenced off, off-stream water should be provided to reduce riparian use and water points should be sited away from preferred areas (although the effects on land condition are uncertain).
- Allowance should be made for protecting biodiversity where grazing-sensitive flora and fauna still exist by not establishing new waters that would make these areas accessible to livestock.

Kevin McCosker's reef plan water quality risk framework for grazing notes that the risk of erosion is greatly reduced if fence lines follow contours or ridge lines where possible in steep country, and whoa-boys are used on fence-lines where required.

Laneways are also a form of infrastructure that is becoming important as labour costs rise and beef businesses rely more on family labour. These make it possible for only one or two people to muster mobs of cattle and move them to other paddocks or yards. Laneways can also reduce cattle stress associated with mustering, especially for cows in late pregnancy or with young calves, as this allows them to be moved slowly and quietly. As laneways make it easier and cheaper to move cattle, they increase the efficacy of other best practices, such as pasture spelling, stocking rate adjustments, pregnancy testing, early weaning and animal husbandry.

3.4.3 Grazing land management practices

In relation to grazing land management, McIvor (2010) developed principles and guidelines of for stocking rate management, pasture resting and prescribed burning.

Stocking rate management

The principle is 'managing stocking rates is vital to meeting livestock production and land condition goals'. Recommended guidelines are:

- Set stocking rates to match long-term carrying capacity. Plan for the average paddock stocking rate to match estimated long-term carrying capacity, as operating at or around the long-term carrying capacity will help maintain land in good condition. The extent to which stocking rates can exceed the long-term carrying capacity without reducing economic returns and/or reducing land condition is unclear.

- Regularly assess the need to adjust stocking rates in relation to current and anticipated feed supply and feed quality. Some variation in stocking rates over time is required to manage periods of below-average pasture growth. Relative to conservative fixed stocking, constrained flexible stocking can significantly improve cattle productivity while maintaining or even improving pasture. As such, forage budgeting is used to determine how much forage is available for consumption by cattle at the end of each wet season, and then stocking rates are increased by up to 5% or decreased by up to 20% depending on how much forage is available (Pahl *et al.* 2011).

- Management factors and issues other than forage supply may also determine the need to vary livestock numbers.

- The adjustment of stocking rates over time should consider land condition trend, ground cover, grazing pressure from other herbivores and economic risk.

Pasture spelling

The principle is 'spell pastures to maintain them in good condition or to restore them from poor condition to improve pasture productivity'. The guidelines are:

- Spell pastures during the growing season. As a rule of thumb commence the spell period after 40-50 mm of rain or sufficient to initiate pasture growth at the beginning of the growing season. If it is difficult to access country after rain then spelling should commence before the wet season starts.

- Spell pastures for the whole growing season. Spelling pastures for the whole growing season is likely to provide the most reliable benefit albeit most of this benefit appears to accrue from spell during the first half of the growing season.

- Pastures need two growing season spells to improve by one ABCD condition class. Pastures in B condition need spells for one or two growing seasons to improve to A condition. Pastures in C condition will need longer so plan on taking four good growing seasons to recover to A condition. Where growing conditions are poor, more spell periods will be required.

Prescribed burning

The principle is 'devise and apply fire regimes that enhance grazing land condition and animal productivity whilst minimising undesirable impacts'. Guidelines are:

- Use fire to manage woody species. It may not be necessary to kill target species as top-kill can be sufficient to alter the structure of woody populations. Mid-late dry season fires of moderate to high intensity are most likely to be effective in regulating the density and biomass of woody plants. Fuel loads are a critical issue - to reduce populations/biomass of woody species, a minimum fuel load of 2000 kg/ha is suggested.

- Use fire to change the composition of the herbaceous layer by killing plants, influencing recruitment or altering grazing preferences. Most research relates to the control of wire grasses in Mitchell grasslands and in black spear grass pastures where fire is sometimes but not always effective (e.g. coarse wire grasses in the Burnett region).
- Use fire to change grazing patterns by temporarily improving the attractiveness of previously un-grazed areas and providing rest to previously grazed areas.

3.4.4 Herd management practices

Holroyd and Fordyce (2001) described a number of management practices that are important for improving herd production efficiency. These are summarised below.

Supplementation

Fordyce *et al.* (2013) state that breeding female cattle and bulls should be managed to minimise supplementation. Supplementation should not be used to correct management errors.

Feeding cattle to achieve target weight/body condition occurs at a cost. To minimise feeding costs, but maximise returns (efficiency) options include:

- segregate cattle on the basis of feed requirement
- synchronise lactation with the best nutritional period of the year, using mating to achieve calving early in this period, combined with weaning to reduce the number of cows lactating into the period of poorest nutrition.

Weaning and weaning management

Weaning management is an important component of overall herd management practice. Weaning improves body condition of cows, thereby increasing fertility and the probability of dry season survival. Good weaning management is a key factor in achieving average weaning rates of 80-85% in the dry tropics.

Some general principles can be applied to weaning strategies and weaner management (Tyler *et al.* 2012):

- Calves are taken from their mothers mainly for the benefit of the cow.
- Weaning to maintain the cow's body condition will improve re-conception for the next mating.
- With seasonal mating, calves are normally weaned at four to eight months of age between April and June.
- If the wet season fails, all calves can be weaned younger under both seasonal and continuous mating systems.
- Hay is the main feed for weaners in the yard. Good quality hay must always be available from the first day of weaning.
- Calves weaned under 150kg should gain at least 100g per day, and will need supplements of highly digestible protein and energy if pasture quality is insufficient.
- Heifer calves retained as breeding cows should be fed to gain at least 100g per day over the dry season after weaning.
- Weaning is the time for educating young animals to set them up for ease of handling throughout their lives.
- Weaner education includes being worked calmly through the yards and being tailed out from the yards to the weaner paddock and back for five to seven days.
- Weaner paddocks should be rested over the year to accumulate a body of good grass and herbage; they should not be used as holding paddocks for sale or sick stock, or for the working horses.

Botulism vaccination

Botulism caused by the toxins from *Clostridium botulinum* types C and D is one of the most economically important infectious diseases of northern Australia. Major precipitating factors are nutrient deficiency, such of phosphorus, and drought leading to bone chewing and carrion eating. Phosphorus supplementation may reduce incidence of the disease.

Heifer management

Under continuous mating, initial lactation of heifers often occurs during the dry season because of lack of a cattle control. These animals have a high mortality risk, and a poor chance of re-conceiving whilst lactating. Segregation of females up to 3.5 years of age, irrespective of reproductive performance, to provide preferential nutritional management is a cost-effective way of improving fertility. . The major features of recommended management for heifers are:

- Heifers should be segregated from cows. Heifers require approximately a third of the grazing area allocated for the rest of the female herd. Within this area, weaners (0.5-1.5 years) should be segregated from older heifers (1.5-3.5 years).
- Mate heifers for only three months each year. Yearlings should be mated if bull control cannot be guaranteed.
- Wean all calves from heifers at the end of the growing season when bulls are removed.
- Transfer heifers to the cow herd at 3.5 years of age.

Schatz (2012) listed a number of key messages for heifer management, being:

- Body condition at mating has the greatest effect on heifer fertility.
- Heifers should be segregated from the cow herd, grazed on the best paddocks and may need supplements over the post-weaning dry season to reach critical mating weight.
- The majority of heifers should be at or above the critical mating weight (CMW) at the start of mating. The CMW for *Bos indicus* heifers is 320–340kg.
- The heifer needs to have a body condition score (BCS) of 3.5 (on the BCS scale of 1–5) or higher at calving to maximise the chance of getting pregnant again while rearing her calf.
- Mate more heifers than are needed for replacements using young bulls evaluated for breeding soundness, 'calving ease' and 'low birth weight'.
- Select replacement heifers from those that conceive early in the mating period—and on temperament.
- Ideally, cycling heifers should be mated for only three cycles (63 days). On extensive properties, pregnancy diagnosis can be used to identify heifers that conceived early in the mating period.
- Calf losses in first-lactation females are often high (>20%) and mostly occur around the time of birth.
- Vaccinate all heifers against botulism and against any other diseases that could have significant economic impact.

Selection of breeding cattle

Selection criteria when breeding or purchasing replacement bulls and heifers should be consistent with future production objectives. The economic value of each trait is dependent on its effect on production efficiency and market value, its heritability, and its measurement accuracy. Selection emphasis on different traits should be balanced because selection for extremes, e.g. growth rate, almost invariably has undesirable effects on other important traits such as dystocia and must be avoided. The use of Estimated Breeding Values (EBVs) for various traits can minimise this.

Efficient culling

The objective of heifer and cow culling is to remove females with low fertility as fertility is repeatable and heritable. After about 8-10 years of age, cows with deteriorating dentition have poorer ability to forage and have higher mortality risk under drought conditions. Culling should be based on reproductive records and visual assessment for physical normality and traits of other economic importance.

Pregnancy diagnosis is used to increase efficiency of culling by identifying low-fertility cows up to a year earlier. Trained, experienced veterinarians achieve close to 100% accuracy using rectal palpation when cows are at least six weeks into pregnancy.

Sale of females surplus to requirements for breeding is an important source of income. Culled females may not be suitable for sale because of poor body condition. Prevention of pregnancies by surgical spaying is widely used, especially where segregation and cattle control are problems, to improve their sale value.

Control of reproductive diseases

In well-managed herds, an achievable level of reproductive wastage from early pregnancy to weaning is 5-10%. Heifers and first-lactation females are the groups most likely affected by reproductive diseases, with older cows having developed some degree of immunity through previous exposure. There are a number of important diseases in northern Australia affecting fertility. These are:

- Bovine ephemeral fever (‘3-day sickness’) and a range of other diseases caused by insect-borne viruses may cause some reproductive loss in some years.
- Bovine viral diarrhoea virus (a pestivirus), with the development of improved diagnostic techniques, has now been associated with a spectrum of significant reproductive loss such as fertilisation failure, embryonic mortality, abortion, foetal mummification, congenital abnormalities, stillbirths and calf death may be the most important viral disease affecting productivity in northern Australia.
- Campylobacter (vibriosis) is a common infectious venereal diseases causing repeated return to service associated with embryonic mortality, abortions in mid gestation and pyometra. Trichomoniasis is a similar but less common disease.
- Though leptospirosis is widespread, its effect on herd reproduction has only occasionally been demonstrated.

Bull selection and management

The main points with bull selection and management for are:

- A systematic physical and reproductive examination of a bull is the foundation of a breeding soundness examination.
- Semen examination including assessment of sperm morphology should be incorporated into bull selection.
- Serving assessment for *Bos taurus* bulls primarily.
- Multiple-sire mating bulls at 2.5% is adequate under most extensive conditions.
- Bulls should be mated in similar age groups to minimise the effects of social dominance.
- Bulls should be purchased as yearlings if possible to avoid problems associated with relocation and adaptation to local conditions.
- Bulls should be culled from about seven years of age, usually when they develop behavioural problems.

Controlled mating

Controlled or seasonal mating is the practice of leaving bulls with cows for a number of months of the year rather than having bulls with the cow herd all year round. The major objective is to match the period of peak nutritional demands of the lactating cow with the peak nutrient in the pasture. In the dry tropics, controlled mating aims to

prevent dry season lactation rather than restrict the calving period. There are many advantages in controlled mating including:

- avoiding out-of-season calves including premature conceptions in heifers
- more efficient management procedures such as segregation and supplementation
- more uniform progeny groups, thereby enhancing marketing
- better bull control which reduces spread of venereal diseases.

In the dry tropics, recommended start of mating varies from early December to late January. This causes the start of calving in the following year to coincide with the start of the wet season. Good quality pasture is matched with peak nutritional needs of lactating cows. Calves are then weaned at the end of the pasture growing season.

Dry season segregation of cows

There is a range of physiological states of cows within a herd during the dry season. This means that there are a range of classes of animals with different survival risks and re-conception rates. Those with the highest risk of death and lowest probability of re-conception can be segregated in the early dry season for preferential management such as supplementary feeding. The early dry season is the best time to segregate cattle as few young calves have to be mothered-up.

Improving cow survival

Henderson *et al.* (2013) reported a number of management practices that lower cow mortality rates. A policy of last mating of cows at or under 10 years of age was recommended as analysis showed that breeding females over this age present the biggest mortality risk in the region where this study was conducted.

Wet season phosphorous supplementation has potential to lower female and male death rates. An underlying message may be that supplementation with phosphorous should efficiently target females on the most phosphorus deficient country and the most susceptible cattle as opposed to attempting to supplement the whole herd.

The segregation of cows during the dry season was a significant factor associated with reduced mortality rates in females and males. Properties that segregate cows in the dry season are presumably also likely to be managing cattle differently and possibly managing land and pastures differently.

Spike feeding

Spike feeding is the feeding of high quality supplement to late pregnant heifers or cows for a short period in the late dry season. Feeding should be for about 50 days, starting six to eight weeks before calving commences. The strategy increases conception rates in lactating cows in the following year by an average of 15%.

3.4.5 Business management practices

The MLA Edge network (2014) course called Business Edge is a two day financial and business management training workshop for northern beef producers (http://www.mla.com.au/News-and-resources/Events-and-workshops/BusinessEDGE-Mt-Isa).

The aim of the workshop is to enhance producer knowledge and skills in basic financial and business management to improve beef business efficiency and profitability. The workshop equips participants to keep accurate records, identify if their business is economically sustainable in the long term, understand the key profit drivers in their business and herd, and effectively manage debt and capital.

This course makes the following recommendations for improving the economic performance of a beef business. These were:

- identify and examine the key profit drivers
- develop strategies to overcome weaknesses
- don't lift stocking rate above carrying capacity, but attempt to lift carrying capacity
- focus on heifer management, cow performance and bull selection
- continually improve business management skills.

The Business Edge course emphasises three pillars for good financial management, being Cashflow Statement, Income (profit and loss) Statement and Balance Sheet.

The cash-flow statement is used to show the flow of cash in and out of the business by month and year. It is based on actual rather than accrual accounting, and does not distinguish between operating and capital.

The profit and loss statement is similar to cash-flow, but also includes non-cash items such as depreciation, cost of sales, owner wages and some over-head expenses.

The balance sheet is a snapshot at a point in time that shows the worth of a business. It shows current assets and liabilities, equity (difference between assets and liabilities), and includes herd inventory change, tax liability, finance costs, depreciation and debt principal.

The Business Edge course provides key indicators of financial health, being:

- generates a profit and has positive cash flows
- internal funding of activities
- growth in expenses in line with inflation
- pays tax
- growth in equity
- debt reduction and provisioning (for super etc.)
- minimal volatility.

Indicators of financial stress are:

- no debt repayments
- liabilities increasing
- over-draft always in red, meaning some debt should be in the core loans
- equity maintained by land value.

The Business Edge course proposes that the key performance indicators are the cost of production and the operating margin.

The cost of production = total costs (variable and fixed)/kg beef produced. Labour efficiencies and scale are important components of costs. Labour efficiency should be at least 1500AE/labour unit in most areas (AE = 450 kg animal). Cost of production should be less than $1 per kg of live weight produced, and preferably it should be $0.80. For a cow it should be no more than $75-$80.

