Northern Australia Beef Industry Conference

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THE GOVERNMENT OF WESTERN AUSTRALIA

DEPARTMENT OF

MEAT & LIVESTOCK AUSTRALIA

TROPICAL SAVANNAS CRC

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Future issues for the Northern Australian Beef Industry
Which way to go – How can we get there?

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The Northern Australian Beef Industry is a large part of Australia's beef industry, comprising 14 million (60 per cent) of Australia's beef herd of 26 million. Queensland dominates the industry in terms of cattle numbers and turn off contributing approximately 50 per cent of Australia's $4.4 billion export business. The Western Australian Northern Beef Industry is a similar size to the Northern Territory industry and in both States the live export side of the industry dominates (Table 1).

Table 1. Meat cattle numbers by State (1998/99) and live cattle exports (2000/01)

State	Meat cattle numbers 1998/99	Live cattle exports 2000/01
New South Wales	5,942,308	9,486
Victoria	2,208,772	55,740
Queensland	10,536,000	169,992
South Australia	1,021,260	12,660
Western Australia	1,845,393	356,892
Tasmania	498,753	2,972
Northern Territory	1,591,266	251,165
ACT	71,250	
Total Australia	**23,715,002**	**858,907**

The Northern Cattle Industry has changed significantly over the last 20 years. Prior to 1980 the industry was largely one of feral harvesting with little cattle control infrastructure in place. Cattle distribution was largely controlled by water availability with, in the case of much of the Kimberley, the majority of waters being natural, often on river frontage. The implementation of the Brucellosis and Tuberculosis Eradication Campaign provided an imperative and a reduced cost of capital, enabling very significant investment to occur in cattle control. This control has enabled the industry to increase significantly its capacity to manage stock. It is interesting from an historical perspective that the decision to commence the BTEC program in Northern Australia coincided with a decision by CSIRO to cease its cattle industry work in WA and the Territory on the grounds that the industry was not interested in R&D and was not adopting research results. Some lobbying to the effect that BTEC would totally change the capitalisation and the management of the industry was not accepted and it took a number of years before meaningful engagement re-occurred. It is, I think, an excellent illustration of the need for research organisations to understand the industry and the context of R&D.

As a consequence of the demands of BTEC, and the evolution of more controlled grazing, mating, weaning and turn-off has the industry been able to better manage its resources and to be more responsive to the market opportunities and demands.

Since 1980 the beef market has also dramatically changed in terms of quality requirements and specifications, destinations and prices. In 1980 the Australian industry was still recovering from the shock of the Japanese closing its market to imports in December 1973, and was totally reliant on the US boned manufacturing beef market. The US beef import quotas and the politics around them totally determined the well-being of Northern Australian graziers. The industry was also affected by significant difficulties in its processing sector as old, inefficient abattoirs totally focused on the US boxed beef market struggled to reform their businesses and labour practices. The resulting closures, strikes and annual uncertainty over whether this work or that would open, made it very difficult to be a Northern cattle producer through the late 70s and 80s. Indeed even concerns over the imposition of the BTEC program led to some in the industry forecasting that eradication could not be achieved and that as a consequence the industry was doomed.

Now the marketing scene is quite different, with markets during the 2001 season being at all time highs, at least in Australian dollar terms. This has been assisted by our declining Australian dollar, and major events overseas such as BSE and FMD. However, the development of new markets and new products for existing markets has resulted in the array of options for Northern beef producers being very wide.

No longer is the turn-off restricted to four-year-old plus bullocks. Beef bred in Northern Australia can end up in feedlots producing prime beef into Asia, particularly Japan and occasionally the very high value Japanese ox market. Live cattle of varying ages and specifications are exported to a range of countries including Indonesia, Egypt, Philippines and the Middle East, or are slaughtered for the US boned beef market or the domestic manufacturing meat markets.

While the current period is very sound, if not rosy, the industry is still in a very early stage of developing its response to these opportunities. Indeed, the industry faces a range of challenges as it moves to a sustainable future and it needs to decide how to deal with them. To do this, the industry needs to consider what it wants, where to go and how to get there.

Some of the issues needing consideration include:

Marketing

While current markets are strong, and food consumption trends strongly indicate that beef consumption will increase significantly in most Asian markets over time, the Northern Industry is still largely selling its product as a commodity in one-off, or at best a seasonal contracts. This is the traditional way of selling agricultural products and study after study shows that this approach inevitably results in the producer receiving a declining share of the market value or return. Long term relationships are required where the northern product can achieve a premium as a result of establishing its particular qualities or attributes in the market place. Such long term relationships with the market place are essential to the development of a brand which in today's food business is critical to long term success. In many cases this will require producers working collaboratively, often not an easy task in Northern Australia.

Production systems

Research and development must focus on efficiently producing beef for specific markets in a way that provides a return on capital which is large enough to allow the producer to reinvest in business growth. Performance of the product in the market, whether it is meat quality or the performance of the live animal in a feedlot or on grass, will be critical. For example, it is known that cattle from different regions and indeed different stations perform differently in feedlots in Indonesia, even in cases where the genetics seem to be similar. Is this due to prenatal factors, peri-weaning nutrition or other nutritional or genetic factors? The answers to these type of questions will become important to future returns in the market place.

