final report

Project code: P.PSH.0965

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Date published: 8th November, 2020

PUBLISHED BY
Meat and Livestock Australia Limited
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NORTH SYDNEY NSW 2059

Grazing Supply and Demand in the Maranoa – matching long-term sustainability with profitability

This is an MLA Donor Company funded project.

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Abstract

Grazing system dynamics require a diverse managerial skill set to harness land capability for beef production whilst navigating seasonal variability and market signals. Through objective assessment of long-term carrying capacity of grazing lands and the financial health of the overarching business operating on that land, this project has demonstrated there is a synergy between sustainability and profitability of extensive grazing businesses. This project worked with an established group of commercial graziers in Southern Inland Queensland supporting them in developing, refining and applying a process to better match their stocking rate to their property's carrying capacity. Over three years, working with nine businesses over 15 properties, the project assessed current and potential long-term carrying capacity of nearly 1,600 km^2. All businesses were trained and coached in feed budgeting and were active participants in business benchmarking. Tools and resources were developed supporting enterprise planning, including adaptive capacity to climate risk influences on land condition, thus long-term carrying capacity and profitability. The objective was to support producers in a peer learning setting, to make the most productive, profitable and sustainable use of their land's capability through identification and adoption of appropriate practices and business management systems, foundational to achieving and maintaining good land condition.

Executive summary

Grazing system dynamics require a diverse managerial skill set to harness land capability for beef production whilst navigating seasonal variability and market signals. Through objective assessment of long-term carrying capacity of grazing lands and the financial health of the overarching business operating on that land, this project has demonstrated there is a synergy between sustainability and profitability of extensive grazing businesses in the Maranoa region.

'Matching stocking rate to carrying capacity' is one of the fundamental tenets of pastoral production. However, there are practical challenges in its application and there is evidence that its adoption across the grazing industry is poor at commencement of this project. This was evidenced by a continuing decline in land condition (Tothill and Gillies Report, 1992), although awareness and practice change towards grazing management better matching supply and demand, appears to be gaining traction.

In the past, failure of graziers to integrate land capability into their property and business planning has led to land condition decline and vulnerability to elevated seasonal stock losses. Productivity of the land resource alone when in poor (C) condition, and therefore long-term carrying capacity, can be less than half its potential when in good (A) condition. Setting up the livestock management program and calendar to make best use of the available capacity (within and across years) while striving for optimal land condition is an area where significant gains can be made in improving long-term business and environmental performance.

This project worked with an established group of commercial graziers in Southern Inland Queensland to support them in developing, refining and applying a process to better match their stocking rate to their property's carrying capacity (in the short & long-term). The objective was to support them in a peer review setting, to make the most productive, profitable and sustainable use of their land's capability through identification and adoption of appropriate practices and business management systems, foundational to achieving and maintaining good land condition for their properties. This was done by incorporating existing science and developing new technology to incorporate into business management practises of group members.

This project focussed on taking advantage of changing industry management perceptions and attitudes, and to accelerate the adoption of improved grazing land management and consequently, business management and resilience. Practice change achieved through the project can be measured by participants through their own individual business performance.

The businesses included in the group were representative of the top 25% of beef businesses per criteria outlined in the Northern Beef Report (Holmes, P. et al., 2017). Over three years, the Maranoa Business Group were engaged in the 'Grazing Supply and Demand in the Maranoa – matching long-term sustainability with profitability project'. By the end of the project nine businesses who collectively managed 15 properties, worked together with the project team to assess current and potential long-term carrying capacity of nearly 1,600 km^2 - an area the size of Toowoomba and Ipswich City Council areas combined. From assessments undertaken, over a third of land area across the group was assessed to be in 'A' condition, and approximately a third of the land area was assessed to be in 'C' condition or lower.

While there were some sheep producers in the group, it was predominantly rangeland cattle producers with extensive pastoral properties and a small amount of forage cropping.

Feed budgeting provided critical information to support business planning and grazing land management through enabling and matching seasonal variability and stocking rates for short and long-

term outcomes. This project actively supported capacity building of group members on how to implement this process on their own properties.

Each business provided production and financial information each year, which was then analysed by Bush AgriBusiness using the *The Business Analyser*. The information pertinent to each individual business was provided back to the business and discussed on a one on one basis with Bush Agribusiness.

Coupled with long-term carrying capacity assessments, all businesses were included in business analysis and where possible, attended quarterly group meetings to discuss the group benchmarking results of this analysis.

This pooled information enabled comparisons across the group of businesses at group meetings. This information was used to support business planning and strategy development to respond to constraints identified in property long-term carrying capacity assessment.

Climate risk was also reviewed in this project, with efforts to improve adaptive capacity through integration of key decision dates for grazing land management thus annual business planning calendars. The two main conclusions that could be drawn from this work were;

- In the Maranoa region, a failed season will be experienced about one in every four years, and in those years less than two-thirds of long-term carrying capacity can be run.
- If reasonable pasture growth has not occurred by mid-February, there is only a 20-25% chance that it will occur that growing season, and the sell down strategy should be implemented.

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1 Background

'Matching stocking rate to carrying capacity' is one of the fundamental tenets of pastoral production. However, there are practical challenges in its application and there is evidence that its adoption across the grazing industry is poor at the commencement of this project. This has been evidenced by a continuing decline in land condition (Tothill and Gillies Report, 1992), although awareness and practice change towards grazing management better matching supply and demand, appears to be gaining traction.

In the past, failure of graziers to integrate land capability into their property and business planning has led to land condition decline and vulnerability to elevated seasonal stock losses. Productivity of the land resource alone when in poor (C) condition, and therefore long-term carrying capacity (LTCC), can be less than half its potential when compared with land in good (A) condition. Setting up the livestock management program and calendar to make best use of the available capacity (within and across years) while striving for optimal land condition is an area where significant gains can be made in improving long-term business and environmental performance.

This project worked with an established group of commercial graziers in Southern Inland Queensland to support them in developing, refining and applying a process to better match their stocking rate to their property's carrying capacity (in the short & long-term). The objective was to support them in a peer review setting, to make the most productive, profitable and sustainable use of their land's capability through identification and adoption of appropriate practices and business management systems, foundational to achieving and maintaining good land condition for their properties. This was done by incorporating existing science and developing new technology to incorporate into business management practises of group members.

This project focussed on taking advantage of changing industry management perceptions and attitudes, and to accelerate the adoption of improved grazing land management and consequently, business management and resilience. Practice change achieved through the project can be measured by participants through their own individual business performance and the land resource condition.

2 Project objectives

The project team, in consultation with the grazier group members, identified a range of objectives to be achieved over the life of the project. These project objectives included but were not limited to: -

- Producers will have independent, science-based assessment of Long-term Carrying Capacity (LTCC) and Land Condition of their selected properties undertaken. This will benchmark their land resource's capabilities.
- Options for improving land condition and LTCC will be compared, and the economics of each assessed, providing a priority for development and improvement strategies. The output from this will be individual property development plans.
- Producers will be trained in quantifying short-term carrying capacity (feed budgeting). Support will be given to individuals as they develop their own forage budgets.
- Clear processes will be developed (to conduct, record and analyse feed budget and stock flows) to match stocking rate to carrying capacity in the short and long-term in consultation with group members.
- A management calendar will be reviewed, to ensure the production system makes best use of available capacity and accommodates seasonal variability.
- Participants will have improved climate risk management skills, supporting their adaptive capacity and enterprise resilience.