The operating margin is the price received – cost of production per kg live weight. Best practice operating margin is $0.60, and should be consistently above $0.30.

Sale price is also important, but much less so than cost of production and the operating margin. A key business practice is to maximise live weight of cattle sold. Though there is not a lot that can be done about sale prices/kg, it is important to sell into the heaviest end of the specifications of the market being supplied, and avoid selling young and/or light cattle.

Business analysis

Fordyce *et al.* (2014) recommend that the management decisions of beef producers should be based on a full business analysis, including costs of options and the time required to achieve financial returns.

The use of business principles and practices for informing management decisions on cattle properties is being promoted by Resource Consulting Services (RCS) (2014), Bush Agribusiness (2014) and DAF. DAF projects, such as Research to Reality (Nelson *et al.* 2008) and CQ Beef (Donaghy *et al.* 2010), both used the RCS ProfitProbe tool to identify areas of weakness in cattle businesses.

The $avannaPlan-Beef$ense program in Queensland's Gulf country, delivered via a partnership between DAF and the northern and southern Gulf NRM bodies, is another example of a project that uses business analysis as a prerequisite to taking actions on beef properties. The last five years of financial records and sales figures are analysed along with a number of other key business indicators, and compared with industry benchmarks. On this basis, and with cash flows for the next two to three years, future actions to improve the business are planned. Much of this work occurs on the beef producer's property, where the project team will meet several times over a period of 12 to 18 months. The Beef$ense business analysis component was introduced in July 2013. Beef$ense outputs for each business include:

- overall business position (assets and liabilities)
- detailed analysis of Profit and Loss from 2009 to 2013
- benchmarks to track herd and business performance
- partial budgets and cash flows in relation to on-property capital improvements and off-farm investment options
- sales and herd performance data analyses over the previous five years detailing herd structure, age of turnoff, female sales as a percentage of total sales, weaning rates and average annual live-weight gains
- a multi-purpose summary document that clients can utilise for business planning, family meetings, bank quotes and benchmarking.

Business analysis was also at the core of the extension model for improving beef businesses (see Figure 2) developed by the Cash Cow project (McGowan *et al.* 2014). This model contains a number of stages. The first is *Business Monitoring*, involving processes such as standardised herd monitoring, reproduction records, *StockTake* for forage budgeting, stocking rate adjustment, and NIRS for monitoring forage quality. Concise, relevant records need to be kept. The Cash Cow project has developed a recording framework that uses minimal mob based data inputs with only cattle numbers and weights by class (i.e. younger cattle / older cattle / weaners and sales). This basic data will supply a beef business with the production information needed to start critically analysing the business. The use of individual ID based systems can also be incorporated, but for most producers a basic, low input (paper based) approach is the starting point.

The second stage is *Business Assessment*, using an alternative benchmarking tool known as BRICK, together with business advisor software. This stage involves assessment of a range of property and business practices using Grazing BMP. Key indicators for breeding herds are measured on an annual basis (most often at the final major mustering round). Key indicators are:

- weaner production (kg weaned per cow)
- live-weight production (live-weight produced per cow)
- live-weight production ratio (live-weight produced per total kg run in the mob).

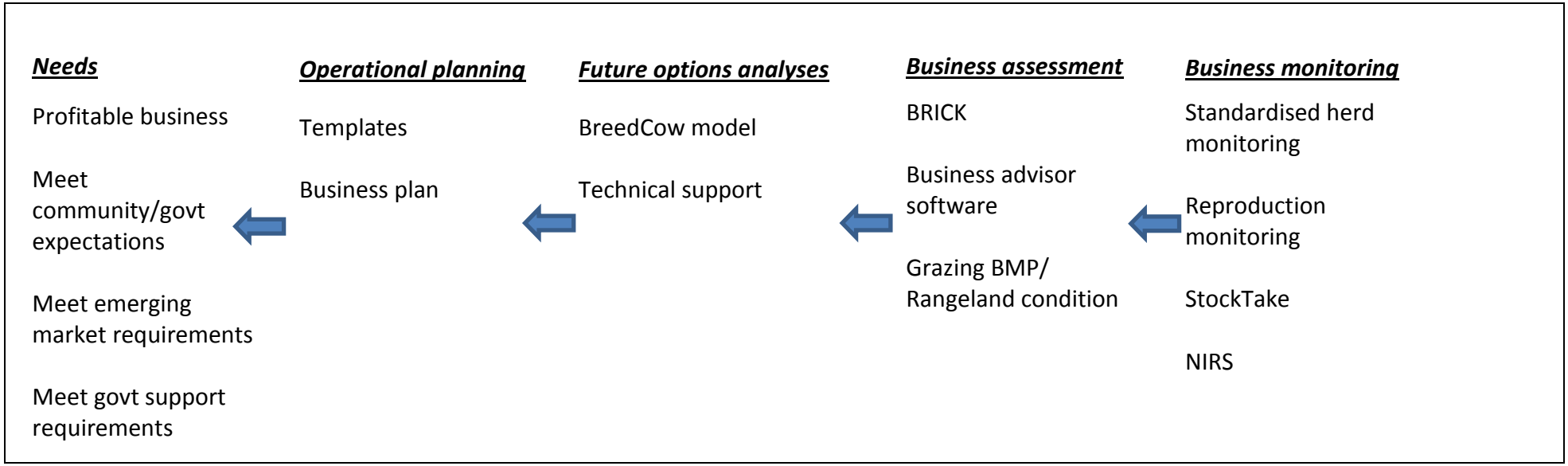

Figure 2. Cash Cow Extension Model (provided by Geoffry Fordyce).

Then, using the key indicators, compare current production with industry benchmarks above. If current productivity is below achievable industry benchmarks, then assess the opportunities to change practices to improve the situation.

The next stage is *Future Options Analysis*, where technical support using models such as Breedcow and Dynama, identifies practices that will most likely achieve the desired improvements in the business.

This is followed by *Operational Planning*, including the development of a business plan and various action plans.

Business analysis was also a strong component of the Research to Reality project conducted near Charters Towers (Nelson *et al.* 2008). This project used a continuous improvement and innovation cycle approach which was developed by Clark *et al. (*2001). While business analysis was the main activity in the situation analysis (Figure 3), it was later recommended that this be preceded by the identification of personal and business goals, followed by social, environmental and practices analyses. These analyses identify areas that need to be improved and actions that could be taken to achieve improvement. Actions were then prioritised based on their impact on the business, implemented, assessed and revised where results did not meet expectations, as per the cycle in Figure 3.

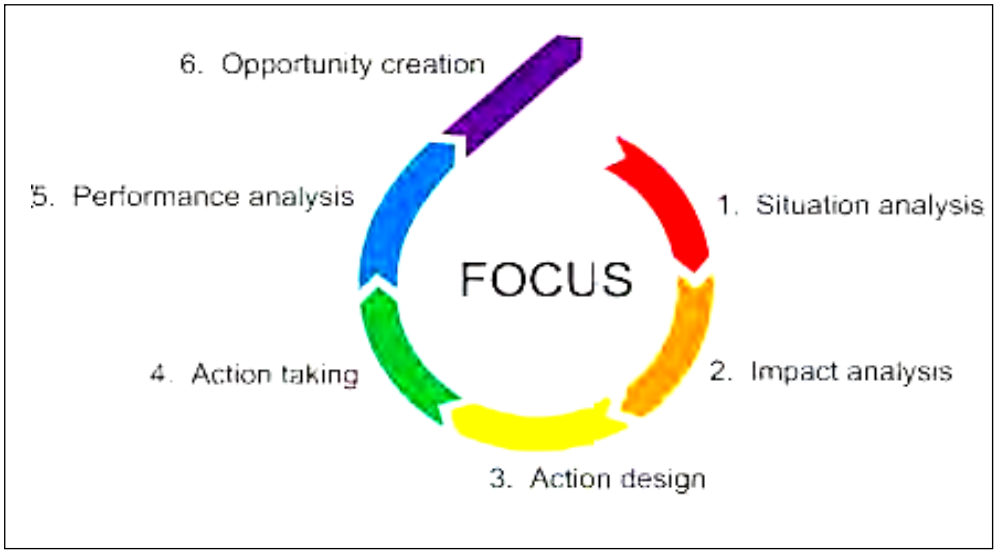

Figure 3. Continuous Improvement and Innovation (source Nelson *et al.* 2008).

3.4.6 Grazing BMP

Grazing BMP (2013) is a voluntary, industry-led program for the cattle grazing sector. Many beef producers and beef industry stakeholders have contributed to the on-going development of the Grazing BMP program. Grazing BMP is a joint program of AgForce, the Fitzroy Basin Association, and DAF. It is a voluntary, industry led process which helps graziers to identify improved practices which can help improve the long term profitability of their enterprises. It also helps identify the steps that need to be taken to incorporate best management practices into enterprises.

Grazing BMP follows the development of best practice programs in other broad-acre primary industry sectors such as the cotton (BMP Cotton 2014) and grain (Grains BMP 2014) industries. Grazing BMP has drawn on the many projects and grazing trials that have identified individual best practices, and has collated these under a number of topics. The purpose of the agriculture BMP programs is to help producers identify practices that can improve the long term profitability and sustainability of their enterprise.

Grazing BMP contains five modules, being:

- Soil Health
- Grazing Land Management
- Animal Production
- Animal Health and Welfare
- People and Business.

Each module consists of a number of Key Areas, and several practices or industry standards are listed under each of these. In total, Grazing BMP has 25 Key Areas and 157 practices/industry standards. Beef producers complete a voluntary self-assessment of their management practices against industry standards.

Star *et al.* (2013) writes that Grazing BMP is a strategic self-assessment review of all aspects of the grazing business. The delivery of the program works on the premise that a high level of participation will lead to industry wide improvement in management practices. Completion of modules provides a producer with an opportunity to self-assess where they believe their management fits within the best management practice framework of below, at or above industry standard. Throughout the self-assessment process participants are automatically requested to develop action plans to progress from their current identified standard of management to a higher level. On completion of each module the identified actions are summarised into a module action plan. The plan is available for download for the applicant to utilise as necessary. Also, an automated reminder of a grazier's action plan is sent out at six month intervals to remind them of any outstanding actions.

McKenzie-Mohr and Smith (1999) have proposed that prompts can be very effective at reminding people of commitments they have made. They suggest that for prompts to be most effective:

- make prompts noticeable
- make the prompt self-explanatory
- present the prompt in close proximity to where the action is to be taken
- use prompts to encourage people to engage in positive behaviour.

The Grazing BMP process also helps beef producers identify information gaps which may be addressed through training. In the Fitzroy and Burdekin regions, some Grazing BMP workshops also deliver technical information related to the module in an effort to stimulate greater workshop participation and provide a level of information that is often sought by participants.

Star *et al.* (2013) also noted that participation in Grazing BMP can help producers access training funded by other programs, and thus grow their knowledge and in-turn improve their management. As Grazing BMP standards cover all aspects of the business, graziers are supported in the provision of animal production and business information and advice, ranging from herd modelling to workplace health and safety.

Additional information and skills that are commonly sought by beef producers after completion of Grazing BMP are provided by Meat & Livestock Australia's EDGENetwork of workshops (MLA 2014). The four topics offered by EDGE workshops are: Breeding, Business, Grazing Land Management and Nutrition.

Another training program commonly sought by producers who have completed the Grazing BMP is the *Stocktake* workshop (Stocktake 2014). *Stocktake* is a paddock-scale land condition monitoring and management package. It has been developed to

assist grazing land managers assess long-term carrying capacity and calculate short-term forage budgets and stocking rates.

Private consultants have also developed information and skills training programs that they deliver to beef producers. Resource Consulting Services (RCS 2014) have successfully used grazing business analysis and benchmarking tools to inform and motivate changes in management for several decades. Using these tools, beef producers identify weaknesses in their business which they can then improve.

Participants of Grazing BMP complete expression of interest forms, to indicate what training they feel would be beneficial to their business. As of June 2014 (Jo Gangemi pers. comm.), over 947 expressions of interest in training opportunities have been collected, and the highest responses are as follows:

- 104 responses – Grazing Land Management EDGE course
- 91 responses – Breeding EDGE course
- 90 responses – Nutrition EDGE course.

A potential weakness of Grazing BMP is that there are 157 industry standards listed under five modules, with no discernable point of entry. The large size and apparent absence of a clear starting point or logical sequence of modules to be completed may limit participation by beef producers. Also, the large number of standards covered by the program may make it difficult for beef producers to identify the practices that most need to be improved or which may make the most difference to their business. Similarly, beef producers may become frustrated when they are required to rate their performance against all 157 standards, when there are many fewer standards that align with their interests and goals.

There may also be some confusion in the minds of beef producers as to the main purpose of Grazing BMP. Is it a tool to be used for benchmarking their own performance, or is it mainly for demonstrating good industry-wide practice to the general community? Using the program for both purposes may encourage producers to over-rate their standards of management, reducing the utility for benchmarking personal performance.

Grazing BMP accreditation

In time, the Grazing BMP should allow the grazing industry to demonstrate good environmental management to the wider community. This is being progressed through the Grazing BMP Certification and Audit Assurance System (2015). Over one-third of the total Grazing BMP module standards have been identified as key area performance indicator requirements – or ‘core criteria’. These are based on the specific Grazing BMP practices mapped to:

- the Grazing ABCD Reef Water Quality Protection Plan (Reef Plan)
- Australian Animal Welfare Standards
- Grazing BMP Core Criteria for Audit and Accreditation.

These criteria isolate demonstrable key performance indicators most relevant to maintaining good land condition and the employment of animal welfare practices that meet national standards. All core criteria are aligned to readily recognised performance indicators and the Grazing BMP Audit Checklist. An Industry Accredited Auditor then audits a property in accordance with the internationally recognised standard ISO 19011.

The Grazing BMP website claims that in the long term, it is envisaged that accreditation will be beneficial to those graziers wishing to enhance supply chain opportunities, community recognition of their product or seek potential community

funding. To ensure this progression, attention to industry acceptance and engagement, in conjunction with supply chain recognition of Grazing BMP is required to foster further development of tiered accreditation system, as recently demonstrated by the Pasturefed Cattle Assurance System (2015).

Talks between Grazing BMP and leading supply chain and associated grazing groups on accreditation are progressing slowly due to a variety of social, economic and environmental impediments (Grazing BMP Certification and Audit Assurance System 2015). As the program gains more exposure and acceptance a range of drivers for accreditation may develop. Until such time as farm gate assistance opportunities or market drivers have been finalised, the progression of graziers beyond self-assessment will be limited. As such, Grazing BMP will deliver the audits as a means of validating producer data provided through self-assessment.

3.5 Review of beef industry current management practices

McLean *et al.* (2014) noted considerable variation in management practices and performance between beef businesses within the industry. The top 25% of beef producers, with average annual income after interest between $150,000 and $250,000, consistently outperformed the average and had businesses more likely to be economically sustainable over the long term. The superior performance of the top 25% of producers was attributed to management practices that resulted in higher income through better herd productivity and lower operating expenses. Their higher income was due to better productivity (more kg beef/AE) which was a function of higher reproductive rates, lower mortality rates and higher sale weights.