Issues such as the biological and business efficiency of management and turn-off strategies are important but not well understood. Similarly the nutritional requirements of cattle on various land systems and environments, feeding and supplementation, and the integration of management into the markets or downstream production systems need to be better defined and understood if the industry is to continue to develop. In a WA context a number of pastoral businesses have used recent good cash flows to purchase properties in the agricultural areas north of Perth. How should such opportunities be best integrated with the pastoral business to optimise sustainable business performance? Similarly how does the Queensland northern industry best integrate with the backgrounding industry or the feed-lotting industry. Little of the research to be discussed over the next two days seems to address these issues of market or business outcomes. It is important for the industry to define which market or markets it wants to be in, what characteristics that market requires and then ensures that research and technology is focussed on delivering to those requirements.

Rangeland management

The efficient utilisation of naturally produced fodder drives the Northern Beef Industry and it is in the interests of every producer to manage pastures in a sustainable way. However, the industry is now under much more scrutiny from governments and the community as to how it performs in achieving sustainable use. Most pastoralists do look after the range resource, but some either through apathy or ignorance do use the range resource unsustainably. This misuse does threaten the access of all pastoralists to the resource. Understanding the resource, its productivity, its safe use and its within and between season variability and managing it well is critical to business performance and community support for ongoing pastoral use of the resource.

Biosecurity

We have seen over the last five years several large industries overseas collapse overnight as a consequence of being ravaged by exotic diseases. FMD in Taiwan destroyed an export pork industry to Japan that was bigger in value than the entire northern beef industry in 24 hours. Neipa virus in pigs in Malaysia, FMD in UK, BSE in Europe and now Japan, have all decimated animal industries causing great financial stress to producers and indeed the whole industries.

Managing the risk of an exotic disease outbreak and responding to an incursion is not a problem for governments, it is one for the industry, the community and governments to manage together. The Northern Industry needs to involve itself in strategies and plans to minimise and manage these risks. In this context the issue of feral animals in Northern Australia is an interesting case study. Undoubtedly the presence of feral animals could make the management of an exotic disease very difficult. Indeed in the case of FMD wild pigs could make it impossible to control the disease and as most of the markets for northern cattle require FMD freedom, the inability to control FMD would result in indefinite loss of markets. Hence, perhaps the wild pig control should be viewed as a part of industry biosecurity, not just as a pest that the government should be doing something about!

Other issues of biosecurity that are important include surveillance, emergency management plans and agreements on compensation. Again the industry needs to consider where it wishes to be on these issues and ensure that these outcomes are achieved.

Alternative land uses

Conservation, mining and tourism use are all competing with pastoralism for access to the land resource in Northern Australia.

The transfer of pastoral land into conservation reserves has been important over the last 10 years as States, Territories and the Commonwealth have pursued a program of comprehensive and adequate reserves. However, most people in the conservation area agree that off reserve conservation, will be of critical importance to biodiversity management in the future and the pastoral industry as a major user of land will need to engage in this process.

The development of tourism has been dramatic in Northern Australia over the last few years. Although the US terrorist attacks and the Ansett collapse have caused a temporary downturn in tourist numbers, the wilderness of the north and its comparative safety will see tourism grow in the future. While some pastoral businesses have benefited by engaging directly in tourism, in the main tourism growth is causing the industry some difficulties.

The industry needs to engage these uses and assist governments and the community establish land use frameworks, including tenure that provide for sustainable use in the best interests of all. This will certainly result in the 'loss' of some pastoral land to other uses, the challenge is to keep productive land that is being sustainably used in the industry.

Native Title and Aboriginal use

A large proportion of land across Northern Australia is used by indigenous people and much more is subject to Native Title. The importance of the current public perception that pastoralism is in conflict with Aboriginal use and rights cannot be overestimated. The industry does need to address this issue in a way that results in benefits to all. Again, it is important that the industry decides its preferred outcome and negotiates this with Aboriginal people and governments. An important issue is the future role Aboriginal people could play in the industry and how to achieve this outcome.

Animal welfare

Animal welfare is a major issue for the industry to consider and decide an appropriate position to take. On one hand the industry continues to be plagued by occasional issues of animal welfare that are unacceptable by all standards. These occasional incidents are usually caused by transport delays, often associated with inadequate planning of feed and water. Most industry participants want to see these incidents eliminated and individuals involved removed from the industry.

On the other hand there are a number of more difficult issues such as transport over long distances and of course live exports. While there are good arguments to the effect that live exports to Asia, particularly from WA and NT to Indonesia provide much better welfare outcomes than trucking to southern markets, the issue will always be difficult to manage. The industry does need to be aware of these issues and ensure that all in the industry operate at the highest standards with a view to the long term sustainability. Again there is a lot of R&D required to move these issues forward, but little on the agenda of this meeting.

Summary

In summary, the industry is currently in a sound economic position and decisions taken now can ensure it has a long and viable future. Research and new knowledge will be critical to the industry advancing and this needs to be developed in the context of a clear view of where the industry can be in the future and how it wants to get there. I hope that this conference can contribute to this process.

Facing the future – North Australia's beef industry

John Childs

Program Coordinator – Resource Management, Northern Beef Program, MLA

A matter of numbers

The Northern Beef Industry is made up of many things. It is about people, cattle, dollars, country, machinery, infrastructure and communities.

It starts with how much surplus money people have. Often it is considered that this is the end of the story but in fact it is where it starts. It is one of the reasons people engage in the industry and without it people don't continue in the industry.

How much money is around is influenced by turnoff. The particular market and the ability to meet that market also influence it.

In the North, turnoff is predominantly influenced by how many breeders people have and how efficiently the breeder herd functions. Weaning rates and growth rates influence all this.