- Participants will have a detailed understanding of animal unit performance and productivity, and how this relates to both their grazing land management and whole business performance.

The project model aims to have replicability and through observation and consultation with group participants, project effectiveness in bridging the gap to match long-term sustainability and profitability will be discussed.

3 Methodology

As an adoption focused project, a process to support medium term changes (five years) were identified by the project team as: -

1. Project participants will be skilled in using objective information in the application of grazing land management principles in the management of their properties.

2. Project participants will be skilled in using grazing management, and other cost-effective interventions, to influence land condition on their properties through skills acquired over the life of the project.

To be effective in achieving practice change, a co-innovation approach was supported by measurement of current land condition and business performance. Key information to be facilitated for exchange and evaluation in a farmer to farmer, 'peer review' setting over the life of the project.

The process aimed to provide participants with a clear and seamless path to long-term sustainable production and also reduce the impact of seasonal variation on business performance by forecasting feed shortages and surpluses, informing early season decisions. The project process focused on collating key information for each property and enterprise, enabling benchmarking for key indicators of grazing sustainability and profitability.

3.1 Determining land condition and long-term sustainable carrying capacities

In consultation with the businesses involved, each property was to be mapped according to its dominant grazing land types and current infrastructure locations. Queensland land type classifications and the land assessment system described in MLA's Grazing Land Management material were used. The system applies the A, B, C or D classification to land types in each paddock of the properties, where A is, "as good as it gets" and D is "very poor".

Property visits, where relevant, were conducted and professional assessment of current land condition and long-term carrying capacity assessment undertaken by EcoRich Grazing. This information was summarised into a property report, discussed with each enterprise, and included in group meetings where relevant.

Property long-term carrying capacities were calculated using the Grazing Land Management methodology (Chilcott et al. 2003) based on estimated annual pasture growth of the different land types and anticipated consumption by grazing livestock on an annual basis at a safe utilisation rate for the land type. Two estimates of LTCC were provided. Current LTCC, taking into account current land condition and tree basal area, and potential LTCC if land condition was A (excellent). Estimates of LTCC were given in Adult Equivalents (AE – A 450kg steer with zero liveweight gain, consuming 60 MJ of energy per day) and took the following aspects into account:

- Land types, their areas and maps were downloaded from the Queensland State Government's Long Paddock web site[1], FORAGE database. Land type areas within each paddock were used to calculate LTCCs. Not all the land types from this database were found to be correct so some were adjusted for the exercise.
- Land condition of each land type at the paddock scale was estimated by assessing pasture and soil condition to give an overall land condition rating of A (excellent), B (good), C (poor) and D (very poor). Median annual pasture growth information from the Stocktake Database was used for this exercise.
- Foliage Projective Cover (FPC) was measured from satellite imagery for each land type and verified with Tree basal area (TBA) estimations within paddocks and across the property. Pasture growth is discounted as FPC or TBA increases.

Distance to water was not always included in the calculations of long-term carrying capacity. Grazing efficiency is 100% if stock have to walk no further than 1km to water. As a general rule of thumb for larger properties with greater distances between watering points, 90% of grazing occurs within 3km of water points and 10% occurs outside this range (Jones and Alexander, unpublished data). Where distance to water exceeded 3km distance to water discounts were included in the assessment. These factors could be used in combination with a GIS assessment of water distribution to refine the assessment of LTCC. Total grazing pressure included kangaroos in the assessments where relevant.

The outcomes of the LTCC assessments are based on the best available information but they can be affected by various parameters used in calculations. These include:

- The land types given in the Forage Indicative Land Type maps and reports (Queensland Government Long Paddock web site) and choosing the appropriate land type to match from pasture growth tables derived from the GRASP modelled output.
- Mapping errors and estimations of areas of each of the land types.
- Estimations of land condition for areas of the property not visited.
- Estimations of land condition for entire paddocks. Land condition was assessed at as many points as practical within the timeframe allowed but not all paddock areas could be inspected.
- Estimations of tree basal areas and Foliage Projective Cover (FPC) by satellite imagery interpretation

The LTCC quoted are estimates and actual LTCC may vary for the above reasons, differences in local climatic conditions and grazing system used, but they do provide a point of reference and the relative LTCC due to land condition differences show the impact of improving land condition.

3.2 Feed budgeting training and coaching

As part of the process for determining a property's long-term carrying capacity, land condition assessments included assessment of forage availability. At the time, a property's LTCC assessment was undertaken, there was opportunity for discussion of current practices around annual feed budgeting and demonstration of the process by EcoRich Grazing. The focus of this interaction was to be on development of producer skills for undertaking their own feed budgets, including information regarding animal intake, pasture quality, understanding of animal unit performance and productivity and components of forage budgets. A practical group training activity also included over the life of the project to help develop producer's skills and reinforce practices learned, with emphasis on key templates and tools for independent and ongoing use.

[1] https://www.longpaddock.qld.gov.au/forage/index.html

3.3 Understanding and measuring whole business performance

Each business provided their financial statements each year, which were then input by Bush Agribusiness into the *The Business Analyser*. The process provided producers in the group with: -

- an objective analysis of exactly how their business is performing in its own right, and in comparison, to the average and top producers in their region
- an understanding of what the strengths of their business are, and areas for improvement, allowing better focus and attention and allocation of resources
- an understanding of how much debt the business can afford and whether the current debt is being used effectively
- confidence in predicting impact of different strategies on performance
- ability to develop meaningful management budgets and plans that are based on actual business performance, not guess work.

This individual information was reported back to individual businesses but then also pooled and compared across the group of businesses in a benchmarking process at group meetings. This information used to support business planning and strategy development to respond to constraints identified in property LTCC assessment.

3.4 Climate and grazing information analysis

A literature review in the context of how to best manage climate risk for grazing land management was undertaken in conjunction with pasture growth modelling for representative land types and locations across the group. A range of climatic zones were investigated using the pasture growth model, covering relatively higher rainfall zones in the east to lower and more erratic seasonal rainfall in the west and strongly summer dominant in the north to a higher proportion of cool season rain in the south of Queensland. Regionally relevant climate information was compiled to support participants' climate risk management skills, supporting their adaptive capacity and enterprise resilience. This information was collated to provide support for a business planning and management calendar, particularly informing key decision dates and triggers relative to grazing land pasture productivity.

Key dates considered were:

- Green date or break of season
- The likely date following a break of season where there would be sufficient pasture growth for stock to be gaining weight. This is known as the "Production point" in the GLM EDGE package. This is an important target date for forage budgets.
- A mid-growing season date that could become a key decision date for implementing destocking strategies as a failed season is likely

3.5 Group meetings

A co-innovation process was undertaken to support business group members. Regular group meetings were conducted over the life of the project involving producers, project team members and guest speakers on key topics of relevance identified by the group. Over the life of the project, there was to be a minimum of six quarterly group meetings held. These meetings to include project progress activities and updates in the agenda. These meetings also provided opportunities for other project activities such as forage budget training and coaching, stock flows and relevant topics identified through the co-innovation approach.