McLean *et al.* (2014) reported that many beef producers were not able to accurately estimate reproductive, mortality and growth rates because of inadequate record keeping, lack of consistency in calculating these measures and infrequent and incomplete mustering of cattle.

It was noted that seasonal variability, and particularly failed wet seasons, had a significant impact on the annual performance of northern beef production systems. Many beef producers did not manage this risk well due to management deficiencies associated with:

- strategies regarding selling down
- the ability to seek and properly cost agistment
- an understanding of the critical number of cows to be retained for timely post drought recovery
- feed budgeting and appropriate management of residual pasture dry matter to ensure pasture integrity following the recovery phase
- the ability and/or capacity to properly quarantine capital raised from the sell down process for use in the herd rebuilding phase
- the ability to manage the inevitable tight cash-flow conditions in recovery as the herd rebuilds, especially if this is compounded by lower than desirable equity.

McCosker and Barbi (2014) conducted a *Grazing Management practice adoption survey* focusing on the Burnett-Mary, Fitzroy, Mackay-Whitsunday, Burdekin, and Wet tropics regions. The objective of the survey was to determine the extent that producers met current benchmarks for Reef Plan with regard to adoption of best management practices that improve reef water quality. A total of 394 properties were surveyed over the period 2011 to 2013. Management practices were categorised according to four levels of sophistication, being A (highest), B, C and D (lowest). Producer practices were benchmarked against a number of performance indicators, where each indicator was weighted. These indicators were partitioned into management impacting hill-slopes, stream banks and gullies.

In relation to the four levels of management sophistication:

- 10% of producers met the requirements of A
- 26% of producers met the requirements of B
- 40% of producers met the requirements of C
- 19% of producers met the requirements of D.

Based on these figures, current practices of almost 60% of beef producers in these reef catchments were regarded as poor to very poor (C and D).

Further evidence of low sophistication of management is seen in the numbers of producers that are adopting best practices. For example, McCosker and Barbi (2014) found that for beef producers in the Burdekin and Fitzroy catchments:

- 15% record changes in total AE of stock in each paddock every time there is a change in numbers
- 15% have documented records, including property maps and safe stocking rate calculations based on land types, land condition and infrastructure
- 6% routinely use forage budgets and stock records for each paddock to adjust cattle numbers to ensure adequate residual pasture and groundcover at break of season
- 19% regularly observe and aim to maintain good ground cover, density of 3P grasses and land condition.

In contrast to this, during completion of Grazing BMP, beef producers in the Burdekin and Fitzroy catchments self-assessed their management practices to be of a higher standard. Brown *et al.* (2013) report the self-assessments made by beef producers who completed a total of 245 modules of Grazing BMP during the period September 2010 to June 2013 (Figure 4). Figure 4 shows that only 10 to 15% of producers regard their current management to be below industry benchmarks. Many more, 80 to 90%, rate their management as equal to or above current industry benchmarks.

McCartney and Durante (2013), in their interviews with members of the cane and beef industries, found that habits and entrenched beliefs and practices were barriers to change and provided inertia that can be difficult to overcome. They found many landholders have firmly entrenched management practices that provide a cognitive barrier against new practices, which are seen to be less effective or irrelevant to landholders. Also, many landholders were content with their current operations and returns and did not see any need to change their practices.

In discussion session of the Rockhampton workshop it was noted that optimistic self-assessments of management practices partly occurred because many beef producers believe their performance is a lot better than it really is. For example, many beef producers do not keep comprehensive and accurate business records and, consequently, adoption rates of record-keeping and business analysis are low.

Forums of the Better Beef and Reef project recommended that new approaches were required to lift adoption rates of grazing industry best practice above current levels. Participants of the Rockhampton workshop believed that more social science principles and practices in traditional RD&E approaches were needed to increase adoption of best practice.

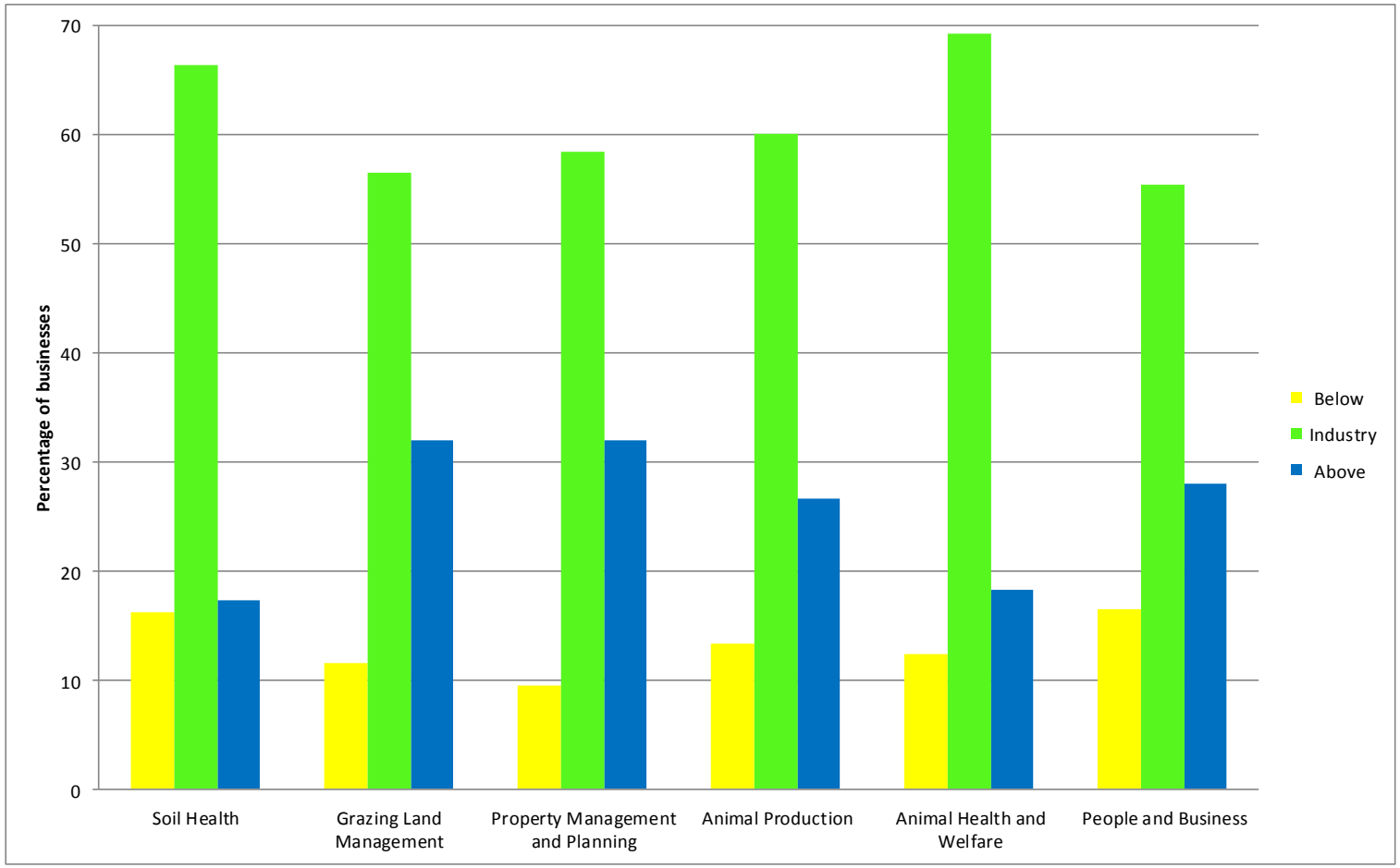

Figure 4. Percentage of businesses by management practice standard within each module September 2010 - June 2013 (Brown *et al.* 2013).

Accordingly, this final project report builds upon the social science theme which emerged from the Rockhampton workshop and follow-up webinar. As such, the adoption of industry best practice was considered within social science frameworks, where finance is just one of the many influences present within the complex decision environment of beef producers.

This commences with description of the behaviour (decisions and actions) of beef producers associated with the adoption of new practices. An understanding of this behaviour will help RD&E providers target key decision points. This is followed by a discussion of the many factors which influence adoption behaviour.

3.6 The behaviour of best practices adoption

Pannell *et al.* (2006) claimed that adoption of management practices is a dynamic learning process that can be broken into a number of stages. This is not new, as Beal and Bohlen (1957) described the stages that farmers go through when accepting new ideas. They identified five stages, being awareness, interest, evaluation, trail and adoption. These stages are very similar to those of Pannell *et al.* (2006), described below:

1. **Awareness of the problem or opportunity**
   'Awareness' is not just awareness that an innovation exists, but that it is potentially of practical relevance to the landholder, consistent with their goals and motivations.

2. **Non-trial evaluation**
   Stage 1, awareness, is the trigger that prompts the landholder to begin collecting information about the innovation in order to inform the decision about whether or not to go to the next step of trialling. The landholder's perceptions of it must be sufficiently positive to believe that there is a reasonable chance of adopting it in the long run. Before trialling, the landholder's assessment of a technology or practice relies strongly on information from outsiders. At this stage, social information networks are important influences on the decision to proceed to trial. The more significant, costly or risky an innovation is, the more a landholder will seek information about it. Producers will seek information from a variety of people who are seen as experts, such as other producers, stock agents, consultants and researchers.

3. **Trial evaluation**
   Trials contribute substantially to both the decision-making and skill development aspects of the learning process. If small-scale trials are not possible or not enlightening for some reason, the chances of widespread adoption are greatly diminished. Landholders will be cautious about leaping to full-scale adoption due to the risk that the innovation will prove a full-scale failure. Trialling an innovation requires a level of knowledge and skill to be applied in practice, particularly as this relates to the unique circumstances of an individual property. Through learning-by-doing, as well as by reading, listening and watching, the necessary skills can be established and enhanced.

4. **Adoption**
   Depending on the trial results, use of the innovation may be scaled up. Typically, adoption is not an all-or-nothing decision — there is a grey area between small-scale trialling and the eventual scale of adoption. Adoption is often a continuous process, and may occur in a gradual or stepwise manner, sometimes ending in only partial adoption.

5. **Review and modification**
   Landholders often change and modify the practice or technology to adapt it to their own circumstances. Indeed, such adaptation is often an important outcome of the trialling process. Viewed in this light, the adoption process is never completed. All options are continuously open to question and review as new information is obtained or

circumstances change. Similarly, Wilkinson (2011) noted that the adoption of new practices is not an event, but rather a process involving changes over time in the nature and/or extent in the use of a practice.

6. **Non-adoption or dis-adoption**
   If external information or local trial results are not sufficiently encouraging and that the landholder's goals will not be advanced by the innovation, the landholder will reject it.

The dominant form of agriculture in Australia is family farming (Fulton and Vanclay 2011), which is the case for the beef grazing industry in northern Australia. The decision and learning processes relating to adoption of new practices often occur within the context of the family unit, and in particular, the husband-wife unit. Accordingly, it needs to be recognised that women have an active role in most beef businesses.

The behaviours associated with the adoption of BMP by beef producers are influenced by a number of factors.

3.7 What influences adoption behaviour?

Adoption of innovations by beef producers is influenced by the characteristics of people, properties, the innovation itself and the practices of extension programs (Pannell *et al.* 2006).

3.7.1 The characteristics of people and properties

One of the key findings of the Better Beef and Reef project workshops and relevant literature was that a better understanding of beef producers and beef properties could be used to improve the effectiveness and efficiencies of extension programs.

In their introduction, Bohnet *et al.* (2011) wrote:

> *It is broadly accepted that developing effective NRM policies and agricultural extension programs necessitates better understanding of the people who manage these resources, including their socio-economic circumstances and value systems…….. Many researchers have recommended the use of landholder typologies to improve the effectiveness of agricultural, forestry and NRM policies and extension programs.*

Robinson (2009) noted the important role than understanding the needs of different segments of farmers plays in the adoption process. This occurs because different segments of the population have differing propensities to adopt particular innovations, thereby requiring different extension tactics for adoption to occur. Greiner *et al.* (2009) recommended that the design of extension programs should be based on a better understanding of the motivations and risk attitudes of graziers, so as to tailor and bundle incentives for maximum effectiveness and efficiency.

Pannell *et al.* (2006) identified three personality traits that influence adoption. The first was strength of an individuals' belief in their ability to influence the circumstances of their lives, where people who believe this strongly are likely to experience less stress in decision making and changing practices. The second personal trait was an individual's propensity for risk, which varies widely amongst farmers. The more risk-averse a farmer is, the greater will be their tendency to adopt an innovation perceived to reduce risk, or conversely, to not adopt an innovation perceived to increase risk. The third trait was introversion-extroversion. Shrapnel and Davie (2001) and Shrapnel (2002) found that Queensland graziers have a tendency to introversion and discomfort within group situations. This may indicate why one-on-one relationships are likely to be preferred by many farmers over group settings.

Pannell *et al.* (2006) also described a number of demographic and situational factors that may influence adoption rates of innovations. These included profit expectations of adopting the innovation, access to off-farm income, property size, age, education and reasons for holding the land. Similarly, Baumgart-Getz *et al.* (2012) concluded that farmers in the US were more likely to adopt agricultural best practices if they had large farms, had high income and capital, and were younger.

McCartney and Durante (2013), who interviewed cane-growers, graziers and related industry stakeholders in Queensland, found that:

- Smaller farms have a lesser ability to fund change and adoption of best practice is generally less feasible. Smaller properties faced greater economies of scale and as such were more challenged to break even or return a financial benefit from investments in associated technologies.
- Bigger, often corporate-run farms, have a larger scale and a more business-like approach which perhaps predisposed managers to taking greater risks in investments and adoption of new technologies.
- Smaller farms in contrast were often cast as managed as *'still a very cultural practice rather than a business type practice'*.

The size of beef cattle properties varies greatly across northern Australia. Martin *et al.* (2013) found that only 25% of cattle properties in northern Australia had more than 1600 head of cattle, but yet they accounted for around 70% of all cattle sales. A similar trend in beef property size and number may also occur within the Fitzroy and Burdekin catchments. Information supplied by Chris Holloway of DAF Queensland in February 2015 on the carrying capacity (adult equivalent cattle) of beef properties in the Fitzroy and Burdekin regions is shown in Table 2. In the Fitzroy region, only 6% of beef cattle properties have >1600 AE of cattle, but account for 51% of all cattle in the region. In the Burdekin, 14% of properties have >1600 AE of cattle and account for 81% of all cattle in the region. In both regions, a relatively small number of beef producers are responsible for a large proportion of grazing land area, and it is these beef producers who are more likely to adopt industry BMP.

Table 2. The number of properties within the Fitzroy and Burdekin regions which have a carrying capacity of <100, 100-400, 400-1600 and >1600 AE of cattle (assumes land is in A condition).