Costs are all-important. They are a mark of how effectively people are managing, the nature of the property and the scale and features of the enterprise.

How many stock are carried and the way they are run and moved around influences their performance. Making best use of feed and its quality has an impact on cattle performance. The way in which pasture is utilised also influences its ability to regenerate following rain.

Pasture feed is also fuel for burning. This can be a problem when fire is unwanted. But it can be an advantage when fire is used in a constructive way in weed control, grazing management and rejuvenating country. There is always a consideration of the relative value of pasture as fodder and as fuel.

The health of the landscape is a major concern. This can be assessed in terms of how well the soil, rainfall, plants and animals are functioning together. It is also about how well biodiversity as a whole is working. And it is also how well people's aspirations and needs are being met.

And importantly it is about people, how many of them and their levels of skill and ability.

The next big changes

The Industry has seen many changes.

Initially the early settlers brought in big herds and then gathered and turned off what they could. They relied on natural waters and unfenced grasslands. They alternated between reasonable turnoffs and major drought crashes, always with difficult prices.

This was followed by a period of consolidation and considerable expenditure on infrastructure development. In particular artificial waters made access to greater areas of country possible and considerably changed the consequences of drought. In addition the people of the time learnt about the country they were using; its capabilities and limitations.

The BTEC era had a major impact on the northern industry. With major government and private investment, fencing of country, controlling stock and segregating different components of the herd brought new standards of herd management and productivity. It also brought the opportunity to significantly change the genetic make-up of the northern herd. This also had a major impact on cattle productivity and efficiency and also on cost of production efficiency.

Most recently we have had the advent of live cattle export. This has resulted in a major change in the profitability of the northern industry. A consequence of this is that breeders are more valuable both for themselves and for the calves they rear. An associated change has been a considerable increase in property values. As stock values and profitability increase, so does the value of the land they use.

The next major change is already beginning to happen. It will involve a combination of intensifying the use of natural resources coupled with protecting the value of those resources. Adjusting cattle numbers to best utilise pasture as well as to more evenly use country will involve a major change in infrastructure and management. Cost efficiency per square kilometre will become more significant in addition to cost efficiency per head. It will be essential to continually monitor the condition and health of country in order not to over utilise and damage both the resources and productivity.

This will require significant changes in approaches to risk. As the limits are pushed, the room for error and the buffer against a crash become less. Importantly this will require new skills and knowledge to cope with the demands of more intensive production.

The requirements of society at large will also be more obvious and relevant. Responsibility for caring for natural resources will require additional attention.

The opportunity is tremendous. The future is encouraging. But remember, those circumstances have occurred before. This time we can do it better.

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The Australian livestock export industry – 2000/2001

David Inall

Manager – Industry Services, Livecorp

Industry overview

The Australian livestock export industry again demonstrated its value to Australia's econrcy, and its livestock producers by generating a number of records during the fiscal year 2000/2001.

The total trade (cattle, sheep and goats) contributed $767 million to Australia's agricultural export earnings, an impressive 22% (or $140 million) above last year's value and almost $126 million above the previous record set in 1996/97 before the Asian currency crisis.

Cattle exports to 26 countries set a new record value of $497 million, up 13% on the previous year. Numbers exported were slightly below the record 895,000 shipped in 1996/97 at 858,814.

Global demand for Australia's live goats continued to strengthen with record exports of 87,717 head worth over $4.6 million. The trade continues to provide Australian producers with access to a diversity of overseas markets, significantly increasing demand and consequently, this year, providing record returns for stock.

Cattle

The live cattle trade has shown remarkable resilience given the difficulties experienced in the major markets in South East Asia. Shipments to the Philippines and Indonesia were severely curtailed in the latter six months of the fiscal year by a combination of factors. Beef consumption levels in those markets reacted adversely to the European BSE and FMD crisis, by dropping as much as 80%.

Additionally, political turbulence and currency volatility together with high cattle prices in Australia resulted in a backlog of Australian cattle in the market causing a cut back in cattle shipments. Despite these difficulties Indonesia managed to maintain its position as Australia's major cattle export destination taking 284,483 head, 55,374 more than last fiscal year, representing 33% of total cattle exports.

Exports to the Middle East continued to strengthen with Egypt consolidating its position in the market and becoming the only major market actively importing numbers above those of the same period last year. Rising oil revenues and incomes and bans on competitors, particularly European and African beef and cattle, substantially assisted increased shipments.

The slow down in demand from South East Asia also freed up Australian cattle and shipping for this region. Egypt took 215,278 head or 25% of total cattle exports replacing the Philippines (which took 156,385 head) as our second most important cattle market.

There was also solid growth in other Middle Eastern countries such as Jordan, Israel and Palestine despite ongoing conflicts, and an expansion in the cattle trade to other smaller markets, including Malaysia and Mexico. Considerable effort is underway to develop new and emerging markets such as Thailand, Taiwan, Vietnam, China and Korea.

Forecast

Tight supplies and high livestock prices are likely to act as major constraints on the trade for the foreseeable future. In the short term this will impact on export profitability but should assist in encouraging herd rebuilding to capture the opportunities that exist. The value of the $A remains critical, with any significant appreciation impacting on industry performance.

Intense competition for available young cattle for the slaughter and feeder trade has already driven slaughter cattle prices to record levels. A further factor, which could influence competitiveness, is the anticipated strengthening of competition from South American cattle and beef, particularly into the Middle East and North Africa.