These facilitated meetings were to be mainly hosted on property by group members and provide an opportunity for peer review of pastoral business management across the group. This process enabled farmer to farmer learning in a supported environment with key technical guest speakers invited as part of the agenda. These meetings provided an opportunity for both individual and group performance to be discussed and analysed in depth. There were also meetings which involved visits to key research facilities and innovative producers outside the region to stimulate ideas and discussion by group members.

4 Results

The project commenced with seven grazing businesses and added two more businesses in the second year of the project. All businesses were included in business analysis and attended group meetings. A total of 15 properties were included for long-term carrying capacity assessments and all businesses provided the opportunity to participate in forage budgets coaching and training. A combined area of 158,939ha was assessed in this project, an area equivalent in size to the combined area of Toowoomba and Ipswich City Councils in Queensland.

Drought conditions dramatically impacted on the project timelines for delivery, with a failed 2019 summer season severely limiting the ability to undertake effective evaluation of land condition for determining LTCCs. The project was extended, and season break in February and March 2020 across the group enabled the completion of these field assessments. COVID19 travel restrictions which came into effect in March 2020, impacted on the timing but these on ground assessments of land condition of the properties have been completed with reporting back results for two properties post June 30, 2020. The project team will follow up on these properties with the landholders involved and review these reports for use post COVID 19 as part of ongoing group activities.

Travel restrictions also impacted on the project team's capacity to bring the group together face to face to review feed budgeting training and climate risk analysis key findings as planned. This information was presented to the group via email and webinar meetings.

4.1 Determining long-term sustainable carrying capacities

4.1.1 Property mapping

Each business provided their property description details and existing mapping data where applicable. This information was used to develop three types of property maps to be used to support assessment of long-term carrying capacity. These maps were the most recent satellite imagery commercially available, Queensland Government indicative grazing land management land types and property infrastructure such as livestock water points, fencing and yards. Examples of the type of mapping developed is included in this report as Appendix 1a, b & c.

4.1.2 Land condition and long-term carrying capacity assessments

Individual property reports were written, detailing long-term carrying capacity using the best information available. The assessments included site inspections and observations, calculations of LTCC based on median annual pasture growth data generated by GRASP pasture growth model and included in the Stocktake database, and output by the Long Paddock web site's FORAGE pasture growth tool.

Figure 1. Relative Land Condition for each property

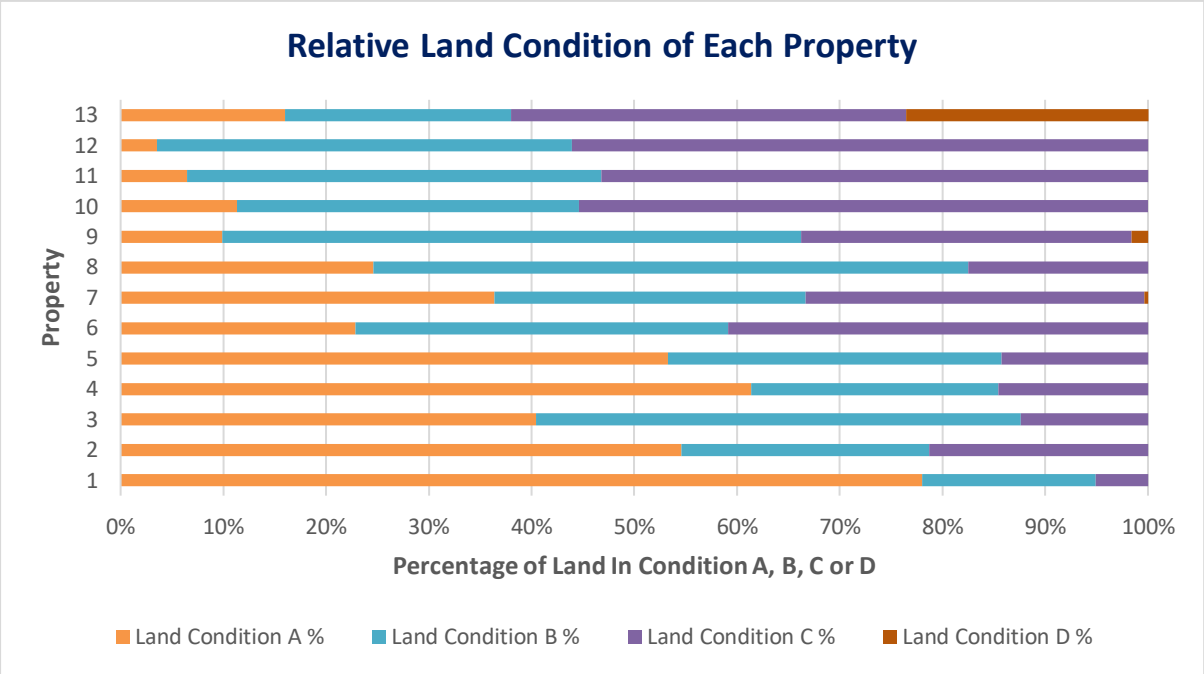
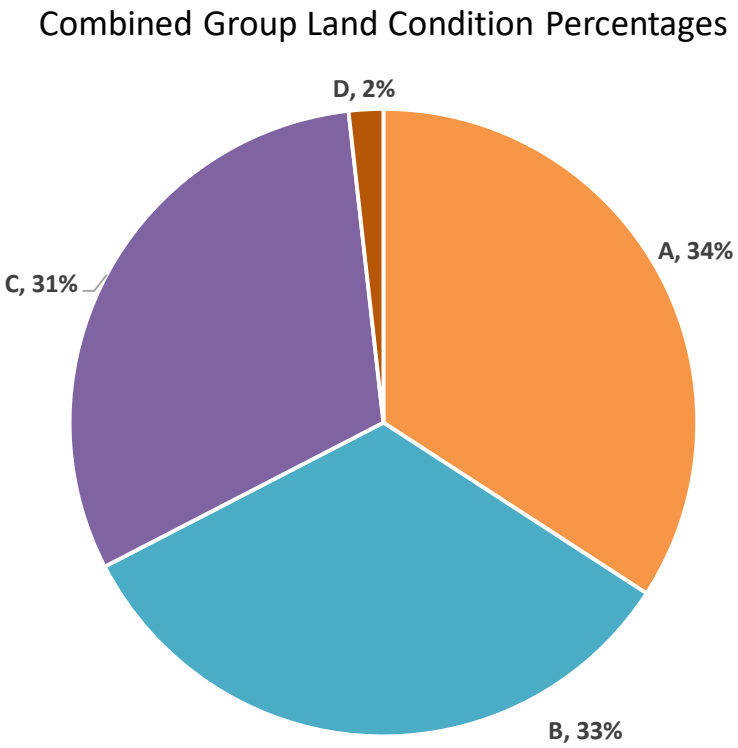


Figure 2. Combined Group Land Condition Percentages



Individual property reports were provided back to the relevant producers for review and future use. An example of the report format is supplied as an Appendix 2 to this report. The relative land condition across 13 properties is shown in Figure 1. At a group level this is combined in Figure 2. A summary of

the group's current land condition and comparison of current and potential long-term carrying capacity is detailed in Table 1.