Number of cattle AE	Number of properties in Fitzroy	Fitzroy total AE	Number of properties in Burdekin	Burdekin total AE
<100	3728	71313	1353	20485
100-400	1003	220162	161	33784
400-1600	1003	836055	233	209752
>1600	373	1167038	274	1115548
Totals	6107	2294568	2021	1379569

McCartney and Durante (2013) recognised the influence that age can have on a producers' propensity to adopt new practices. Older landholders were considered more risk-averse and less willing to change, and they were also seen as having less rationale to adopt new practices (e.g. less time to benefit from improvements). Some were of the opinion that widespread adoption of improved practices was contingent on generational change, where older landholders were seen as much less likely to adopt new practices.

Several studies have attempted to partition producer populations into a number of categories or typologies. Bohnet *et al.* (2011) identified three typologies of farmers in the Bowen-Broken basin of north Queensland.

1. Traditionalists (older than 60, continuous grazing, low investment in infrastructure, value their independence as a grazier, do not participate in incentive or other NRM programs, have low debt, income from farm only, follow a proven low risk path).
2. Diversifiers (under 60, rotational grazing and spelling, medium investment in infrastructure, value being a successful business person, have on and off-farm income, participate in NRM programs, high debt, diversification mainly off-farm).
3. Innovators (under 60, cell grazing, high investment in infrastructure, value being an innovative grazier, participate in NRM programs, no off-farm income, high debt, diversification mainly on farm).

Bohnet *et al.* (2011) wrote that traditionalist graziers place much value on their independent way of life and being their own boss. They are not interested in learning about new management techniques, and many do not use agricultural extension services. Traditionalists also appear to be sceptical of government programs and did not expose themselves to new information. It was recommended that different approaches to RD&E are needed to reach traditionalists if they are to be the target audience of specific NRM policy or agricultural extension programs.

In contrast, Bohnet *et al.* (2011) said that the diversifiers and innovators have attended grazing workshops and seek information from a wide range of government and non-government sources and networks, including grazing industry consultant companies. Some have also made use of incentives, where Greening Australia offered subsidies for a range of on-ground projects.

Marshall *et al.* (2014) categorised beef producers in northern Australia using the results from phone surveys with 240 producers (79% of those contacted). Four typologies were identified:

1. Not good at managing risk, unlikely to plan and experiment, not interested in change, less likely to cope with change, had weak networks, had small properties, and the mean age was 59 years. (43% of the sample)

2. Poor at managing risk, less likely to plan and experiment, not able to cope with change, had little interest in changing, poorly networked, had medium sized businesses, and the mean age was 51 years. (41%)

3. Better at managing risk and coping with change, interested in change, had stronger networks, and managed or owned larger businesses. (13.4%)

4. Managed risk well, liked to experiment with options, interested in change, managed extremely large properties, were well networked, perceived themselves as responsible for the future productivity of their land and were early adopters of new technology. (2.6%).

As such, 84% of the industry consists of type 1 and 2 producers who were unlikely to plan and experiment, had low interest in change, poor capacity to change, and were poorly networked. For these reason, Marshall *et al.* (2014) concluded that these producers had little capacity to adopt new practices.

Marshall *et al.* (2014) suggested that the future of the industry may rest with the 16% of type 3 and type 4 producers who were interested in and could cope with change. Ironically, these producers do not appear to need assistance to change, but are more likely to receive attention from government and researchers because of their interest in new technologies.

In contrast to them, type 1 and 2 producers who most need assistance with coping with change and adopting new practices were likely to be the least receptive to interventions.

Marshall *et al.* (2014) suggest that creative solutions such as facilitating their involvement in networks may enhance their adaptive capacity.

Durante and McCartney (2013) identified three categories of primary producers from two focus group sessions and 73 face-to-face interviews on how prepared or responsive farmers were to increasing their productivity. The three categories of farmers were those who:

1. Felt strongly that they were already farming/grazing the land to its full capability, and that there were only small incremental gains to be made in increasing production, which could only be realised by technological advances or research into production gains.

2. Felt that they were not necessarily using the land to its full capability, but perceived the costs and risks required to further develop the land would not be offset by gains made.

3. Have no intention of farming or grazing the land to its full capability due to environmental attitudes or other commitments (alternative employment or interests).

While a range of factors influenced farmer decisions relating to productivity increases, such as declining terms of trade, it appears that personal factors had the most impact. For example, an individual's 'love of farming' was perceived to play a significant role in influencing their production decisions. For many interviewees, their love of the land, their lifestyle goals, and a perception that there is nothing else they could picture themselves doing, were put ahead of being highly productive or profitable.

A well-known form of population segmentation, first reported by Beal and Bohlen (1957) and developed by Rogers (2003), are the segments of people along the diffusion or technology adoption curve. Beal and Bohlen (1957) appear to have provided the first descriptions of innovators, early adopters, early majority, late majority and laggards shown in Figure 5.

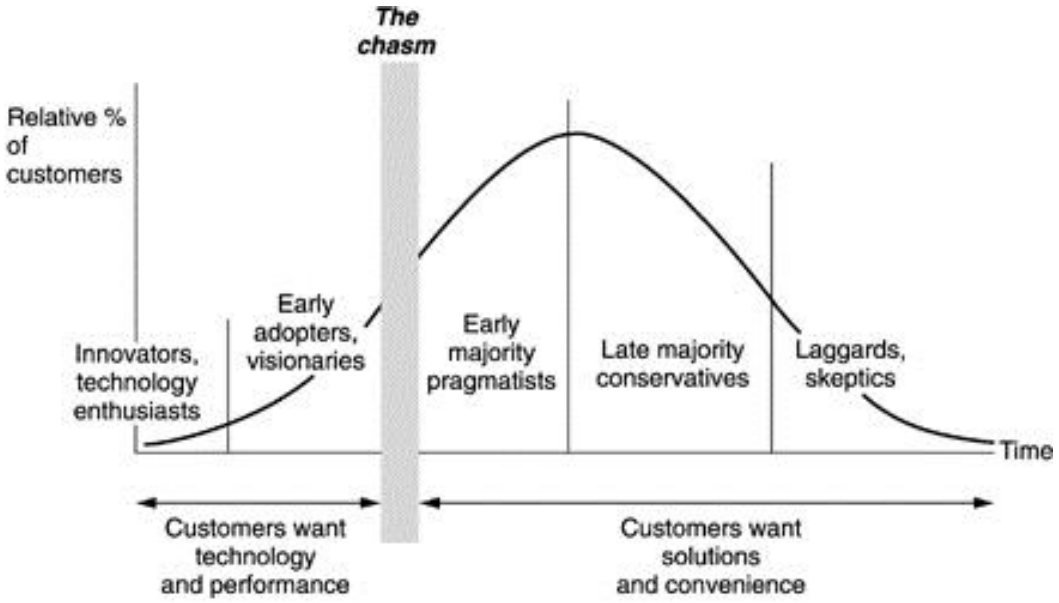

Figure 5. Segments, as a percent of a population, that differ in their adoption of products or behaviours (source Nielsen Norman Group: http://www.nngroup.com/).

Descriptions of each segment based on Beal and Bohlen (1957), Rogers (2003) and Robinson (2009) are provided below.

1. **Innovators**: Innovators are willing to take risks, have the highest social status, have financial liquidity, and have closest contact to scientific sources and interaction with other

innovators. Their risk tolerance allows them to adopt technologies that may ultimately fail. Financial resources help absorb these failures. They tend to have larger farms, are more educated, more prosperous and more risk-oriented.

2. **Early adopters**: Once the benefits start to become apparent, early adopters leap in. They are on the lookout for a strategic leap forward in their lives or businesses and are quick to make connections between clever innovations and their personal needs. They love to be seen as leaders. Their natural desire to be trend setters causes the 'takeoff' of an innovation. Early adopters tend to be more economically successful, well connected and well informed and hence more socially respected. What early adopters say about an innovation determines its success. They become an independent test bed, ironing out the chinks and reinventing the innovation to suit mainstream needs. Fortunately early adopters don't need much persuading because they are on the lookout for anything that could give them a social or economic edge. Early adopters tend to be younger, more educated and community leaders, but less prosperous than innovators.

   A 'chasm' between visionary early adopters and pragmatic majorities explains why many products are initially popular with early adopters, but crash and burn before they reach mass markets. This chasm denotes that a product or behaviour will not spread unless it becomes easier, simpler, quicker, cheaper, and more advantageous.

3. **Early majority**: Assuming the product or behaviour leaps the chasm, it may eventually reach majority audiences. Early majorities are pragmatists, comfortable with moderately progressive ideas, but won't act without solid proof of benefits. They are followers who are influenced by mainstream fashions and wary of fads. They want to hear 'industry standard' and 'endorsed by normal, respectable folks'. Majorities are cost sensitive and risk averse. They are looking for simple, proven, better ways of doing what they already do. They require guaranteed off-the-shelf performance, minimum disruption, minimum commitment of time, minimum learning, and either cost neutrality or rapid payback periods. The early majority adopt an innovation after a varying degree of time that is significantly longer than the innovators and early adopters. They have above average social status, contact with early adopters and seldom hold positions of opinion leadership. They are more conservative but open to new ideas, active in community and influence their neighbours.

4. **Late majority**: They are conservative pragmatists who hate risk and are uncomfortable with new ideas. Practically their only driver is the fear of not fitting in, hence they will follow mainstream fashions and established standards. They are often influenced by the fears and opinions of laggards. They adopt an innovation after the average participant. These individuals approach an innovation with a high degree of scepticism and after the majority of society has adopted the innovation. Late majority have below average social status, little financial liquidity, are in contact with others in the late majority and early majority, and have little contact with opinion leaders. They tend to be older, less educated, fairly conservative and less socially active.

5. **Laggards**: Laggards hold out to the bitter end. They are people who see a high risk in adopting a particular product or behaviour. These individuals typically have an aversion to change-agents and tend to be focused on 'traditions', lowest social status, lowest financial liquidity, oldest among adopters, and in contact with only family and close friends. They are very conservative, have small farms and capital, and are the least educated.

According to Rogers (2003), the percent of each segment in a population is:

- Innovators: 2.5%

- Early Adopters: 13.5%
- Early majority: 34%
- Late majority 34%
- Laggards 16%.

However, Robinson (2009) proposes that a good rule-of-thumb is 20:60:20, where:

- Innovators and early Adopters are 20%
- Early majority and late majority are 60%
- Laggards are 20%.

Robinson (2009) suggested that when designing an extension activity it is critical to know the percentage in a given population who have already adopted the innovation, providing insight into how to design projects and how to pitch communications to producers. With an understanding of the different needs and characteristics of segments of beef producers, it is then necessary to consider their decision processes associated with the adoption of new practices.

Robinson (2009) provides the following guidelines on how to successfully work with producers in each of these segments.

Work with innovators by:

- tracking them down and becoming their first followers, providing support and publicity for their ideas
- invite keen innovators to be partners in designing your project.

When working with early adopters:

- offer strong face-to-face support for a limited number of early adopters to trial the new idea
- study the trials carefully to discover how to make the idea more convenient, low cost and marketable
- reward their egos e.g. with media coverage
- promote them as industry leaders
- recruit and train some as peer educators
- maintain relationships with regular feedback.

To work with the early majority:

- offer give-aways or competitions to stimulate interest
- use mainstream advertising and media stories featuring endorsements from credible, respected, similar folks
- lower the entry-cost and guarantee performance
- redesign to maximise ease and simplicity
- cut the red tape: simplify application forms and instructions
- provide strong customer service and support.

To work with the late majority:

- focus on promoting social norms rather than just product benefits: they'll want to hear that plenty of other conservative folks like themselves think it's normal or indispensable
- keep refining the product to increase convenience and reduce costs
- emphasise the risks of being left behind
- respond to criticisms from laggards.

To work with laggards:

- give them high levels of personal control over when, where, how and whether they adopt the new behaviour
- maximise their familiarity with new products or behaviours. Let them see exactly how other laggards have successfully adopted the innovation.

The characteristics of best practices also influence adoption rates.

3.7.2 Characteristics of practices

Pannell *et al.* (2006) believe that innovations which have high relative advantage and high trialability are much more likely to be adopted by farmers.

Relative advantage

This is the degree to which an innovation is perceived as better than the idea it supersedes, measured in terms of what matters to the user. The greater the perceived relative advantage of an innovation, the more rapid its rate of adoption is likely to be. Pannell *et al.* (2006) identified a large number of factors which contribute to the overall relative advantage of an innovation:

- generate short-term results and income, as medium- to long-term results are less attractive to most producers
- have low adjustment or establishment costs relative to profits gained
- have positive impacts on other components of the property
- reduce the riskiness of production
- be compatible with existing technologies, resources and practices
- have low complexity and be easy to understand
- be encouraged by government policies
- be less costly or more profitable than the traditional practice the innovation is replacing
- be compatible with existing beliefs and values
- have a positive impact on family lifestyle
- have a positive impact on self-image and social standing
- increases perceived environmental credibility.

Trialability

Relative advantage is mostly about the perceptions of the worth of an innovation, whereas trialling is more about testing its worth. Trialability is the degree to which an innovation can be experimented with on a limited basis (Pannell *et al.* 2006). An innovation that is trialable, represents less risk to the individual who is considering it.

It is important that innovations can be trialled and that information is learnt from the trial. In short, a trial needs to reduce any uncertainties about the relative advantage of an innovation.

Trials are also important because they help the producer acquire the skills needed to implement a practice or innovation. The factors that influence the trialability of an innovation, some of which also influence relative advantage, are:

- Degree of divisibility of an innovation. Innovations are more likely to be trialled if they can show results on a small scale.
- Observability of results. The more observable the results of a trial are, the more likely it is an innovation will be more widely adopted. Observability also enhances ‘over-the-fence’ learning by producers.

- Lag time. The longer it takes for results to be observed, the less an innovation is likely to be trialled, and a producer may perceive that the costs of adoption outweigh the benefits.
- Complexity. The more complex an innovation, the more difficult it is to trial, and the less likely it is to be adopted.
- Cost. The greater the cost of trialling, the less likely that trialling will occur.
- Establishment failure. Innovations that are more prone to establishment failure, such as from climate, disease and pests, are less likely to be trialled and adopted.
- Similarity with familiar practices. The more similar an innovation is with known practices, the more confidence a producer will have interpreting the results of a trial.
- Influence. If an individual producer perceives that they can only have a minor influence on an outcome, such as improving the quality of water entering the reef lagoon, then they may be less likely to trail innovations that contribute to this.

3.7.3 Alignment with the goals of beef producers

Pannell *et al.* (2006), Robinson (2009), Bohnet *et al.* (2011) and Greiner and Gregg (2011) all propose that adoption of a product or practice will not occur unless this is consistent with the goals, needs and motivations of farmers.

Pannell *et al.* (2006) emphasised that adoption begins when a farmer perceives a particular technology or practice will help them achieve their goals. They wrote:

> *The core common theme from several decades of research on technology adoption is that landholder adoption of a conservation practice depends on their expectation that it will allow them to better achieve their goals. If the landholder does not perceive that goals are likely to be met, adoption will certainly not follow.*

It is highly likely that this conclusion would apply equally to the adoption of other beef industry best practices. That is, they will not be considered for adoption unless they align with goals and motivations of beef producers.

Pannell *et al.* (2006) listed the main goals of landholder families or individuals as:

- material wealth and financial security
- environmental protection and enhancement (beyond that related to personal financial gain)
- social approval and acceptance
- personal integrity and high ethical standards
- balance of work and lifestyle.