Future issues

Given Australia's traditional cattle markets are volatile by nature, it is inevitable that key destinations will ebb and flow with currency fluctuations, cheaper competitor proteins (pork, chicken and fish) and our domestic cattle prices. For example, the pressure that the Philippines market currently suffers could well ease in the short to medium term, and another key market may come under pressure.

Market access will continue to be a significant issue, with health protocols remaining high on the agenda. Our access into markets can at times suffer difficulties given the trade imbalance of importing countries with Australia. This issue was best highlighted with our trade dispute with the Philippines in 2000.

Dairy cattle demand will continue to rise as Asian, European and South American countries are searching Australia for dairy cattle. Australia's reputation for quality grass-fed dairy cattle is well recognised; however, tight supplies are hampering this growth area.

Tight supplies also of feeder steers for beef cattle will continue to put pressure on the trade, with a double affect being that this also keeps prices at historically firm prices.

Competitor support into some new markets will restrict Australian exports in the short term. This is particularly evident in China with competitors such as the US and Canada offering a significant after sales service package that lifts their products favourably above others.

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Managing resources for improved profitability

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Developing sustainable grazing management systems for the semi-arid tropics in the Northern Territory

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Abstract

Research undertaken in the Victoria River District (VRD) of the Northern Territory has improved our basic understanding of how the grazing lands function and provided some guidelines as to how to better manage them. A number of valuable tools for researchers and land managers have been developed. Key parameters that drive pasture growth have been identified and pasture growth models have been developed for several key pasture communities. It has been shown that woody thickening in the absence of fire will reduce pasture production as a result of increased competition for soil moisture or nutrients. Although many woody communities are adapted to periodic burning, the prescribed use of fire has been demonstrated to have an important role in the management of tree-grass balance and pasture condition. Guidelines concerning its use as part of a management system have been developed. The identification of safe utilisation rates from grazing trials, development of software applications and the use of pasture growth models have contributed to methods for estimating paddock carrying capacity. Factors that determine the distribution of grazing pressure throughout extensive heterogeneous paddock, and means to manage grazing, have been investigated. Despite this progress changing global, industry and market trends require new and innovative research to ensure that productive, healthy grazing lands are maintained.

Introduction

In the early 1990s a number of grazing land management issues were identified which required research throughout the Victoria River District (VRD) of the Northern Territory. A research program was put in place to improve the knowledge of basic grazing land ecology and to encourage the adoption of sustainable grazing management on pastoral properties throughout the Victoria River and Sturt Plateau regions of the Northern Territory.

A number of research activities were undertaken by the Northern Territory Department of Primary Industry and Fisheries (NTDPIF), with additional funding provided by Meat and Livestock Australia (MLA). Research was undertaken to provide information to land managers to assist them in dealing with seasonal variability, fire management, carrying capacity decisions and woody plant management and was carried out in six sub-projects. This paper reports on some of the highlights resulting from this work and makes some suggestions for future research.

Rainfall and seasonal conditions

Seasons throughout the VRD between 1993 and 2001 were characterised by a succession of excellent rainfall years and growing conditions. Rainfall was either very near, or above the top 20% decile in all but one of the last nine years (Figure 1). These conditions stimulated significant improvement in land condition and high levels of animal productivity throughout the district. We are aware that care must be taken with the interpretation of research results collected in such exceptional circumstances, and results should be viewed in this light.

Describing the ecology and seasonal growth of native pasture communities

Prior to the current work limited research had been undertaken on the basic ecology and growth potential of the main native pasture communities throughout the VRD. Using pasture growth models such as GRASP (Littleboy and McKeon 1997), with inputs of daily rainfall and climate data, large seasonal variations in pasture growth between communities and rainfall zones can be predicted more accurately than using rainfall alone. Key growth parameters are generally first identified using a systematic field sampling and model calibration process.

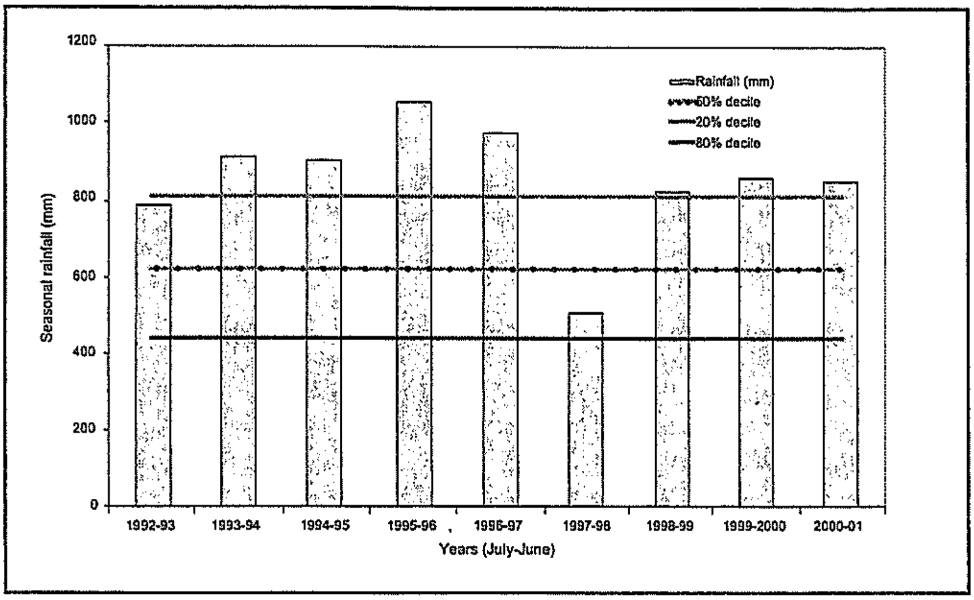

Figure 1. Seasonal rainfall totals (mm) and rainfall deciles at Victoria River Downs station between 1992–93 and 2000–01.