This information was also used as part of the business assessment with group and key summary figures included in Table 2.

*Table 1. Summary of Group Long-Term Carrying Capacity for 13 properties**

Current Land Condition	Total Area (ha)	% of Total Area	LTCC** for current condition	LTCC ** potential in A condition
A	53310	34	8328	10560
B	51877	33	8104	10276
C	48085	31	7512	9525
D	2771	2	433	549
Grand Total	**156043**	**100**	**24377**	**30910**

*Group total of 15 properties at time of report, 2 properties not included as cropping/forage properties

**AE Adjusted to 2,738 kg/yr intake

Table 2. Summary of Group Land and Livestock Data

	2015	2016	2017	2018	2019	Average
Total Area (km^2)	1,663	1,918	2,065	2,067	2,062	**1,545**
Effective Area (km^2)	1,571	1,818	1,961	1,962	1,958	**1,467**
Total AE Managed	25,900	32,874	33,996	33,979	34,494	**27,028**
Total AE Grazing on Effective Area	25,875	32,857	33,818	34,088	34,494	**26,704**
Effective Stocking Rate (AE/ km^2)	16.5	18.1	17.3	17.3	17.6	**20.0**
Avg Rainfall (mm)	594	542	524	472	337	**487**

4.1.3 Improving land condition

Some examples of strategies for improving land condition were included in the property LTCC reports where appropriate and relevant. The purpose of the reports was to show the opportunities for improved carrying capacities, where they existed, show the benefits of improving land condition and encourage managers to think about and discuss in group sessions what management options might be practical and relevant for optimising land condition in the different circumstances encountered at each property. The improvements in land condition and LTCCs were translated to economic benefits which drove home the benefits of maintaining good land condition. In some instances, it may not be possible, or economically feasible, to return the whole landscape to A condition. However, there are significant potential gains to be had from improving land condition to its optimum level. That level is a function of the cost and time of improving those areas in poor condition, which is outside the scope of this report.

Key strategies for improving land condition detailed across the individual LTCC reports included:

- spelling paddocks regularly in the growing season to encourage better grass species (3Ps)
- using fire to control regrowth of woody weeds,
- clearing of regrowth where fire is not an option, or using fire in conjunction with clearing operations

- pasture replacement, where pastures are in poor condition and recovery is likely to be very slow. Some highly productive land types can be normally very slow to recover, even with strategic spelling. A pasture replacement strategy for these areas could be considered.
- sub-dividing some paddocks with fencing, so they can be spelled from grazing periodically. Example areas where selective grazing of the creek flats which are in poorer condition.
- adding water points to distribute grazing more evenly
- the exceptionally dry summer has caused plant deaths on some properties and it will be important for pasture recovery to manage stock numbers so grazing pressure is light for the beginning of the next growing season.
- controlling weeds in sown pasture areas in poor condition
- sowing pasture species where land condition remains poor or where legumes could boost productivity

Some of these options will have a substantial cost which will need to be considered in light of the extra returns that might come from their implementation or, in verso, the future cost of not implementing them if soil and land condition are further eroded. Also, it will take time for these changes to occur (Jones et al. 2016). Reverting land condition from C to A by spelling alone can take as long as three to ten years depending on seasonal conditions. Sown pastures can make that transition quicker if the right seasonal conditions for establishment are experienced and the risk of failed establishment is reduced by employing good establishment principles and practices.

In some instances, these recommendations were embraced by the businesses, with implementation plans developed, costed and in various stages of implementation across group member properties at the time of this report. This provides evidence that the project supported real practice change in motivating and enabling producers to implement strategies to match sustainability and profitability.

A progress snapshot of this work was highlighted as part of MLA Communications with an article published under industry news on the MLA website per link: -

https://www.mla.com.au/news-and-events/industry-news/understanding-true-carrying-capacity/

4.2 Training and coaching in forage budgets

As part of all property visits to assess land condition and long-term carrying capacity, a level of one-on-one coaching and skill development occurred. This process included establishment and baseline assessment of land condition monitoring sites, providing a project legacy to producers in supporting their capacity for ongoing, independent assessment of land condition and also their skills for assessing feed availability for forage budgeting.

A forage budgeting field day was held during the project at a group member property on 16 March 2020. Col Paton, Eco Rich Grazing, presented an overview of the practice and value of forage or feed budgeting, followed by hands on activities for the group.

This activity was well received, with varying levels of experience in the process across the group members. This activity contributed directly to project objectives by building producer capacity to assess land condition which is fundamental for benchmarking asset condition relative to their business management. It also supported development and evaluation of considered improvement strategies and plans in conjunction with their individual property long-term carrying capacity reports.

Most importantly, this activity trained the group in quantifying short-term carrying capacity through practical support for undertaking feed budgets. This event built group member capacity to better manage climate risk, supporting their adaptive capacity through enabling objective and measured information to be collected and to be used going forward as a key activity in their management

calendar. Feed budgeting provides critical information to support business planning and grazing land management through enabling and matching seasonal variability and stocking rates for short and long-term outcomes. This project activity was central to whole of business performance and well received by the group.

Photos 1 & 2 – Producer group members participating in Forage Budget Training in March 2020

A pasture budgeting spreadsheet tool was refined in consultation with the group. This was a modified version to templates available via Grazing Land Management EDGE training packages. This was

distributed to all group members electronically and an overview is included at Appendix 7. A follow up webinar activity was held in June 2020, to support group members with their own experiences in undertaking their own forage budgets post the field day event and review the pasture budgeting spreadsheet tool as fit for purpose for their future enterprise management.

4.3 Understanding and measuring whole business performance

Each business provided their financial statements each year, which were then input, by Bush Agribusiness, into the *The Business Analyser*. Analysis was undertaken for the 9 businesses for eight financial years from 2011-2012 to 2018-2019.

The information pertinent to each individual business was provided back to them and discussed on a one on one basis with Bush Agribusiness. This information was used to support business planning and strategy development to respond to constraints identified in property LTCC assessment.

The individual business information was presented to the group as an open book, with all businesses sharing their financial performance details. Group trust and adherence to confidentiality, given the sensitivity of this information, also built social capital but provided space for peer discussion and shared challenges to be reviewed and experience gained.

This individual business information was then collated across the group of businesses in a benchmarking process at group meetings. These group business analysis reports are provided in Appendix 3 and Appendix 4. Some key points regarding income, business assets and profitability are included in Figures 3 – 6. Severe and extended drought has impacted on cashflow and profitability expressed as operating return. In terms of return on assets across the group, capital return has increased considerably since 2018. This can be explained by property land valuation increases.

The average business of the group is turning over $800,000/year, with an operating profit upwards of $200,000 per year.