Pannell *et al.* (2006) also listed the more detailed goals presented by Makeham and Malcolm (1993), being:

- survive and grow
- set and overcome challenges
- farm well and be recognised for this
- improve the physical state and appearance of the farm
- acquire extra land or to control a larger business for the future and for heirs
- have a reasonable but not profligate standard of living which compares reasonably with others in farming and society at large
- earn enough profit to be able to improve and develop the farm so as not to have to work so hard in old age
- achieve capital gain and increase wealth
- have good quality animals and crops in good condition

- reduce income tax
- have a satisfying rural way of life
- have children well educated
- have enough leisure, increasing over time
- be a respected member of the community
- have enough money to pursue non-farm interests.

For most primary producers, it is apparent that while making money is not their core goal, it is important for achieving a number of other goals, such as the education of children or keeping the farm property in the family (Pannell *et al.* 2006). This view was voiced strongly at the Rockhampton workshop, where participants were of the opinion that money is often not the primary driver of beef producer decision making, and instead, family, lifestyle and connection with the land are more important.

Similarly, Greiner and Gregg (2011) noted in survey of beef producers in the Burdekin Dry Tropics, Northern Gulf and Northern Territory NRM regions that more graziers were motivated by conservation and lifestyle considerations than by financial and social factors. Bohnet *et al.* (2011) also believed that personal motivations and values are the main drivers of a graziers land management and business strategies, and concluded that policies and extension programs will not be successful unless these values and motivations are considered. Fulton and Vanclay (2011) emphasised the value of a needs-based approach to extension that is responsive to the needs of individual farm businesses. These authors propose that this poses a challenge for extension agencies which favour group extension approaches, whereas consultants tend to operate more at the individual property level.

3.7.4 Raising awareness of new practices

A common method used to make people aware of new products or services is commercial advertising. McKenzie-Mohr and Smith (1999) and Robinson (2009) both noted that advertising and media stories spread information about innovations, and thus can be effective in creating public awareness and in changing attitudes. To be effective, McKenzie-Mohr and Smith (1999) recommend that agencies which communicate with producers should consider the following:

- Capture attention. Use vivid, personal and concrete information.
- Know your audience. Design communication based on a clear understanding of the attitudes, beliefs and behaviour of your intended audience.
- Use a credible source. The presenter of the message has a large impact on how it is received by producers, so they must be credible (expert, trustworthy).
- Frame your message. Emphasize the losses of inaction rather than the savings of action.
- Carefully consider threatening messages. Refrain from presenting the doom and gloom (negativity) of a situation, and focus more on the positive actions people can take.
- Make your message easy to remember. Messages need to be clear and specific to be remembered, including what to do and how to do it.
- Provide personal or community goals. Provide targets to motivate behaviour.
- Emphasise personal contact. People we interact with have a major influence upon our attitudes and behaviour, so create opportunities for contact between people to enable social diffusion.
- Provide feedback. Provide feedback to people about the effectiveness of their actions.

Pannell *et al.* (2006) also recommended that effective extension programs need to use multiple methods to make producers aware of new practices. Multiple extension channels, repetition, multiple deliverers of the message, and harnessing peer pressure are among the standard tools of effective extension agents. Reliance on any particular method (e.g. print articles, verbal presentations, group extension, advertisements) will fall short of the potential

impact on adoption compared with a diverse portfolio of extension approaches and channels. Different landholders have different learning styles and prefer to receive information in different ways, or from different sources. Repetition can help to reinforce a message and build confidence, especially if it comes through different channels and from different sources.

Bruce Howie (section 3.3) also placed importance on knowing your audience and using this to capture their attention. The challenge for RD&E providers is to convince beef producers who are currently in the early and late majority groups that their information and technologies are relevant to their interests and values. In effect, new RD&E information may be needed and/or existing information may need to be repackaged and represented to align more closely with the interests and values of producers in the majority groups. Bruce argued that we need to 'sell' our innovations and technologies to the early and late majority using commercial sales and marketing methods to appeal to their feelings and emotions.

An example of this can be found in the recent drought relief events that occurred in western New South Wales and Queensland. Robyn Moore (Moore 2014), the voice of Blinky Bill and now a motivational speaker, spent the past 18 months touring drought-stricken areas and has recently visited Charleville in Queensland's south west. Robyn has been a voice-over artist for 40 years, during which time she has had to sell millions of dollars' worth of products in 30 seconds. In doing this, Robyn has learnt to place great importance on every word, and now aims to create one 'bugger-me-moment' every 30 seconds. These are moments when you gasp at the meaning of something that suddenly struck you. Robyn says:

> *'It is not enough to know about something, as this will not motivate you to take action. You need to move the information from your head, experientially, down into your gut, your spirit, your heart. Only then are you likely to be motivated into taking action.'*

Triggering an emotional response from beef producers appears to be a key to opening their minds to new possibilities, but this may be beyond the capabilities of many RD&E providers. To do this successfully, it may be necessary to engage the services of social scientists to identify what is personally and emotionally important to beef producers, and advertising companies to design communication and extension activities that effectively link what is important to beef producers with the services of RD&E providers.

3.7.5 Adoption of best management practice is a social process

Primary production is a socio-cultural activity that is influenced by a range of social processes, making it much more than an economic activity (Vanclay 2011). When adoption is considered to be a social process, landholder decisions relating to adoption will be influenced by their social networks, the strength of their associations with them, their broader social environment (social norms, ideologies), their personal and family circumstances, the proximity to other adopters, the distance of the property from sources of information, and the history of relationships with advocates of the innovation (Pannell *et al.* 2006).

McKenzie-Mohr and Smith (1999) also wrote that while education and advertising can be effective in creating public awareness and in changing attitudes, numerous studies show that behaviour change rarely occurs as a result of simply providing information. Research in the social sciences demonstrates that behaviour change is most effectively achieved through initiatives delivered at the community level.

Beef producers often first hear of a new practice through their social networks, and their initial interest in that practice is likely to be strongly influenced by comments about the practice within those networks. If this is positive, then beef producers may seek more information and advice about the practice in an attempt to assess its value to their personal circumstances.

The social processes of the influence of conversation are discussed below.

The influence of peer conversations

Robinson (2009) argues that while advertising and media stories spread information about innovations, it is peer-to-peer conversations that spread adoption. McKenzie-Mohr and Smith (1999), Pannell *et al.* (2006) and McCartney and Durante (2013) agree that peer-to-peer conversations have the greatest influence on decisions to adopt new practices.

Conversations with peers are needed because adoption of new products or behaviours often involves risk and uncertainty. It is usually only people producers know personally and trust, and who have successfully adopted the innovation, who can give them credible reassurances about the innovation. Robinson (2009) writes, as an innovation spreads from the early adopters to the majority audience, face-to-face communication becomes more essential to the decision to adopt. Over time, face-to-face communication is more influential than mass media.

The important influence of peer-to-peer conversations in raising awareness and leading to adoption of new practices was evident in the results of cane-grower and beef grazier surveys of McCartney and Durante (2013). They emphasised that grower-to-grower 'over the fence' communication is an important means of gaining information. The significance of grower-to-grower communication was a clear theme arising from their interviews, where information was gained via word of mouth and personal communication with other farmers.

Personal interaction between producers locally can be facilitated through producer demonstration sites, case study properties, field days, paddock walks, bus tours, and group formation. In this respect, putting producers in contact with local innovators and early adopters who trial, simplify and promote new practices could be an effective means of spreading the uptake of RD&E products.

Credibility and trustworthiness of RD&E providers

Pannell *et al.* (2006) argues that trust and credibility in the relationship between agencies and landholders is crucial if agencies are to influence the adoption process. Extension needs to be focused on credibility, reliability and legitimacy, which have to be earned. As such, a key determinant of an adviser's credibility to a farmer is trust. Trust was, in turn, strongly related to the extent a farmer believed an adviser understood and respected the goals of the farmer. The adviser who is trusted may be invited to participate at a deeper level of decision making where information is more deeply assessed against the goals of the landholder.

Pannell *et al.* (2006) wrote that while a history of valuable advice relevant to a landholder's goals is probably the single most important source of credibility, this can be enhanced to some extent by a range of factors, including:

- authority and technical expertise of the extension agent
- perceived similarity of the extension agent to their audience
- local profile of the extension agent (e.g. local residence)
- communication skills of the extension agent
- personal relationships between the extension agent and landholders
- extension agent acknowledgment of/empathy with the circumstances and problems of landholders.

McCartney and Durante (2013) emphasised the importance of effective interpersonal communication in increasing the trust that producers have for agency staff. This included:

- build relationships through personal visits and interactive field days and workshops

- visits by representatives to a grower's property were also favoured, allowing growers to receive advice tailored to their unique situation
- encourage producers to visit local offices
- one-on-one visits or personal attendance at field days or shed meetings were put forward as the most effective means of conveying information to growers.

Some common characteristics of RD&E agencies limit the development of trust and credibility, including short-term funding, rapid turnover of staff, the youthfulness and inexperience of many staff, and the lack of technical farming expertise of many staff (Pannell *et al.* 2006). Beef producers at the Townsville workshop noted that rapid turnover of staff in some regions meant that producers did not get to know agency staff and the staff did not develop sufficient understanding and experience of the industry.

Even more potentially disruptive is the trend over the last couple of decades in the decline in numbers of RD&E staff located in regional centres. If influence and impact occurs within local communities, then it is important for RD&E staff to be embedded in those communities.

Trust has also declined where government extension agents have moved away from supporting landholders in making good decisions to achieve their own goals, towards encouraging landholders to make decisions that achieve outcomes for the public good (Pannell *et al.* 2006). In many situations, this has the potential to reshape the social contract between adviser and landholder, creating a far more complex social interaction that may be less comfortable for both. McCartney and Durante (2013) also found that landholders were increasingly viewing information from official government sources with suspicion, preferring instead to gain information from trusted local sources, such as other producers.

The influence of networks

Operating within networks, agency and/or local, is believed to have significant positive impacts on adoption of best management practice (McKenzie-Mohr and Smith 1999, McCartney and Durante 2013). This was the case with the adoption of agricultural best practice in the United States of America (Baumgart-Getz *et al.* 2012) and in Canada (Tamini 2011).

Networks often extend beyond local peers, and contain a diversity of people. As such, a network may consist of people who are different to and distant from the local community, acting as an external source of information, ideas, advice and inspiration. The beef producers at the Townsville workshop looked outside of their properties and businesses for inspiration and ideas. They said that personal interactions with successful people and advice from respected professional people could motivate beef producers to change their practices. These producers were connected with successful peers and successful professional people who they constantly sought information and advice from them.

McKenzie-Mohr and Smith (1999) recommended that networks can more effectively influence producers when industry- or opinion-leaders are recruited to spread and promote innovations within them. This was also one of the messages obtained by McCartney and Durante (2013). Local champions were seen as a key mechanism to foster increased adoption of best practices among landholders. In some areas, groups of landholders have banded together to investigate and trial new practices on their properties, forming 'hubs of best practice innovation adoption' from which adoption had radiated. In other cases, physically seeing, touching and feeling equipment and talking with other growers about what they're doing was thought to spur other people to do something similar.

Operating within formal groups of producers also helps increase the level of commitment that a producer may make to adopting a new practice. McKenzie-Mohr and Smith (1999) wrote that it is important to gain commitment from a producer to adopt a new practice, and an

effective way to achieve this is for producers to make this commitment to a group of which they are a member. Commitments are more effective when they are written rather than verbalised, are made public, actively involve the person making the commitment, are voluntary rather than coerced, and are made at their existing points of contact.

In many cases it is not necessary to create new networks. Instead, linkages can be made with existing networks, such as those developed by regional NRM bodies and state agencies, various groups or associations, email and newsletter distribution lists, industry organisation distribution lists or memberships, and dedicated websites such as Beef Central (http://www.beefcentral.com/), Kondinin Groups Farming Ahead Online (http://www.farmingahead.com.au/) and FutureBeef (http://futurebeef.com.au/). .

The power of social norms

Sociologists describe norms as informal understandings that govern individuals' behaviour in society (Scott and Marshall 2005). Social norms are accepted by a significant number of people in a community, and those people who do not follow a norm can become labelled as a deviant (Appelbaum *et al.* 2009).

McKenzie-Mohr and Smith (1999) were aware of the tremendous influence that social norms have on individual behaviour. In response to the Rockhampton stakeholder workshop report (Rebecca Niebler; pers. comm.) wrote:

> '*In the long-term, social norms and values are much more powerful in changing behaviour than external motivators such as financial rewards or penalties. External motivators may achieve quick behavioural change, but the downside is this kind of change can be short-term. Take away the external motivator and people revert back to the old behavioural patterns. Long-term change has to be driven by intrinsic motivators, such as an individual's values and beliefs, which in turn are shaped by their social environment*'.

Stanley *et al.* (2006) suggest that peer-pressure can be detrimental to the introduction of innovative ideas that lie outside of a community's social norms. This can create social isolation, decrease social influence and diminish community respect, which can be strong barriers to the adoption of new practices by many primary producers. McCartney and Durante (2013) also noted the desire for producers to conform to social expectations and norms of 'good farming practice' and the censure brought to bear upon those seen to be operating outside these boundaries. In some cases, strong local personalities who were negatively disposed towards innovation or continual improvement could stifle the adoption of new practices by other landholders. This can lead to the ostracising or maligning of landholders who have adopted an innovation or best practice. In such instances, less dominant landholders may be unwilling to challenge the status quo and instead continue to conform to group norms.

Social norms are powerful, they are difficult to change and change can take many years to occur. It is important to recognise the large influence that social norms and other aspects of the social environment have on the adoption of industry best practice. A structured and strategic long-term approach is required, working in collaboration with the beef producer community, beef industry organisations, and the wide range of service providers associated with the industry. It is the weight of numbers over time that is needed to create social norms that are conducive to the adoption of best management practices.

3.7.6 Pathways that encourage adoption of best practice

An important output of this project is the development of an Enterprise Improvement Pathway (EIP), which identifies the practices that beef producers in the Fitzroy and Burdekin reef

catchments could implement over an extended period of time to improve their management, leading to higher profitability, better land condition and reduced impact on the reef.

A pathway for making adoption of best practice easier and more compelling is consistent with the characteristics of segments in Rogers (2003) adoption curve. RD&E providers working with the early adopters in the development and trialling of industry best practice have developed pathways that make adoption easier and more structured for the early and late majority segments.

Early majorities are pragmatists and they want to hear 'industry standard' and 'endorsed by normal, respectable folks'. Similarly, the late majority are conservative pragmatists who avoid risk and are uncomfortable with new ideas. Their driver is the fear of not fitting in and hence they will follow established standards.

Pathways could increase the adoption of best management practice by early and late majority beef producers by being regarded as a respected and endorsed industry standard, by being a simple off-the-shelf procedure and by providing benefits quickly. Three alternate EIPs are outlined below.

Short and structured list of critical management practices

A smaller number of the most important best management practices, separated into prerequisite and priority higher-order practices, may be useful to beef producers and their service providers compared to long and unstructured lists.