The GRASP pasture growth model was calibrated and validated for 21 sites in the VRD. These sites represented a range of pasture communities, conditions and rainfall zones. This was carried out in cooperation with Queensland Department of Natural Resources (QDNR). From these sites, general growth models and parameter sets were developed for Mitchell grass, arid short grass, ribbon-blue grass, and tropical tall grass. These communities represent significant areas of the VRD. Models representing less dominant pasture states and conditions were also calibrated.

Several key growth parameters were identified in the model calibration process. These include total N uptake, N dilution rate in mature plants, transpiration use efficiency, perennial grass basal area and water use efficiency.

Models developed in the VRD were used in conjunction with long-term rainfall and climate records to investigate the impact of seasonal variability, pasture type and land condition on seasonal growth (Figure 2), stocking rates, carrying capacity and burning opportunities. They provide a valuable resource for researchers and land managers to test and evaluate management scenarios and development options. Output from models is also being incorporated into the MLA funded Grazing Land Management (GLM) education package.

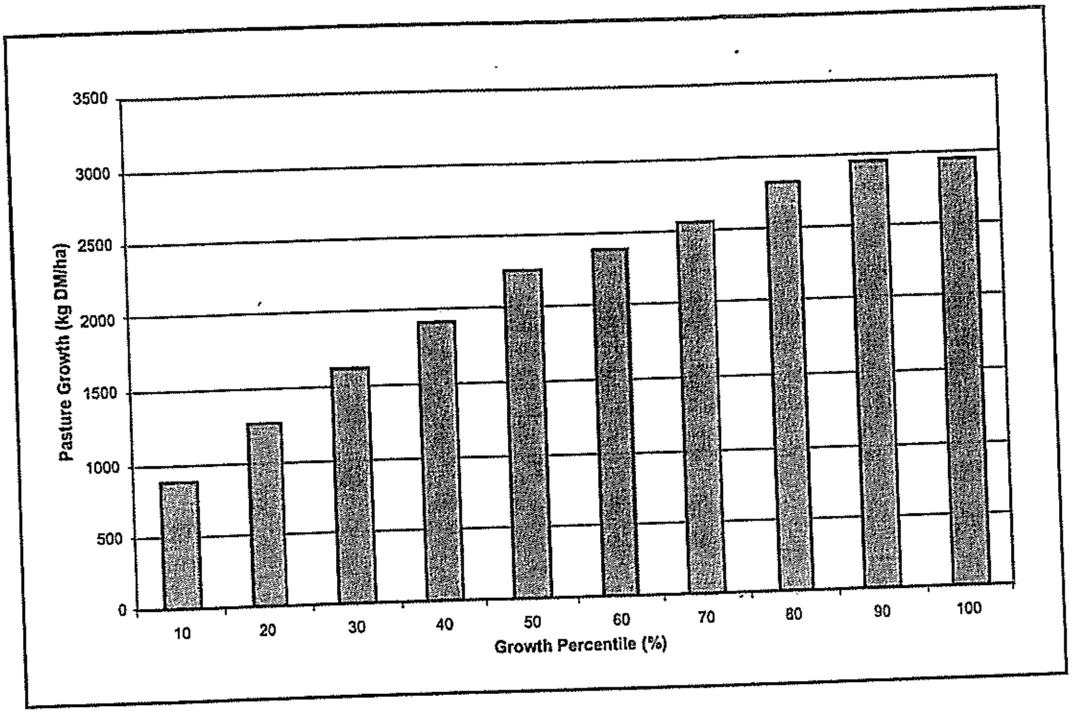

Figure 2. Percentile distribution of modelled pasture growth for ribbon-blue grass pastures on cracking clays at Victoria River Downs Station.

The impact of woody vegetation

Changes to tree-grass balance from woody thickening or tree clearing can influence the competition for soil moisture and nutrients and subsequent pasture production (Mott *et al.* 1985). Quantifying these relationships is essential for predicting the impacts of disturbances such as fire to the tree-grass balance.

Four research sites, with trees left intact or removed, were established to determine the impact of trees (predominantly *Eucalyptus* spp.) on pasture production in two different rainfall zones with strongly summer dominant rainfall. Two sites were located in Katherine (970 mm per year) and two in the VRD at Kidman Springs (690 mm per year). Data from these sites enabled the calibration of tree-effects within the GRASP pasture growth model, which was then used to test a range of tree-grass, climate and management scenarios.

Pasture production, soil moisture and pasture nutrient yield at the four sites was measured over five growing seasons. Cleared plots demonstrated a pattern of significantly higher pasture production, pasture N and pasture basal area that continued over all seasons. Average cleared plot pasture yields were 150% of those in treed plots. Cleared plot average nitrogen yield at peak dry matter was 190% of that in treed plots.

This data has been incorporated into the GRASP model to improve its ability to predict the impact of changing tree densities on pasture production. With a reliable model, historical climate data can be used to study the impact of different management strategies on tree basal area, pasture production and the interactions between the two.