Figure 3. Group Consolidated Income Statement 2012-2019

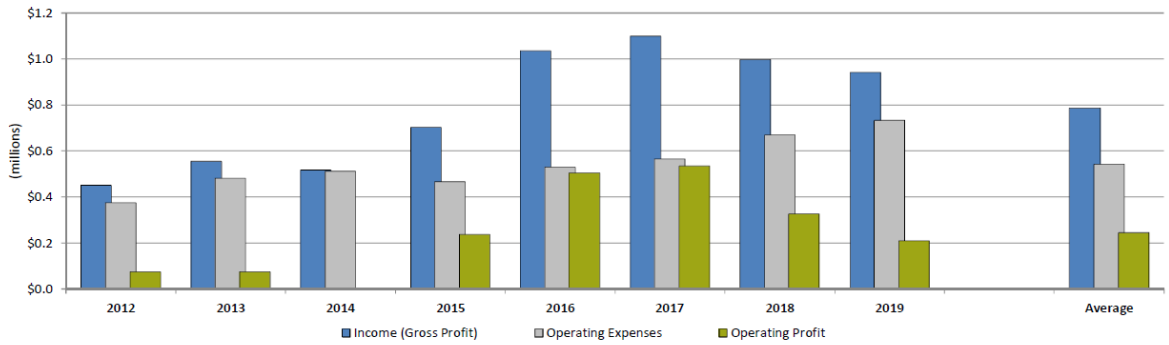


Figure 4. Group Business Assets Split

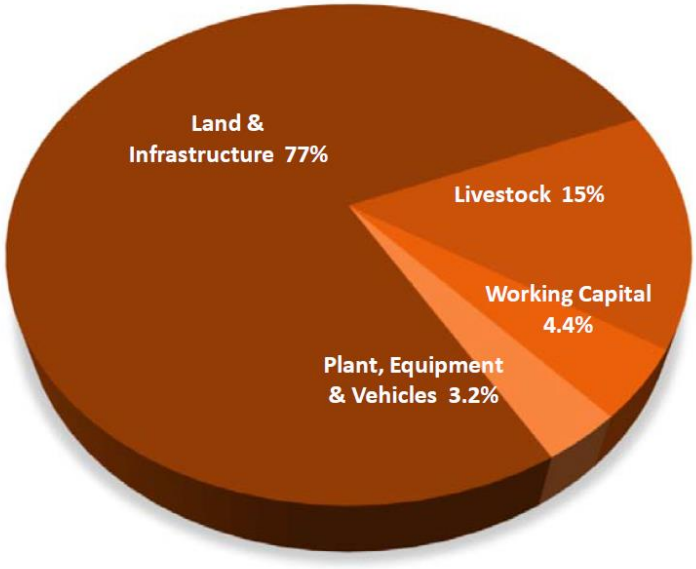
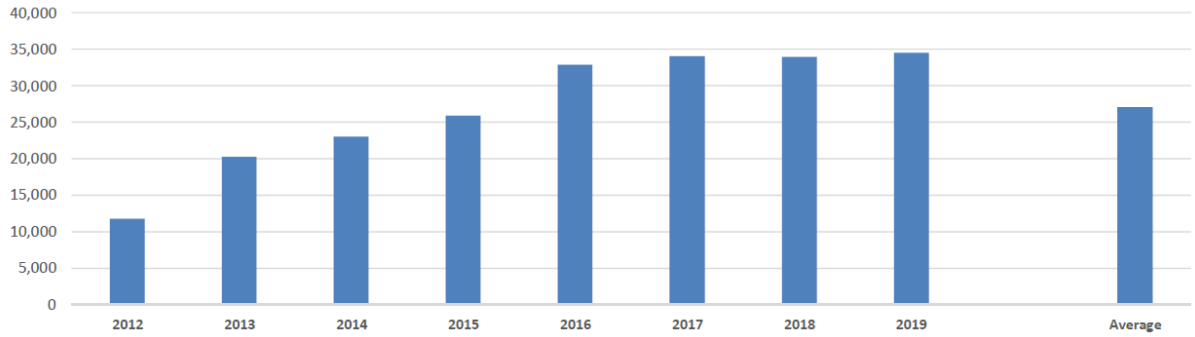
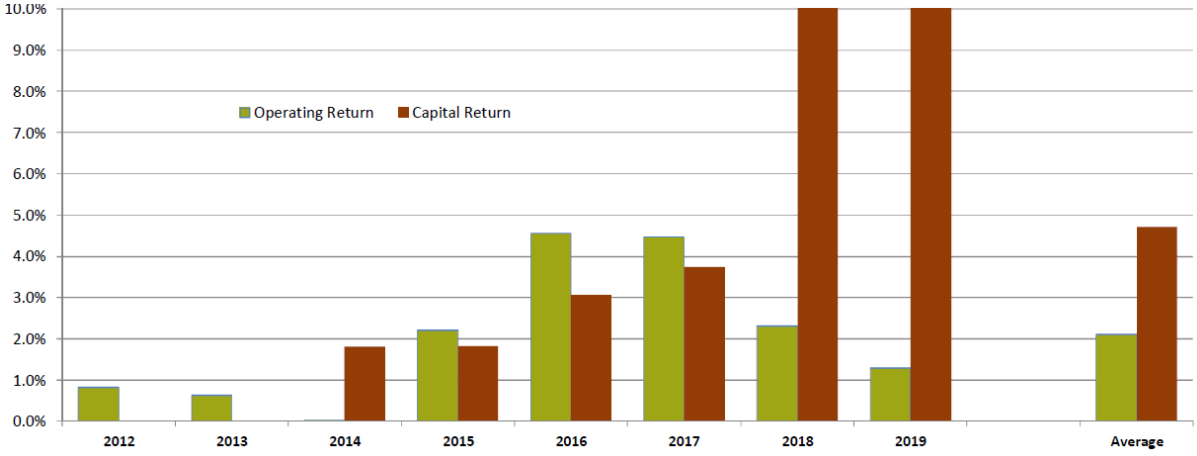


*Figure 5. Group Total AE Managed 2012-2019 ***



***Businesses joined the group over time*

Figure 6. Group Profitability 2012-2019 (return on assets managed)



4.4 Climate and grazing information analysis

Assessing climate risk and looking at how best to manage climate risk was part of this project. The aspiration was for tools developed to support management calendars for each property. By integrating climate driven pasture growth information, could proactive grazing management decision dates be more confidently applied?

The project team sought assistance from the QLD Department of Environment and Science and Dr Jeff Clewett, *AgroClim Australia*. University of Southern Queensland were also consulted by the project team as concepts explored by this project, had linkages to work currently being undertaken through USQ Drought and Climate Adaptation Programs. However, due to project timelines and budget, only AgroClim Australia's Dr Jeff Clewett could be engaged to provide comprehensive GRASP output data. The data was used for analysis to help inform key decision dates for grazing land management decisions within this project. This information is included in the report as Appendix 5, 'Climate Risk Management Work for Maranoa Group MDC Project.'