This includes all prerequisite practices which are:

- continual supply of good quality drinking water
- vaccinations for disease and treatments for parasites
- genetics that are an appropriate mix for the environment and markets
- judicious supplementary feeding
- fences that control the movement of cattle
- conservative, relatively constant stocking rates aligned with long-term safe carrying capacity
- map and inventory of the properties main infrastructure and natural resources
- record keeping and analysis
- basic accounting practices (use of cash-flow statement, profit and loss statement, and balance sheet)
- basic plan for enterprise development.

There are many higher-order practices, but the two most important are:

- regular adjustments of stocking rates to align with variation in feed supply
- controlled mating for more effective and efficient herd production.

Other important higher-order management practices are:

- pasture spelling to improve land condition
- segregation and management of heifers to improve body condition, reproduction and survival
- weaning and weaner management to improve reproductive rates of cows and growth rates and survival of weaners
- culling poor performing heifers and cows to improve production efficiencies and to reduce stocking rates during dry seasons/years
- use fences and water points to optimise grazing distribution

- have more and smaller paddocks to improve targeted management of segregated cattle classes and to provide opportunities for pasture spelling and prescribed burning
- use laneways to reduce mustering costs and stress on cattle
- monitor key performance indicators and benchmark performance with industry standards to improve business efficiency.

Lists of practices such as these are likely to be more useful to beef producers who are just starting out in the industry, or others, who for various reasons, are struggling to be economically viable and sustainable. The usefulness of these practices could be increased if they were structured according to priority. For example, Holroyd and Fordyce (2001) classified management practices into levels, based on their value and when they should be incorporated into existing management programs.

A starting point in prioritising management practices is the formulation of a plan for improving performance. It requires a map of property infrastructure and the natural resource base, and notes on the objectives and methods for property development. The practices to implement first are those that enable beef producers to exert more control over their grazing system. Well placed, reliable and good quality drinking water, and effective fencing are fundamental

Next is the control of stocking rates that are conducive to good herd performance and land condition, based on the long-term safe carrying capacities for each paddock. Maintaining the health and vigour of cattle will help improve herd performance. Appropriate genetics for the geographic location and markets, husbandry for control of disease and parasites, and limited and targeted supplementary feeding are the key actions. With these fundamental practices in place, it is then possible to implement practices that further improve herd performance and land condition. In order of priority, these would be: forage budgeting and annual adjustments of stocking rates, controlled mating, pregnancy testing; foetal aging to identify and separately manage mature females; and a culling strategy that is designed to improve the efficiencies of production, maintain cash flow, and complement forage budgeting. At this stage, it may then be possible to introduce more sophisticated management practices, such as: segregation of heifers to improve condition, reproduction and survival; weaning and weaner management to improve reproductive rates of cows and growth rates and survival of weaners; and pasture spelling to improve land condition. These may require subdivision of large paddocks and laneways to make it easier and cheaper to move cattle.

Grazing BMP

Grazing BMP has some significant advantages as an EIP, as it is already in existence and well-developed, and it is supported by prominent stakeholders such as Agforce, the Fitzroy Basin Association, the Queensland Government, NQ Dry Tropics, Burnett Mary Resource Group and South-east Queensland Catchments. It has been used in a number of regions, and there are plans for it to expand to others.

Beef producers can use its benchmarking capacity to identify their strengths and weaknesses, and then choose to address parts of their business where performance is poor. They can choose to do this individually online, individually with help from agency/organisation staff, or in a group setting.

Other stakeholders could use of Grazing BMP in their interactions with beef producers. For example, NRM Bodies in reef catchments could require a particular industry standard to be achieved by beef producers in exchange for some form of incentive. Similarly, members of beef supply chains may choose key areas of Grazing BMP that are important to consumers and specify these in their contracts with beef producers.

The auditing procedures recently introduced into Grazing BMP may also play a role in beef producer – client interactions. It may be possible for a Grazing BMP auditor to verify that the key areas of interest to a client have been achieved to the required standard.

Basic continuous improvement cycle

As with the research to reality cycle above, the basic continuous improvement cycle of plan, do, check and act provides a generic step-by-step process for continually improving the performance of any beef business. Being a generic process, it is capable of being used to progress the goals of individual beef businesses.

The American Society for Quality (ASQ) (2014) describe the plan-do-check-act cycle (PDCA) as a four–step model for carrying out change (Figure 6). Just as a circle has no end, the PDCA cycle should be repeated again and again for continuous improvement.

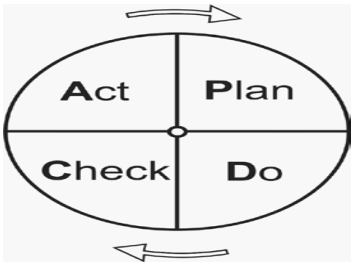

Figure 6. Plan-do-check-act cycle (source Sokovic *et al.* 2010)

ASQ (2014) recommend using the PDCA cycle as a continuous improvement model when implementing any change. They briefly describe each step in the cycle as:

1. **P**lan.
   Recognize an opportunity and plan a change. Involves development of an action plan for a specific objective, and includes specific targets.
2. **D**o.
   Implement action plans, and collect data for analysis in the following 'Check' and 'Act' steps.
3. **C**heck.
   Analyse the actual results (measured and collected in 'Do' above) and compare with expected results (targets from the 'Plan') to ascertain any differences.
4. **A**ct.
   Take corrective actions when there are significant differences between actual and planned results. If the actions did not work, go through the cycle again with a different plan. If that is successful, then incorporate the learnings into wider changes.

This approach is consistent with Wikipedia (2014) statement about the application of best practices to complex problems:

> *For complex environmental problems such as dryland salinity, there are significant challenges in defining what is best in any given context. Best management practice for complex problems is context specific and often contested against a background of imperfect knowledge. In these contexts, it is more useful to think of best management practice as an adaptive learning process rather than a fixed set of rules or guidelines.*http://en.wikipedia.org/wiki/Best_practice - cite_note-16#cite_note-16

These processes of plan, do, check and act are very similar to the learning processes of practice adoption described earlier in this report. Wilkinson (2011) stated that the adoption of new practices by producers is not an event, but rather a process involving changes over time in the nature and/or extent in the use of a practice. For most practices, the process of

reviewing its performance and reconsidering its extent and types of use will continue even when it has been used for a long period of time.

It is apparent then that there are close similarities with a basic continuous improvement cycle and the processes of adoption described by Pannell *et al.* (2006) and Wilkinson (2011). The plan, do, check and act continuous improvement cycle provides a formal structure for the decision and action pathway used by producers when adopting a new practice. It aligns well with the thought processes used by them when considering, planning and implementing a new practice on their property. While a documented structured approach is unlikely to be attractive to many beef producers, if a formal structured process is to be used, then a basic continuous improvement cycle may be a better fit with their current informal processes.

The continuous improvement cycle process was used in the Bestprac project during the 1990's with a number of wool producer groups in south west Queensland. Egerton-Warburton and Sparks (2001) wrote that Bestprac is a facilitated process that supports continuous improvement and innovation in the wool industry. It differs from the traditional approach to extension in the wool industry because it enables producers to seek the improvements they believe will really make a difference. Lloyd Dunlop, one of the first trained Bestprac facilitators in Queensland, posted the following comment on the Bestprac website in response to it finishing up in June 2014 (http://www.bestprac.info/pages/posts/the-end-of-bestprac-as-we-know-it...-606.php).

> *My spin is that its success is due to PROCESS and not content. It is a process that truly engages producers. I have used the process with 4 Qld Bestprac groups (Goondiwindi, Talwood, Cunnamulla and V Gate group), Meat sheep producers, turning wool producers into wheat producers, in business negotiations building meat supply chains and community work. It works! May it live on.*

The basic PDCA cycle could also include requirements of clients in the service industry or supply chains where there is advantage in doing so. The plan, do, check and act steps are central to quality management (ISO 9001), food safety management (ISO 22002), environmental management (ISO 14001) and occupational health and safety management (AS/NZS 4801) standards. It is also central to the Certified Land Management system of the Australian Land Management Group (ALMG), as this standard is based on ISO 14001.

The application of a continuous improvement cycle also needs to occur within the broader context of a beef producer's goals and current performance. Individual cycles for individual objectives should sit under a generic situation analysis that compares current performance with the desired future of beef producers (Figure 7).

Grazing BMP and other benchmarking and analysis tools could be used in the situation analysis to identify strengths and weaknesses. Individual cycles in Figure 7 below could be used to address priorities identified through the situation analysis, or similarly, they could be used for individual prerequisite and selected higher-order practices.

This final report has described producer behaviour associated with adopting new practices and the many factors which influence this. Given the complexity of these interactions, it can be challenging to know where to start and how to proceed with changing the practices of beef producers in reef catchments. For this reason, a strategic framework is required for designing and implementing interventions aimed at increasing the adoption of best practices. Social marketing appears to be well suited to this.

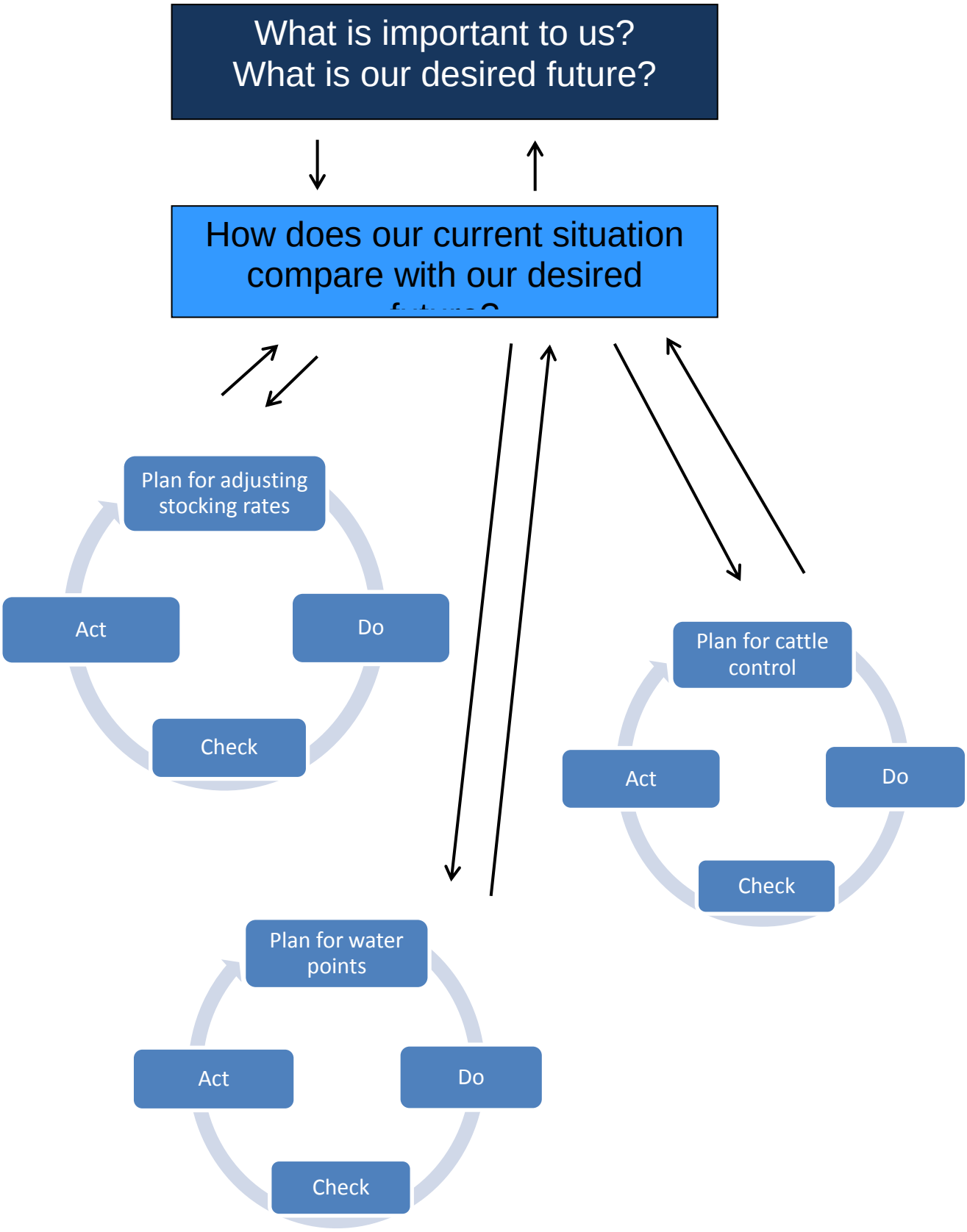

Figure 7. A number of continuous improvement cycles used to address differences between current performance and desired future outcomes.

3.8 Increasing best practice adoption through social marketing

Beef grazing best management practices are well documented and well known, but many are not widely adopted by beef producers. This remains a challenge even though many of the reasons for low adoption rates have been understood for some time. Changing the voluntary behaviour of any person is difficult and often under-estimated in terms of the time needed for change to occur and the resources necessary to facilitate change. Generally, most people do not easily change their behaviour. Even when people are aware their behaviour needs to change, they do not change until some crisis triggers this. In the absence of a crisis, strong external influences are often needed to change behaviour, such as mentors, personal coaches and intensive commercial programs.

The experience and knowledge gained from several decades of social marketing campaigns used to change the voluntary behaviour of people, provides models that could be used by RD&E providers for the beef grazing industry. The principles and strategic planning approaches of social marketing, and particularly its focus on changing behaviour, appears well suited to increasing the voluntary adoption of best management practices in the beef grazing industry.

McKenzie-Mohr and Smith (1999) argue that behaviour change is most effectively achieved through initiatives delivered at the community level through social marketing. Similarly, Marketing for Change (2014) use social marketing to create circumstances where people are inspired and enabled to change. Social marketing seeks to develop and integrate marketing concepts with other approaches to influence behaviours that benefit individuals and communities (On Social Marketing and Social Change 2014). It has been used primarily for changing voluntary behaviours associated with public health and safety, e.g. smoking and obesity, but is suitable for changing many other forms of voluntary behaviour.

Marketing for Change (2014) explains that social marketing is just one ‘branch’ of marketing. However, the key point of difference to all other branches of marketing is that social marketing relates to the wellbeing of the community, whereas all others forms of marketing relate to the wellbeing of the marketer (e.g. sales and profits). Similarly, Hopwood and Merritt (2011) defined social marketing as an approach used to change or maintain people’s behaviour for the benefit of individuals and society as a whole. These authors wrote that social marketing focuses on behaviour. If the goal is only to increase awareness knowledge or change attitudes, then it is not social marketing. Social marketing uses many of the same techniques as commercial marketing. Like commercial marketing, products and services are created that meet the needs of a wide variety of people, yet, social marketing extends marketing’s borrowings from psychology, sociology and economics and further draws on disciplines and concepts that are related to community wellbeing. The primary paradigm is that of marketing.