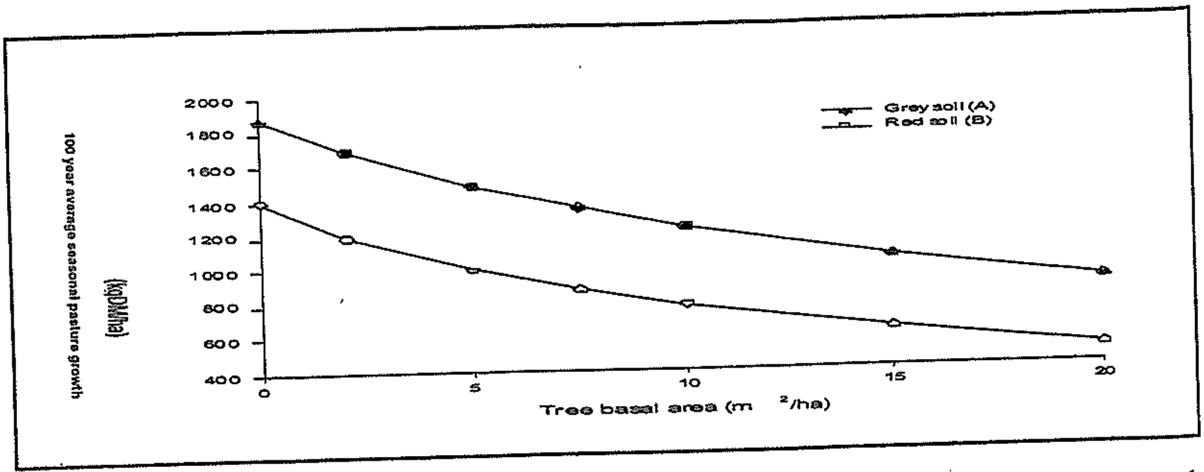

Figure 3.The modelled effect of changing tree basal area on pasture production of a grey soil in good condition and a red soil in poor condition in the VRD.

The competition between trees and pasture is largely for soil moisture and nutrients. Increasing tree basal areas can lead to reduced pasture production and reduced potential carrying capacity. Soils with a higher potential for growth (grey clay soils) are able to support a higher tree basal area before pasture production is compromised than soils with a lower potential (red soils) (Figure 3). Depending upon location the relative competition between moisture and nutrients will vary. In Katherine where soils are poor and rainfall is high and reliable, growth is usually limited by nutrients. At Kidman where soils are variable and rainfall is lower, competition for moisture is often limiting to growth. This can be observed in Figure 4 where the pasture growth deciles show a measure of effective seasonal rainfall. In Katherine there is little change in pasture growth over 90% of years, whereas at Kidman pasture growth declines steadily right from the top 10% of years.

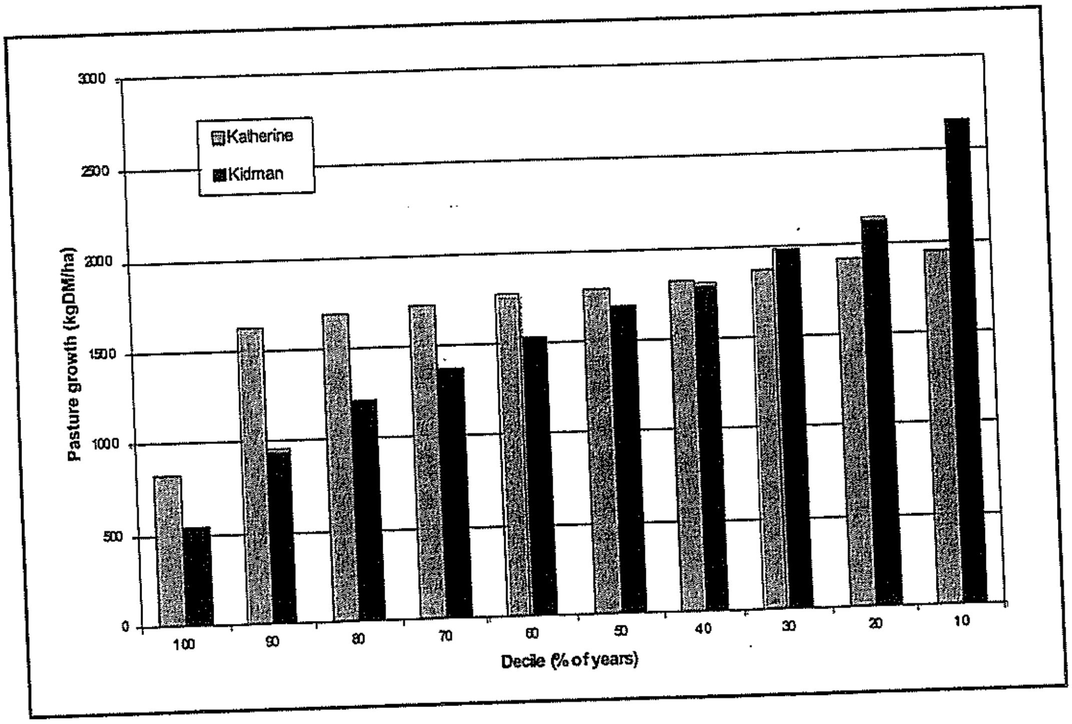

Figure 4. Pasture growth modelled over 100 years for red soil pastures with a 30 cm tree basal area of 10 m²/ha at Katherine and Kidman.