Using this modelled pasture growth data from across the Maranoa region, and across Queensland we could analyse pasture growth growing season to help answer the following key climate information for Grazing Land Management: -

- When is a start to the growing season expected (median date), and what is the spread of starts around that (i.e. in x% of years, the season will have started by y date)?
- What is the likelihood of a failed season?
- When is a failed season declared (or at what point does the likelihood of significant future pasture growth, taking into account utilisation and land condition impacts, get to a point that action should be taken to reduce numbers)?

For the start of growing season, the 'Green Date' is widely used and is commonly 50mm in three days. However, research has found that it is not consistently applied, and is often unrealistic in more arid environments.

The likelihood of getting 50mm of rain in three days over a summer differs in different areas (i.e. there is an 88% chance of getting 50mm in three days between October and March at Wandoan, 75% at Woodlands and 52% at Windorah). The response will be different in different areas as well and is not always a useful indicator for the beginning of the growing season.

Failed season is not a well-defined term. For the purpose of these analyses a failed season was defined as receiving less than the midpoint between the 5^{th} and 50^{th} percentile of growing season pasture growth, as opposed to rainfall. Predicted pasture growth provided a much more useful analysis tool. This method caters for varying levels of pasture growth, which a fixed pasture growth figure would not, also takes into account the distribution of pasture growth and allows a probability to be calculated, which using a percentile figure would not. If a location doesn't receive more than the midpoint between the 5^{th} percentile and median, it can be classified as a failed season. An example is provided in Figure 7.

From this analysis we've been able to determine that, in the Maranoa, a failed season will be experienced in about one of every four years, and in those years less than two-thirds of long-term carrying capacity can be run. The conclusion was that if reasonable pasture growth had not occurred by early to mid-February, then there was only a 20-25% chance of this being achieved.

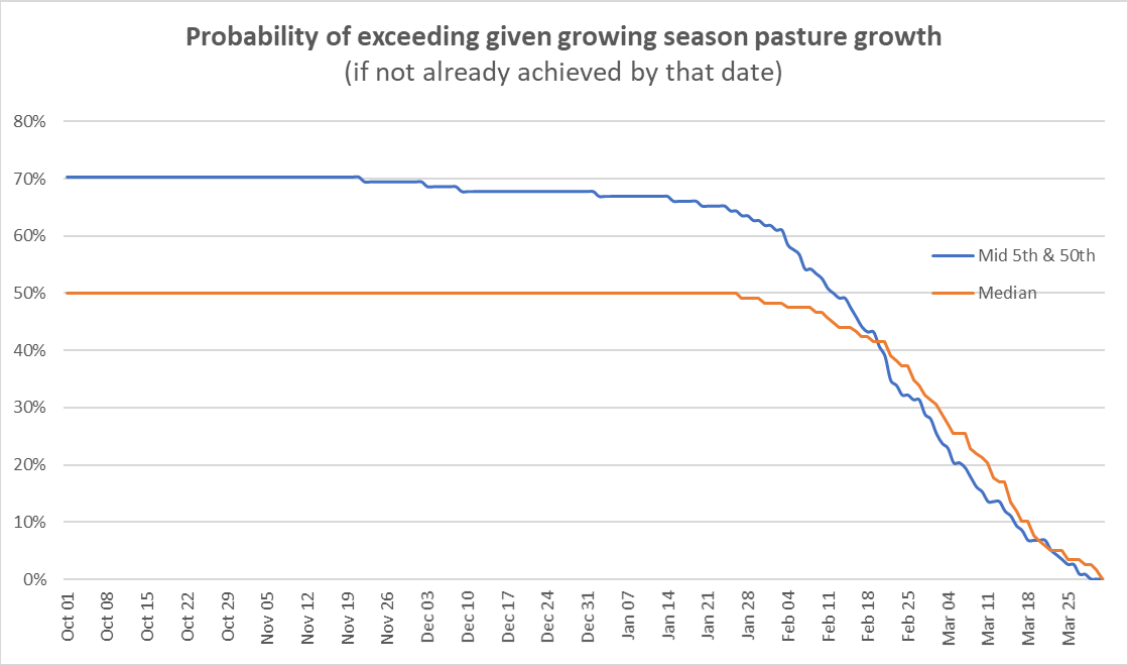
Calling a failed season can be a stressful decision, and the fear of making the wrong decision causes decision paralysis or no decision. Neither this (or the forecasts) will tell you if, come mid-February, you will get sufficient rain to grow pasture before winter. What it does tell you is that, if you haven't

received pasture growth by mid-February and you make a decision to start implementing your sell down strategy, then it will be the right call in 75-80% of years, which isn't bad odds.

The two main conclusions that can be drawn from this work are;

- In the Maranoa region, a failed season will be experienced about one in every four years, and in those years less than two-thirds of long-term carrying capacity can be run.
- If reasonable pasture growth has not occurred by mid-February, there is only a 20-25% chance of median summer pasture growth by the end of the growing season, and the sell down strategy should be implemented.

Figure 7. Pasture Growth Probabilities for Augathella Property



These broad conclusions will be useful for climate risk management in the Maranoa region. However, this research has raised more questions than it has answered. Discussions have commenced with researchers and research organisations, including the Drought and Climate Adaptation Program, about how progress in this area of climate risk management.

Climate risk analysis was discussed with the group at the meeting 14-15th October 2019. In June 2020, a one-page overview and the Climate Risk Management Work for the Maranoa Group MDC Project Report were supplied to all group members. COVID 19 prevented planned group meetings to extend this work within the project. However, support beyond the project will be provided to assist application of this information for business management planning by group businesses.

4.5 Group meetings

Group meetings were held four times a year. These meeting dates were scheduled well in advance and involved producers, project team members and guest speakers on key topics of relevance identified by the group. Over the life of the project, there were six quarterly group meetings held where activities related to this project. These meetings included project progress and updates in the agenda. These meetings also provided support for project activities such as feed budgeting training and coaching, stock flows and relevant topics identified through the co-innovation approach.

These facilitated meetings were mainly hosted on property by group members and provided the host property with an opportunity for peer review of their pastoral business management by the group. This process enabled farmer to farmer learning in a supported environment with key technical guest speakers invited as part of the agenda, discussing topics of group interest from herd fertility, succession planning, animal health and more. These meetings provided an opportunity for both individual and group performance to be discussed and analysed in depth. There were also meetings which involved visits to key research facilities and innovative producers outside the region to stimulate ideas and discussion by group members.

For example, in the first stage of the project, discussion at the meetings were facilitated regarding progress of individual property mapping. There were also discussions and confirmation for individual businesses' schedules and subsequent timings for on property visits by EcoRich Grazing to undertake Land Condition assessments and finalise information to develop Long-term Carrying Capacity Analysis. Annually in October, business benchmarking was reported and discussed amongst the group at this meeting.