Just like any marketing campaign, a social marketing campaign works best when it’s based on good research and good planning (Marketing for Change 2014). A well-planned social marketing campaign stimulates people’s motivations to respond, removes barriers to responding, provides them with the opportunity to respond, and, where relevant, the skills and means to respond. Hopwood and Merritt (2011) also argue that social marketing needs to be a systematic and planned process. Marketing for Change (2014) state that successful marketing is characterised by features such as consumer orientation, segmentation and targeting, and extensive research with potential customers to ensure that offerings are believable, relevant and motivating. Other factors, such as partnerships, stakeholder engagement and monitoring and evaluation, are also important components of social marketing.

Social marketing is most effective when measures to influence individual behaviours are paired with upstream strategies that address structural and environmental determinants of behaviour, such as social norms, policy and legislation. Social marketing campaigns work best when all elements of the marketing mix are integrated, and when the sociocultural, legislative and structural environments facilitate adoption of the product or behaviour. Until social norms shift and desired behaviour is seen as acceptable and even desirable, behaviour change can be limited.

Similarly, the State Extension Leaders Network (2006) noted that extension, based on communication and persuasion, will be more effective if it is coordinated with a range of policy instruments, such as:

- direct investment in on-ground activities
- covenants and memorandums of understanding
- common law and duty of care
- self-regulation based on codes of practice
- market instruments such as quality assurance (QA) and environmental management systems (EMS)
- economic incentives.

Given that adoption of best management practice by beef producers is socio-cultural in its nature, where personal and trusted relationships are highly valued, reef RD&E providers need to develop a social marketing program with a high level of involvement of beef producers, their key stakeholders, and other service providers to the beef industry. On Social Marketing and Social Change (2014) provide a social marketing planning framework that is an example of a systematic and strategic approach that could be used by beef industry RD&E providers who are attempting to change the voluntary behaviour of beef producers. This framework has been expanded through the inclusion of social marketing principles stated by Smith (2006), National Social Marketing Centre (2014) and Weinreich Communications (2014).

Background, purpose and focus

There are several issues that could be considered during the initial scoping phase, including:

- What population will the plan focus on?
- What is the issue or challenge to be addressed?
- Is there sufficient resources and assets available?
- Are there gaps in the information needed to define the issue?
- Is it necessary to commission external help?

It is necessary to give considerable thought to the audiences of the social marketing program. Social marketers often have different audiences that their program has to address in order to be successful. External audiences include the target audience, secondary audiences, policymakers, and gatekeepers, while the internal audiences are those who are involved in some way with either approval or implementation of the program.

Building partnerships with key allies is often required for success. There is a need to collaborate with other organisations in the community to be effective. This can commence with identification of the organisations that have similar goals and then plan to work together. A powerful message requires groups throughout the community to come together in a coordinated effort.

Situation analysis

Conduct a SWOT analysis to identify organisational strengths and weaknesses and environmental opportunities and threats. Investigate what has already been done. Take

advantage of prior and existing successful campaigns. Conduct a literature review and environmental scan of previous programs that have focused on similar efforts and identify the activities used and lessons learned.

Target audience profile

Develop an understanding of the audience and what motivates them behave in the way they do, including the key influences, incentives and barriers. Talk and listen to the people you are trying to reach. Focus on the audience, using a mix of data sources and research methods to fully understand their lives, attitudes and current behaviour. Go beyond interviews and focus groups and use ethnographic techniques as well. Gain key stakeholder understanding and feed this into the methods mix. Involve the target audience and local community, rather than treating them as research subjects.

Segment the audience, using demographics, geographics, relevant behaviours (including risk), social networks and stage of change (readiness to buy). Avoid a 'one size fits all' approach and identify audience 'segments' which have common characteristics. In relation to segments:

- Customer orientation and insight make segmentation possible.
- Don't only rely on traditional demographic and geographic data for targeting the audience, but draw on behavioural and psychographic data as well.
- Identify the size of the segments.
- Prioritise segments according to clear criteria, such as size and readiness to change.
- Start with the target markets most ready for action.
- Directly tailor interventions in the methods mix to specific audience segments.

A separate plan will be needed for each target audience, even though they may be part of one campaign.

Marketing objectives

It is necessary to influence specific behaviours, not just awareness, knowledge, attitudes and beliefs. The objectives should target specific behaviours and should also be SMART: specific, measurable, achievable, relevant, and time bound. Objectives may need to be revised after describing barriers and benefits, or promotional ideas based on final budget realities.

At this stage it is also necessary to establish baseline behaviours and key indicators of these behaviours and behavioural change.

Factors influencing adoption of the behaviour

Human behaviour is complex. However, social science theories or models, such as Stages of Change (Health Promotion Unit 2007), can be used to help understand the target audience and the factors that influence them and their actions. Customer orientation research lets you identify 'actionable insights' – pieces of understanding that will lead the development of an effective intervention. Insight is more than just pieces of data. It is what the data can tell us about people's feelings, motivations and current behaviour.

Exchange is a key concept in social marketing. In all areas of marketing, the notion of an exchange process between the 'buyer' (target) and the 'seller' (marketer) forms a platform of operation (Marketing for Change 2014). A necessary condition for a successful exchange is that marketers offer people something they value in exchange for them purchasing the product or adopting the desired behaviour. 'What's in it for me?' is a key driver in determining appropriate incentives for the various target groups in campaigns. Whether consciously or sub-consciously, people conduct some form of cost-benefit analysis, yet, exchange in social marketing is often non-monetary and typically involves something else the target audience wants for performing the behaviour. The benefit is most often personal and psychological in

nature, such as a good feeling, social recognition or praise. Therefore appealing to an individual's self-interest, through a direct and timely exchange, is in every social marketer's best interest.

Identify and remove barriers to targeted behaviour change. These can be competing behaviours. Understand what competes for the audience's time, attention, and inclination to behave in a particular way, then:

- address direct and external factors that compete for the audience's time and attention
- develop strategies to minimise the impact of competition, clearly linked to the exchange offered
- work with, or learn from, the competing factors
- highlight costs of competing behaviours.

In respect to benefits and barriers, it is important to gain the cooperation of local opinion leaders, industry leaders and other people who influence the target audience. These people have an important influence on how the target audience perceive the targeted behaviour, and its benefits relative to alternative or preferred behaviours. Gaining commitments and pledges from the target audience is an important requirement for changing behaviour, especially when these are publicly made. The use of prompts is also important for sustaining behavioural change.

Marketing mix strategies

The most effective programs use a combination of mass media, community, small group and individual activities. When a simple, clear message is repeated in many places and formats throughout the community, it is more likely to be seen and remembered. The four Ps (product, price, place and promotion) are often referred to during the design of social marketing programs. Weinreich Communications (2014) provided the following descriptions of the four Ps:

- Product: The social marketing 'product' is not necessarily a physical offering, but a continuum ranging from tangible, physical products, services and practices to, more intangible ideas (e.g. environmental protection). In order to have a viable product, people must first perceive that they have a genuine problem, and that the product offering is a good solution for that problem. The role of research here is to discover the consumers' perceptions of the problem and the product, and to determine how important they feel it is to take action against the problem.

- Price: 'Price' refers to what the consumer must do in order to obtain the product. This cost may be monetary, or it may instead require the consumer to give up intangibles, such as time or effort, or to risk embarrassment and disapproval. If the costs outweigh the benefits for an individual, the perceived value of the offering will be low and it is unlikely it will be adopted. Price-related tactics can be used to reduce costs, such as monetary and nonmonetary incentives.

- Place: 'Place' describes the way that the product reaches the consumer. For a tangible product, this refers to the distribution system. For an intangible product, place is less clear-cut, but refers to decisions about the channels through which the target audience is reached with information or training. Create convenient opportunities to engage in the targeted behaviours and/or access products and services. Put your message in places people will encounter.

- Promotion: Promotion is persuasive communications highlighting product benefits, features, price and ease of access. Promotion consists of the integrated use of advertising, public relations, promotions, media advocacy and personal selling. The focus

is on creating and sustaining demand for the product. Messages are extremely important, but so is the messenger.

It is important to pre-test ideas with the audience. Test products, promotional materials and services with the target audience to gauge their potential effectiveness. Social marketing recognises that the customers are the experts on what works best for them. The audience is always right.

Budget

Accurately budget for project funding and the costs of implementing the marketing plan include additional research and monitoring and evaluation. Realistic time-lines for changing behaviour need to be used in the budget. The budget should also include the contributions and costs of partner organisations.

Plan for implementation and campaign management

Each organisation needs to know and accept their roles and responsibilities – who will do what, where, with whom and when? One organisation needs to lead.

Plan for monitoring, evaluation and follow up

The aims of evaluation are to identify the strengths and weaknesses of the intervention, determine if it is making a difference, and measure its return on investment. Data needs to be gathered that will allow measurement of success or failure against the original objectives. Because it can take time until an intervention's full effect on behaviour can be seen, identify interim changes that will allow you to check if you are moving in the right direction. This may include short, medium or long term indicators for measuring the change in people's knowledge, attitude, and behaviour. Sharing evaluation findings enables future developments and interventions to build on successes and failures. This increases the chance that successful interventions will enter mainstream practice.

4. Discussion

Beef producers who attended the Better Beef and Reef workshop in Townsville were all of the opinion that beef enterprises must be run as a business. It is important to clearly define business and personal goals and continually review business performance to ensure these goals are being met. There was also unanimous agreement that beef producers should be continually seeking new ideas and advice from people within and external to their industry. Running a successful beef business requires continual learning and improvement. There was an ongoing need to access inspiration and advice from networks of successful beef producers and other professional people, such as accountants, solicitors, bankers, consultants, agents and staff of RD&E agencies.

Certain land and herd management practices were also necessary to the success of a beef business. These include regular vaccinations, supply of ample quality and quantity water, optimising stock access to pastures using fence and water point locations, education of stock, knowledge of appropriate long-term stocking rates and matching annual stocking rates to variable annual forage supply. Other critical management practices were controlled mating, targeted supplementary feeding, cross-breeding and wet season spelling. While these and other industry best practices have been well known for many years, many beef producers have not been motivated to adopt them. The challenge is to increase adoption rates of well-known and readily available practices, rather than develop more of them.

The beef producers favoured increased communication from trusted sources of information and advice as the methods which would encourage more beef producers in the industry to adopt best management practices. They said that personal relationships with trusted people, personal interactions with successful people, personal invitations to events, promotion by industry champions, and advice from respected professional people were most likely to motivate other beef producers to improve their practices. There was also considerable interest in using television, traditional newspapers and Facebook to promote better practices and advertise training courses. Training was regarded as an important trigger for the adoption of best practices, as were incentive payments for on-ground works. Continual promotion by service providers of important practices and important decision times also often helped beef producers commence and continue new practices. However, it was critical that beef producers know and trust service providers, and that the service providers have a very good understanding of the industry as a whole.

An assumption of the workshop in Townsville was that best management practices which improve herd and business performance are attractive to the majority of beef producers in reef catchments. However, this is questionable. Characteristics of the beef producers at the Townsville workshop were confidence, a desire for continuous improvement personally and in their business, vision, being open-minded, being determined to succeed no matter what, being curious, looking outside of their businesses for inspiration and ideas, hunger for information, and enjoying a challenge. Beef producers with this mix of characteristics and a high level of interest in business principles are likely to be a minority segment of the industry. In line with the theory of consumer adoption of new products and innovations (Beal and Bohlen 1957, Rogers 2003), these producers were likely to be the innovators and early adopters, and hence only 20% of the beef producer population. They are the beef producers who are sufficiently motivated and committed to seek out, understand, adapt and adopt relatively complex business and herd management practices. They appear similar to the 16% of the northern beef producer population that Marshall *et al.* (2014) described as producers with large properties, interested in and able to cope with change, who liked to plan, experiment and learn, and who had strong networks.

During the ‘Focus is on People’ webinar, Bruce Howie said the innovators and early adopters have a strong appetite for information. These beef producers are also likely to be more

confident in their interactions with other people, being extroverts who enjoy social interaction, and are likely to have high self-belief in their capacity to control and adapt to circumstances. They are also likely to be younger, have larger and more profitable properties, and have higher levels of technical knowledge gained through formal education and training, and through experiences with professional people. All of these characteristics make it easy for traditional extension programs to engage with them. Marshall *et al.* (2014) made a similar comment about these types of producers. They wrote that these producers do not appear to need assistance to change, but they are more likely to receive attention from government because of their interest in new technologies.

Yet, as in any population of people, many beef producers do not have a strong desire for continual learning and improvement, do not readily adopt new technologies or practices, and do not respond to information and advice on how to do things differently. They are not business-oriented, and instead, their goals and values are more likely to be associated with lifestyle, such as family and connections with land and livestock. These beef producers are also likely to be older and have less to gain from adopting new practices, and lower levels of education and hence less awareness of them. They are also likely to be inclined to introversion, and thus interact less with other beef producers, networks and industry service providers. Marshall *et al. (*2014) suggested these beef producers comprised 84% of the northern beef producer population. They are not interested in attending formal workshops, and that creative solutions, such as facilitating their involvement in networks, may be needed to enhance their adaptive capacity.

While clear evidence is not available, it is likely that in the current circumstances, only 20% of beef producer populations are implementing industry best practices. They have a desire to continually improve and adapt to the changing circumstances of their industry, and hence regularly engage with RD&E programs and other sources of information. While they need these services less than other producers, they still need them to be successful over time, and they are critical to the success of the beef industry. In contrast, as many as 80% of beef producers could improve their performance, but they are not motivated to do this, and are not accessing RD&E services.

For these reasons, participants of the industry stakeholder workshop in Rockhampton were of the opinion that extension practices need to be modified if wider adoption of beef industry best management practices is to occur. It was suggested that RD&E programs should be more targeted in their delivery of services. One way to do this was to make RD&E programs more relevant to the needs of beef producers who currently were not engaging with them. It was also recommended that reef RD&E programs target districts or properties. In effect, if beef producers will not come to RD&E programs, the programs will go to them.

4.1 Targeting the characteristics of properties

The programs of beef industry RD&E service providers vary in their objectives and in the resources they have to achieve these. Available funding is limited in most cases and programs do not have capacity to engage with all beef producers. This is the case for the reef programs of the Australian Government Department of Environment. An objective of their programs is to reduce soil erosion on beef properties in reef catchments, and hence the amount of terrestrial sediments and nutrients entering the reef lagoon. This may be approached more cost-effectively by targeting areas which contribute the most sediments and nutrients to the reef lagoon. Using source catchments modelled data, Barson *et al.* (2014) estimated that 50% of the total anthropogenic suspended sediments exported to the GBR from grazing lands came from the Burdekin and 30% from the Fitzroy NRM regions. Hence, the Burdekin and Fitzroy sub-catchments, by virtue of their large area, and high total of anthropogenic loads, are rated as very high and high priority respectively for investment in improving grazing management. Barson *et al.* (2014) also indicated that research suggests

some management units within these sub-catchments may deliver disproportionately larger amounts of sediment to the lagoon, and that this information could be used to improve prioritisation within these sub-catchments. Bartley *et al.* (2014) found that within the Burdekin sub-catchment, the Bowen and the Upper and Lower Burdekin management units appear to be the dominant source of the fine silts and clays which are thought to pose the greatest risk to coral reefs. Within these management units, remotely sensed data shows areas of persistent low ground cover, and gully density maps and soil maps show the distribution of very fine-textured basaltic and sedimentary soils which deliver a higher proportion of fine sediment per tonne to the reef. Barson *et al.* (2014) therefore recommended that sub-catchment-scale priority maps should be combined with these high-resolution tools to pinpoint locations for investment. Bohnet *et al.* (2011) also suggested targeting the Bowen-Broken-Bogie basin in the Burdekin catchment because it was identified as a major contributor of sediments and nutrients to the GBR lagoon.