Burning guidelines to manage woody plant and pasture condition

Anecdotal and scientific evidence throughout the VRD suggested that tree and shrub thickening was occurring (Bastin and Andison 1990, R. Fensham *unpublished data*, D. Lewis *unpublished data*). A likely contributing factor was thought to be changes to fire regimes, primarily a reduction in the incidence, extent and intensity of burning, resulting from both direct and indirect impacts of grazing and pastoral land use. A program of long-term fire research was established in late 1993 and continued to the present. This work investigated the impact of fire frequency, fire season, fuel loads and fire intensity on woody plants and pasture condition in arid short grass (ASG) and ribbon blue grass (RBG) communities in the VRD.

Fire and tree-grass balance

Without burning, native woody plant growth/regrowth in both RBG and ASG pasture communities continues rapidly. The decision to burn on ASG pasture is a trade-off between suppressing ever-increasing tree and shrub growth or maintaining pastures in good condition.

Although woody plant mortality following burning is low (0–4%), fire induced top-kill can be used to manipulate canopy cover and plant height in both pasture communities. Top-kill is related to plant height and factors that influence fire intensity. Intense fires have the most impact on plant structure. Once woody plants exceed 2.0–2.5 metres in height they become more difficult to control with fire. Implementing a prescribed burn every 5–6 years will maintain woody plants below this critical height.

Fuel loads of at least 2000 kg DM/ha, fuel cover of at least 60%, as well as appropriate fire weather and fuel curing state are required to cause significant changes to woody plant structure. Grazing pressure on each pasture type needs to be managed prior to burning to ensure suitable fuel conditions.

Fire and pasture condition

Fire in ASG pastures reduced ground cover, biomass and the proportion of perennial grasses. Under low grazing pressure, no further burning and good seasonal conditions, pastures recovered rapidly. Burning should only be carried out in ASG pastures to meet clear management objectives. Fire should be used only when perennial grasses dominate pastures, during periods of above average rainfall and under low-moderate grazing pressure.

RBG pastures were resilient to most burning regimes and grazing. Burning every two years increased the relative proportion of annual grasses and reduced standing yield due to the removal of accumulated litter and increased grazing on more frequently burnt plots. Burning every 4–6 years maintained pasture vigour and composition as well as prevents the accumulation of old pasture generally ignored by grazing animals.

Assessment of stocking rates and carrying capacity for pastoral properties

Stocking rates, safe levels of utilisation and methods for estimating carrying capacity all influence animal productivity, land condition and profitability but were previously poorly defined throughout the VRD.

Stocking rates

To obtain an indication of district stocking rates, stock numbers were collected and stocking rates calculated for 14 pastoral properties located in the southern VRD. Generally stocking rates represented low levels of utilisation in current seasons. Average property stocking rates were 11 AE/km^2 but paddock stocking rates ranged from less than 5 AE/km^2 to over 35 AE/km^2. Approximately 50% of paddock stocking rates were less than 10 AE/km^2 and almost 90% less than 20 AE/km^2. Values of 10 AE/km^2 and 20 AE km^2 represent utilisation rates of

13% and 25% respectively, based on 2000 kg DM/ha of standing biomass in April. These are conservative estimates given the prevailing seasonal conditions.

Carrying capacity and utilisation rates

Preliminary results on Mitchell grass pastures from the Mount Sanford stocking rate demonstration (MacDonald *et al* 1997) indicate that utilisation rates of 20–25% can be supported without adverse impacts on pasture condition or animal productivity. Although these values are consistent with others reported (Hall *et al.* 1998) some caution is required due to the exceptional seasonal conditions occurring throughout the trial. Safe levels of utilisation for less resilient pastures, such as arid short grass, are likely to be considerably less and in the range of 10–15% (A. Ash *personal communication*).

Estimates of utilisation at a range of stocking rates were made using pasture growth models and historical rainfall and climate data for VRD (Figure 5). Based on stocking rates on Mount Sanford station between 1990 and 2000, utilisation rates were very low and averaged around 9%. Although grazing pressure has been uneven, the overall low utilisation rates have provided an opportunity for significant improvement in land condition throughout the station. This has been confirmed by increases in remotely sensed land cover indices (R. Karfs *personal communication*)