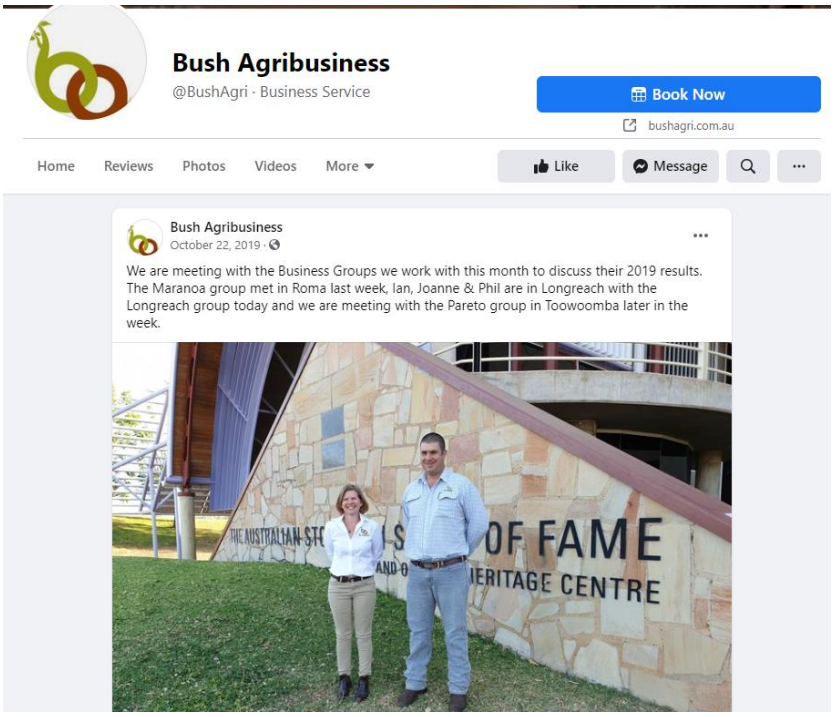
For the meeting in October 2018, all nine grazing businesses participating in the project and project team members, travelled to Armidale in New South Wales. Over two days the group travelled together and participated in activities per the detailed itinerary provided as Appendix 6 to this report.

Some group meetings were posted on social media. These examples per website links: -

https://twitter.com/BushAgri/status/1051650143919857670
https://www.facebook.com/BushAgri/posts/2185238961487546
https://www.facebook.com/BushAgri/posts/2816453088366127
https://twitter.com/BushAgri/status/1186405784986386437

Figures 8 and 9. Screen shots of the tweets

Figures 10 and 11. Screen shots of the Facebook posts



The group meetings also provided overall publicity of the project, as media reported on by Queensland Country Life with an article published per link: -

https://www.queenslandcountrylife.com.au/story/6019512/maranoa-grazing-group-benchmarking-for-success/?fbclid=IwAR1aBaoMrSlCumX_mmwO3VGHALFvbDGYGC7b3W9KHUAVwBC8i4dHW8zdCcQ

Figure 12. Queensland Country Life article

Putting a science behind carrying capacity

Hayley Kennedy
@HayleyS_K

11 Apr 2019, 1 p.m. Beef

The Maranoa group isn't the only one of its kind. Graziers from Longreach and CQ are part of other groups, with interest for more.

A group of grazing businesses from the Maranoa region are participating in a grazing management project to better understand their carrying capacity, manage stocking rates and learn how to assess and monitor land condition.

5 Discussion

Land condition has a big influence on current carrying capacity, independent of season and rainfall. Matching stocking rate to carrying capacity is good land management but can be difficult in practice. It's one thing to work out how many AEs are being carried and how many kilograms of beef each animal unit is producing, but this information is much more meaningful within the context of the carrying capacity of the property; that is, how many AEs it should be running in the long-term. Annual stocking rates can vary around LTCC according to seasonal conditions.

Most producers have a gut feel for what their carrying capacity is and some do it very well. This project formalised this gut feel, and posed the question to group members, what the carrying capacity would be if the whole property was in 'A' or optimal condition.

Setting up monitoring sites and training producers in formal land-condition assessment and annual forage budgeting aimed to support capacity to continue to monitor land condition and better match stocking rate to carrying capacity year-to-year after this project ends.

There are very few places anywhere that are in A condition across the whole property. From assessments undertaken, approximately 34% of land across the group was assessed to be in 'A' condition. However, approximately 33% of the land was assessed to be in 'C' condition or lower.

What we do know is that Land in C condition (poor) is less than half as productive as land in A condition, and this has a proportionate effect on carrying capacity. Land in condition B or C can usually come back to A condition with rest. 'D Condition' can sometimes be irretrievable without mechanical intervention.

Pastures that are in poor condition, need spelling. The poorer the condition, the longer the spelling required for recovery. Where there's woody weed encroachment, that may need controlling. Where pastures are in particularly poor condition, pasture replacement may be necessary. These strategies were recommended where applicable across all properties as part of the LTCC assessment and provided valuable information for consideration by the businesses involved.

More important than the simple pasture classification in this project was assessment of the current carrying capacity and the potential carrying capacity if the land was in A condition. This allowed for application of economics, estimating what it may cost to improve land condition, and what returns could be realised through extra carrying capacity if recommended strategies were implemented.

The project was able to put real figures on improved carrying capacity and improved land condition. Most producers in the group were stocked to capacity for the pasture and land condition that they have but could have higher carrying capacities if the land was in better condition in some areas. If all properties could achieve land in A condition, it is estimated the group could lift carrying capacity by over 6000 AE's. At a gross margin of $170/AE/year, that is close to $1million per annum gross turnover. However, this figure does not consider the cost of implementation of strategies recommended to achieve improved land condition.

The project implemented a social process which supported peer to peer review and learning through regular group meetings. The sharing of their own business information, built trust and social capital, enabling more challenging discussions to be had, and thought-provoking strategies explored to deal with business performance challenges. Benchmarking across the group also helped develop business management skills, as reviewing business financial performance and identification of areas where there were opportunities for improvement relative to the group, proved an invaluable business process that, prior to joining the group, few had been exposed. This can only improve the business acumen for group members, ensuring financial literacy is not constraining their business aspirations.

There is also climate risk to consider, in achieving and maintaining good land condition. This project explored options to refine a management calendar for grazing land management, focusing on when to call a 'failed season', as a key trigger point for stocking rate management review. In the Maranoa region, a failed season will be experienced about one in every four years, and in those years less than two-thirds of long-term carrying capacity can be run. If reasonable pasture growth has not occurred by mid-February, there is only a 20-25% chance that it will occur that growing season, and the sell down strategy should be implemented.

6 Conclusions/recommendations

6.1 Future research and development

Climate risk remains an area where further research investment could yield value. The project aspired to provide a basis to support a responsive management calendar outline for enterprises in the Maranoa. However, this process put forward more questions than it answered, despite progress on evaluating the probability and time of year to determine if it has been a failed season, reducing carrying capacity for a given year. In the Maranoa, a failed season will be experienced in about one of every four years, and in those years less than two-thirds of long-term carrying capacity can be run. Producer confidence in 'calling' a failed season early could support proactive management of stocking rates to reduce negative impacts on land condition and overall business performance.

Determining regionally relevant pasture growth green dates, and subsequent production points, needs further research and development. As part of an enterprise management calendar, being able to determine the production point in particular, is vital for calculating forage budgets. This information gap could add clarity in identification of critical grazing land management decisions.