Using models, remote sensing and data bases to identify properties which have an adverse impact on the reef has potential to be counterproductive. Using these tools to link beef producers with reef programs may not be conducive to the development of effective working relationships with targeted beef producers, and could also diminish relationships with the wider grazing community. A great deal of care is needed with the design of targeted programs to prevent antagonistic relationships developing between beef producers and reef RD&E service providers. Adoption of best management practices is a social process that occurs at the community level, and needs to be based on trustworthy and credible personal relationships with beef producers. Targeting management units with land types that are prone to erosion and which contain the sediments that most damage the reef ecosystem may be less confrontational. Working with the entire community within these units would then be preferable to targeting individual properties and people.

Within selected management units there may be less risk associated with targeting the larger beef properties. Baumgart-Getz *et al.* (2012) concluded that farmers in the United States of America were more likely to adopt agricultural best management practice if they had large farms, had high income and capital, and were younger. Similarly, McCartney and Durante (2013) noted that graziers in Queensland who had large properties were more likely to adopt industry best management practices. Smaller farms had a lesser ability to fund change and adoption of best practice is generally less feasible. In the northern Australia beef industry, Martin *et al.* (2013) reported that small and medium-sized properties (<1600 head of cattle), which comprise 75% of the industry but perhaps only 30% of cattle sales, consistently had small or negative annual profits. While the number of cattle required for economic viability in reef catchments is likely to be lower than 1600 head, a similar trend in property size may occur in the Fitzroy and Burdekin regions. In these regions, less than 15% of properties have more than 1600 cattle but yet account for 50-80% of all cattle in these regions, and possibly a similar proportion of land area. Providing that the characteristics of these properties are relevant, reef RD&E programs may be more effective and cost-efficient if they were to target beef producers who have large and more economically viable properties. They are likely to be more amenable to adoption of best practices, and they are a small proportion of people who manage a large proportion of land within reef catchments.

4.2 Targeting the characteristics of people

During the last decade, as the costs of production and debt have risen without corresponding rises in the prices received for cattle, the majority of northern Australia beef producers may not be economically viable (McLean *et al.* 2014). Given the current terms of trade, only well-run large properties with high efficiencies of production are economically viable. Operating properties according to business principles, adopting new herd and land management technologies and practices, and continually monitoring and managing to improve performance is needed for economic sustainability. However, it seems likely that only 20-

25% of beef producers in northern Australia are operating their enterprises this way, corresponding with the innovator and early adopter segments of Rogers (2003) technology adoption curve. Unfortunately, increasing the number of people that adopt a new practice does not occur by shifting a person from one segment to another. Robinson (2009) says this is not possible. It's best to think of the membership of each segment as static for a particular product or practice. Innovations only spread when they evolve to meet the needs of successive segments, and especially in relation to simplicity and ease of adoption.

Consistent with this was the theme at the Rockhampton stakeholder workshop for extension to focus more on people and their needs and less on technology transfer. There is a need to identify what is most important to the beef producers who do not utilise RD&E services, then align extension services with their values. RD&E providers should make best management practices more relevant to the personal goals of beef producers who are not currently motivated to use these for improving business and herd performance. They may be more interested if they knew these practices resulted in healthy land and pastures they are proud of, high quality and more valuable cattle, a happy and successful family, and more time to enjoy what they have built.

Robinson (2009) suggested that when designing an extension activity it is critical to know the percentage in a given population who have already adopted the innovation. That figure tells you which segment you are addressing next, and provides insight into how to design projects and how to pitch communications to producers. Robinson (2009) offers advice on how to successfully work with producers in each of the technology adoption segments.

With innovators, work with them by becoming their first followers, and provide support and publicity for their ideas. Invite keen innovators to be partners in designing projects. When working with early adopters, offer strong face-to-face support to trial the new idea, study the trials carefully to discover how to make the idea more convenient, low cost and more marketable to the majorities, promote them as industry leaders, recruit and train some as peer educators, and maintain relationships with regular feedback. To work with the early majority, offer give-aways or competitions to stimulate interest, use mainstream advertising and media stories featuring endorsements from credible, respected, similar people, lower the entry-cost, redesign to maximise ease and simplicity, simplify application forms and instructions, and provide strong customer service and support.

To work with the late majority, focus on promoting social norms rather than just product benefits. They will want to hear that plenty of other conservative people like themselves think it's normal or indispensable. Keep refining the product to increase convenience and reduce costs, and emphasise the risks of being left behind.

4.2.1 Targeting adoption behaviour

While it is important for reef RD&E programs to align their interventions with beef producer decisions and actions associated with evaluation and adoption of new practices, it is perhaps even more important to recognise that this is a socio-cultural activity influenced by a range of social processes. For most beef producers, adoption or rejection of new practices is strongly influenced by their family, their neighbours, the community in which they live, and the networks in which they operate. The opinions of local producers, producer networks and broader industry networks have a powerful influence on adoption behaviour. These constitute social norms that either strongly encourage or discourage adoption of a practice. As such, RD&E providers should exert influence at the family and community level if they are to spread the adoption of best practices beyond the innovators and early adopters.

Adoption or rejection begins with beef producers becoming aware of a new practice and its potential value to them and their enterprise. McKenzie-Mohr and Smith (1999) and Robinson (2009) both noted advertising and media stories spread awareness and information about

innovations. Effective communication with producers requires capturing their attention by using vivid, personal and concrete information. In this respect, it is important to know the audience and base communication on a clear understanding of their attitudes, beliefs and behaviours. Use a credible presenter (trustworthy and expert) of the message, as they have a large impact on how it is received by producers. Make messages easy to remember, so they need to be clear, simple and specific. Maximise personal contact with producers as this has a major influence on their attitudes and behaviour.

Pannell *et al.* (2006) proposed that multiple extension channels, repetition, multiple deliverers of the message, and harnessing peer pressure are among the standard tools of effective extension agents. Reliance on any one method (e.g. print articles, verbal presentations, group extension, advertisements) will fall short of the potential impact on adoption compared with a portfolio of extension approaches and channels. Multiple approaches increase the chances of reaching more landholders, and caters for their different learning styles. Repetition can help to reinforce a message and build confidence, especially if it comes through different channels and from different sources.

Initially, a beef producer will have much uncertainty about adopting a new practice, especially when this involves considerable change, effort and expense. It is often only other beef producers they know personally and trust, and who have experience with the new practice, who can give them credible reassurances about it. While advertising and media stories spread information about innovations, it is peer-peer conversations that spread adoption. As an innovation spreads from the early adopters to the majority audience, face-to-face communication becomes more essential to the decision to adopt. Over time, face-to-face communication is more influential than mass media.

New practices are unlikely to be promoted favourably within communities unless they are highly attractive. Relative advantage needs to be high and obvious, where it is readily apparent that the benefits arising from a new practice are considerably greater than costs of implementing it. Even at a small scale, the new practice should generate easily observable results quickly. This helps alleviate any doubts the beef producer may have about the application of the practice under their conditions, and helps them acquire the skills needed to apply the practice effectively and efficiently on a wider scale. If the results of the trial are positive, then the practice may be implemented more broadly. Over time, beef producers may change and modify the practice to adapt it to their own changing circumstances.

To initiate and maintain adoption of best management practices, reef RD&E providers should address all stages of adoption behaviour. In all stages, reef RD&E providers should be perceived by beef producers as trusted, credible and legitimate sources of information and advice. Staff must have good personal relationships with beef producers, understand them and their industry very well, and want to help them achieve their goals.

Adoption of new practices could also be made easier and more compelling by providing beef producers with a framework or pathway that guides the implementation of practices, showing how this relates to other aspects of their enterprise, particularly their own goals.

4.3 Providing a framework or pathway for adoption

Provision of a framework or pathway is consistent with Robinson (2009) who stated that the early and late majorities are followers, they want to hear industry standard and endorsed by normal, respectable people. They require guaranteed off-the-shelf performance. With the late majority, the main driver is not fitting in, hence their willingness to follow established standards.

The Grazing BMP program satisfies a number of these requirements. It is an industry standard that has been developed and endorsed by beef producers, regional NRM groups, government agencies, and a prominent industry organisation. Grazing BMP also seeks supply chain and community recognition of the program, and while this has not occurred as yet, this recognition will be a powerful driver of beef producer participation in this program.

Possible weaknesses of Grazing BMP are that it does not attempt to align its industry standards with the goals and values of beef producers, and there is no discernable starting point for rating performance against 157 industry standards. Also, it is not clear which is more important, benchmarking of current practices for the purpose of improving performance, or demonstrating the good practices of the overall beef industry to the wider community. Separation of these two functions may be more apparent now with development of Grazing BMP Certification and Audit Assurance System. The assurance program is restricted to approximately one-third of the 157 Grazing BMP module standards. Again, these are not necessarily high priority practices for individual beef producers, other members of supply chains, and other industry stakeholders. However, it is likely that practices which improve reef water quality are contained within this program, and hence accreditation to this standard could be required for the flow of incentives to beef producers in reef catchments.

The basic continuous improvement cycle of plan, do, check and act (PDCA) provides a process for continually improving the performance of any beef business. It could be argued that use of continuous learning and improvement processes by beef producers is more important than adoption of individual best management practices. It is the framework provided by the PDCA cycle that encourages beef producers to become aware of best management practices and their value, and therefore provides a rationale for adoption. Beef enterprises are spatially, temporally and socially variable, and the continuous development and improvement of practices and technologies, along with continuous change in economic and social circumstances, means that no one behaviour or practice is ‘best’ all of the time. For these reasons, improving the profitability and sustainability of beef grazing enterprises is approached through processes of continuous improvement, characterised by goal setting, situation analysis, planning, implementation, monitoring, evaluation and refinement. The PDCA cycle is also capable of being used to achieve and be rewarded for achieving the requirements of supply chain clients, given its links with formal quality and environmental assurance standards. Reef programs could also use the PDCA framework to engage with beef producers. Key practices likely to improve reef water quality could be specified for inclusion in a beef producers PDCA cycle.

Alternatively, reef RD&E providers could develop their own adoption pathway, focused on a smaller number of practices which most improve reef water quality. These could be based on fundamental and higher-level management practices. To make this pathway more compelling for beef producers, it would be necessary to provide incentives for their participation. These may be payments for negotiated on-ground works or for adoption of particular management practices. However, this pathway could be compelling for beef producers if participation in it could provide access to benefits from other service providers or clients in supply chains. Consideration could be given to development of a reef conservation label that could be the public face for this adoption pathway, and to gain support for this from other stakeholders.

Given the complexity of interactions between beef producer behaviour and extension services, reef RD&E providers could benefit from a framework that guides the planning, implementation and review of their programs.

4.4 RD&E framework for increasing adoption of best practices

Social marketing appears well suited as a RD&E framework for increasing the adoption of best management practice by beef producers. Social marketing is commonly used for

changing or maintaining people's behaviour for the benefit of both individuals and the whole community. It is a systematic and planned process, characterised by consumer orientation, segmentation and targeting, while ensuring that interventions are believable, relevant and motivating. Other factors, such as partnerships with key allies, stakeholder engagement, and monitoring and evaluation, are also important components of social marketing. As such, it is a framework capable of incorporating the key elements of successful reef RD&E programs, including adoption behaviour and the factors which influence this, such as the characteristics of people, properties and practices, and social features such as families, neighbours, networks, and social norms.

Some of the more important elements of social marketing are noted here. Given the enormity of community practice change programs, building partnerships with key service providers is often required for success. A powerful message requires groups throughout the community to come together in a coordinated effort. By pooling resources with other organisations working towards the same goal, programs have a greater impact and access new audiences.

Social marketing also recognises that efforts to influence individual behaviours are likely to be much more successful when paired with upstream strategies that address structural and environmental determinants of behaviour, such as social norms, policy and legislation. Campaigns work best when all elements of the marketing mix are integrated, and when the sociocultural and legislative environments facilitate adoption of the product or behaviour.

It is also critical to develop a thorough understanding of the audience and what motivates them to behave in the way they do, including the key influences, incentives and barriers. The audience should then be segmented, using demographics, geographical or biophysical criteria, relevant behaviours, social networks and readiness to change practices, then target these segments with programs customised to their characteristics and needs.

Utilising a variety of approaches will also improve adoption rates of best management practices. The most effective programs use a combination of mass media, community, small group and individual activities. When a simple, clear message is repeated in many places and formats throughout the community, it is more likely to be seen and remembered.

The behaviour of beef producers is embedded in a complex social environment and strongly influenced by social norms. Reef RD&E providers need to be a trusted and valued component of communities, and using a good understanding of beef producers and the factors that influence their behaviour, encourage more beef producers to commence and continue adoption of best management practice. Widespread behaviour change will take time and considerable resources, and thus requires systematic and strategic approaches like that used in social marketing programs.

5. Conclusions

Theories of adoption of new technologies suggest only 20% of any population readily adopt new products or practices. The remaining 80% of people are much slower to adopt, and generally wait until the technology is simple to use, low cost, proven and a “norm” within their community. Adoption of grazing land and herd best practices in the Fitzroy and Burdekin catchments is likely to conform to this theory.

The irony of this situation is that beef producers who have poor practices and performance, and hence the most to gain from best practices, are the least likely to adopt them. They are not inclined to use innovations to continuously improve their performance, and hence place little value on industry best practices and related services.

Cattle production is a socio-cultural activity. The majority of beef producers operate as a family unit, live on their property, and are surrounded by similar people. For many beef producers, their management practices are a product of their local environment, being their family and local social networks. To be effective, reef RD&R providers will need to exert their influence at the local community level, where they are perceived as trustworthy, relevant, credible, reliable and legitimate sources of information and advice. Working closely with local innovators and early adopters could be a practical and effective foundation for community participation.

Even then, persuading the majority of beef producers in reef catchments to adopt particular industry best practices will be an enormous task. Social marketing offers reef RD&E providers a systematic and strategic framework for changing the behaviour of beef producers. Key elements of a social marketing plan are:

- population to be targeted
- behaviour to be addressed
- gaps in knowledge of the target behaviour
- budget and other resources available
- allies and collaborators
- participation of local community and target audience
- people and organisations which influence the target audience
- previous efforts to change behaviour and lessons learnt
- current behaviour of the target audience and key influences of this
- segments of the target audience, their size and other relevant characteristics
- prioritisation of the segments for targeting
- clear objectives for specific behaviours
- social science theories and models that explain behaviours and behaviour change
- ensuring benefits arise from the new behaviour
- removing barriers to adoption
- commitments, pledges and prompts
- a mix of extension/marketing activities
- consideration of product, price, place and promotion
- pre-test concepts, methods and communication materials
- monitoring, evaluation and reporting

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