6.2 Practical application for industry

Each business was provided with objective evaluation of their properties' long-term carrying capacity (LTCC). It is known that better matching of stocking rate to carrying capacity, and more productive use of grazing land carrying capacity can improve industry profitability and sustainability (O'Reagain and Bushell, 2011). Baseline assessment supports identification of where LTCC is below its potential, thus strategies for optimising LTCC can be developed and compared from both a practical and economic perspective.

A stock and pasture management calendar containing key decision dates, i.e. when there is a failed season, gives managers a "line in the sand" at which they can begin to implement a sell down strategy with confidence. This enhances drought resilience and adaptive capacity. It also supports better grazing land management and economic outcomes as further delays in destocking can impact land condition and whole property economics. Delaying the decision-making process can result in managers having to buy feed to maintain stock, reducing gross margins, and resulting in declining land condition, which further reduces carrying capacity in future years.

6.3 Adoption and extension for industry

Science based assessment of Land Condition and Long-term Carrying Capacity provides a mechanism for benchmarking the land resource's capabilities. This process, however, is often outside the scope of current skills and training for producers. Access to expertise to support assessment of long-term carrying capacity is required to enable property managers to either learn how to undertake the process themselves or find a suitably qualified technician to undertake the assessment and provide management advice based on their assessment. The process will be more effective if advice reviews possible management strategies for their suitability, effectiveness, ease of implementation and economic implications.

Access to mapping support is fundamental to supporting grazing land management. Whilst producers may have capacity to map their base infrastructure, long-term carrying capacity assessment requires land type mapping. This tends to require technical support on the ground to verify indicative regional level mapping.

7 Key messages

7.1 Condition, carrying capacity and cashflow

Producers gain from having independent, science-based assessment of Long-term Carrying Capacity & Land Condition of their grazing properties. Benchmarking land resource capabilities should be included in benchmarking business performance.

Including an evaluation of the health and condition of the natural assets which underpins a grazing enterprise provides a context for historical business performance, and quantification for the value of implementing strategies to invest in good management of land condition. This a win for landowners and managers and for the environment. This process enables producers to not only recognise and quantify lost productivity due to poor land condition but more objectively evaluate strategies to recover land condition in the longer term and their potential impact on business performance.

Equally, it is evident producers need to have a detailed understanding of animal unit performance and productivity, and how this relates to both the grazing land management and whole business performance.

7.2 Feed budgeting skills

Best practice grazing land management is underpinned by producers quantifying short-term (annual) carrying capacity through feed budgets and managing seasonal variation. Whilst producers may have their own methods of evaluating available feed, regular objective in field measurement improves confidence in the decisions needing to be made for the coming season. Producers benefit from training and support to develop their feed budgets. Tools which are able to be tailored to their enterprise can streamline the collection of this data to inform management decisions at regular intervals per their management calendar.

7.3 Matching stocking rates to carrying capacity

Clear business processes to conduct, record and analyse feed budgets should be integrated with business stock flows. This process of matching stocking rate to carrying capacity in the short-term also supports grazing land management efforts to conserve or improve land condition and carrying capacity in the longer term. A management calendar ensures the production system makes best use of available capacity and accommodates seasonal variability.

7.4 Climate risk management for enterprise resilience

Climate risk management contributes to industry adaptive capacity and individual enterprise resilience. There are limitations with current knowledge and tools which are available to support producer climate risk decision making. Aspirations to reduce the impact of seasonal variation on business performance by forecasting feed shortages and surpluses would lead to more informed decisions made early in the season. Focus on evaluation of what information sources enable producers to evaluate when they are faced with a failed season is a critical trigger point to identify, but further work is required to ensure information gathered is useful for the decision makers. From analysis in this project, we've been able to determine that, in the Maranoa, a failed season will be experienced in about one of every four years, and in those years less than two-thirds of long-term carrying capacity can be run. However, readily determining pasture green date and production point requires further research and development to inform forage budgeting as a cornerstone for best practice grazing land management.

8 Bibliography

AISTHORPE, J.L, PATON, C.J., TIMMERS, P. 2004, Stocktake – A Paddock Scale, Grazing Land Monitoring and Management Package, *Australian Rangelands Society 13th Bienniel Conference Papers*, Alice Springs, Northern Territory, 379-380.

ASH, A., MCINTOSH, P., CULLEN, B., CARBERRY, P. & SMITH, M. S. 2007. Constraints and opportunities in applying seasonal climate forecasts in agriculture [Paper in special issue: Climate predictions for Better Agricultural Risk Management. Meinke, Holger (ed).]. *Australian Journal of Agricultural Research,* 58**,** 952-965.

BIOGRAZE, 2000, Biograze: waterpoints and wildlife, CSIRO, Alice Springs, Northern Territory.

BALSTON, J. & ENGLISH, B. 2009. Defining and predicting the 'break of the season' for north-east Queensland grazing areas. *The Rangeland Journal,* 31**,** 151-159.

CHILCOTT, C.R., PATON, C.J., QUIRK, M.F. & McCALLUM, B.S. 2003. *Grazing Land Management Eduction Package Workshop Notes* - Burnett, Meat and Livestock Australia Limited, Sydney, New South Wales.

HOLMES, P., MCLEAN, I. & BANKS, R., 2017. *The Australian Beef Report*, Bush AgriBusiness Pty Ltd

JONES, P., SILCOCK, R., SCANLAN, J., & MOROVEK, T., 2016, Spelling strategies for recovery of pasture condition, Final Report B.NBP.0555, Meat & Livestock Australia, North Sydney, New South Wales.

KEOGH, D. U., WATSON, I. W., BELL, K. L., COBON, D. H. & DUTTA, S. C. 2006. Climate information needs of GascoyneMurchison pastoralists: a representative study of the Western Australian grazing industry. *Australian Journal of Experimental Agriculture,* 45**,** 1613-1625.

MCCOWN, R. L. 1981. The climatic potential for beef cattle production in tropical Australia: Part I - Simulating the annual cycle of liveweight change. *Agricultural Systems,* 6**,** 303-317.

McCLEAN, I., HOLMES, P., COUNSELL, D. 2014, The Northern Beef Report, 2014 Northern beef situation analysis, Final Report B.COM.0348, Meat & Livestock Australia Limited, North Sydney, New South Wales.

O'REAGAIN, P.J. & BUSHNELL, J.J. (2011). *The Wambiana grazing trial. Key learnings for sustainable and profitable management in a variable environment*. Qld Department of Employment, Economic Development & Innovation. 51pp.

TOTHILL, J.C.; GILLIES, C. 1992. The Pasture Lands of Northern Australia: their Condition, Productivity and Sustainability. 1992. http://hdl.handle.net/102.100.100/246791?index=1

Appendix

8.1 Appendix 1a - Property Mapping Satellite Image

8.2 Appendix 1b – Property Mapping Land Types

8.3 Appendix 1c – Property Mapping Infrastructure

8.4 Appendix 2 – Land Condition and Long-term Carrying Capacity Assessment

8.5 Appendix 3 – Business Analysis – 2012-2017

8.6 Appendix 4 - Business Analysis – 2019

8.7 Appendix 5 - Climate Risk Management

8.8 Appendix 6 – Armidale Tour Itinerary

8.9 Appendix 7 – Forage Budget