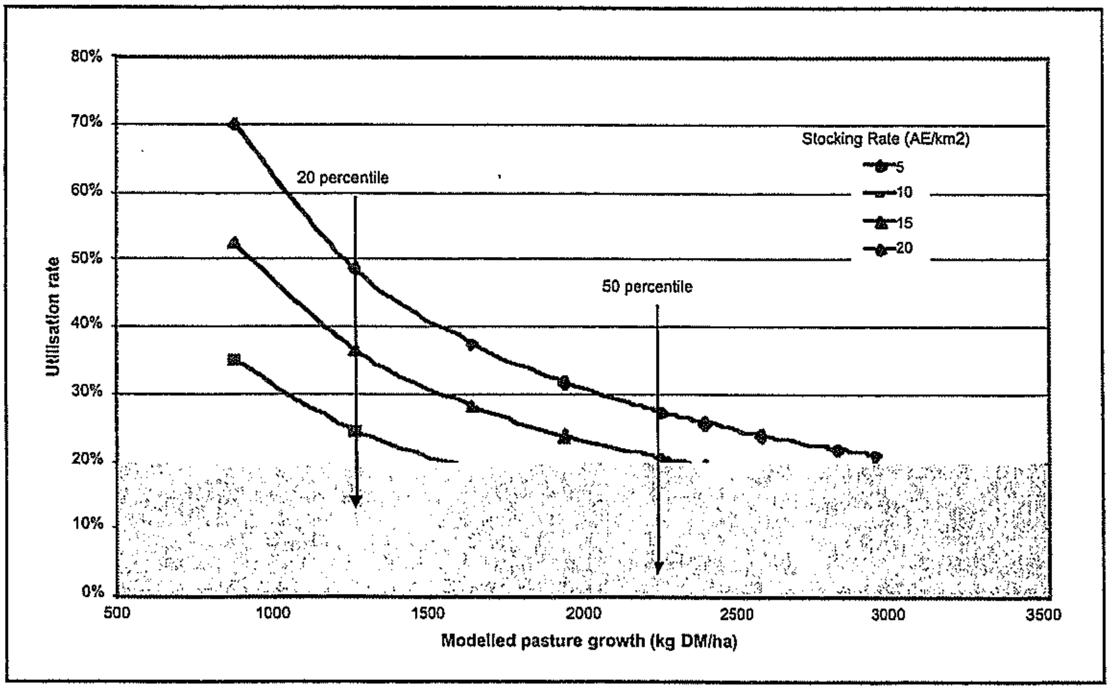

Figure 5. Predicted levels of utilisation from increasing Mitchell grass pasture growth at a range of stocking rates. Stocking rates supporting safe levels of utilisation (20%) for given pasture growth are shown within the shaded area. The 20% and 50% pasture growth percentiles are shown.

Estimating paddock carrying capacity

To assist the process of calculating property stocking rates and estimating safe carrying a stocking rate calculator and mapping application was developed. The package integrates GIS (Arc View; SR Map) and database (Access; SR Calc) and utilises spatial infrastructure and land resource data inputs.

Specifically this application:

1. calculates the area of different land types within existing paddocks;
2. rapidly recalculates the area of land types within new, subdivided or combined paddocks;
3. assigns estimated carrying capacity values to individual land types;
4. calculates the potential paddock carrying capacity based on the carrying capacity and proportion of each land type in the paddock;
5. calculates paddock stocking rates in adult equivalents (AE's) based on livestock classes;
6. compares current stocking rates with estimated carrying capacity values;
7. calculates the area within distance bands to water based on the number and spatial location of water points.

Output from this application can be provided as summary tables or property and paddock maps. The integration of GRASP pasture growth models with this package to account for variability of seasonal pasture production and stocking rates is the next logical step and is being examined.

Managing grazing distribution

Uneven grazing distribution across paddocks has the potential to cause significant land degradation, even at low average paddock stocking pressures. Distance to water, influenced by the number and location of water points is one of the main factors affecting grazing distribution in extensive rangeland paddocks (e.g. Pickup and Bastin 1997). Other factors such as previous grazing history, land condition, preferred pasture type and burning also potentially influences grazing distribution. The distribution of grazing is likely to influence spatial paddock utilisation, areas of overgrazing, land degradation and overall animal productivity within paddocks.

Research was undertaken to provide an insight into the factors that determine the spatial distribution of grazing pressure. Preliminary results from the Mt Sanford Stocking Rate Demonstration (MSSRD) suggest that when utilisation rates are low (less than 25%), and paddocks small, grazing distribution is determined primarily by distance to water, land type (soil and vegetation), and previous grazing.

Strategic burning on a rotational basis was tested to determine if fire could be used to even out grazing pressure across the landscape. Twin paddocks, with and without rotational burning, were assessed for grazing distribution. The introduction of rotational fire to one paddock had the effect of reducing the influence of distance to water on grazing distribution. Results indicate that uneven spatial grazing distribution can be modified by strategically burning less preferred areas. This can lead to more even utilisation throughout diverse paddocks.

Understanding the interaction between fire and grazing, and improving the implementation of fire management strategies at a paddock/landscape scale remain significant challenges that need to be addressed in future work.

Where to from here

A trend towards intensification and development in the northern pastoral industry has been occurring in an effort to meet increasing demands, to reduce the costs of production, increase the efficiency of production and maximise returns. This trend is likely to continue, albeit along with increasing public and industry concerns over both local and global sustainability issues.

One obvious response to pastoral intensification and development is increased utilisation of native pastures. A lack of knowledge and poor management under such systems has the potential to result in widespread land degradation. A priority for future research should be to improve the utilisation of native pastures in a manner to ensure both productive and healthy grazing lands. This incorporates work aimed at identifying acceptable and productive levels of utilisation for different pasture communities, improving the spatial distribution of grazing pressure within paddocks or in areas currently not grazed, and developing reliable means of estimating carrying capacity for different land types. Research should also aim to develop and test stocking strategies to cope with seasonal variability and the use of short-term grazing strategies such as flexible stocking rates, or wet-season spelling, that may deliver improved sustainable pasture utilisation.

As intensification progresses there is a real risk that the use of management tools such as fire will be dismissed, as grass is increasingly utilised as forage. Under such situations increased grazing pressure and reduction in fire would almost certainly lead to irreversible woody thickening, and declining land condition over a relatively short period. Understanding the impacts of fire and its implementation in more intensive systems is therefore a priority.

The need for spatial monitoring systems for use at the paddock, property and regional level is essential in situations where more intensive use of country is occurring. The integration of existing technologies provides an opportunity to develop monitoring and decision-making systems that account for seasonal variability. Such systems also need to recognise and incorporate the latest development in seasonal forecasting. Activities to address these issues should be undertaken in an integrated framework across northern Australia. A combination of on-property research and demonstration, scenarios and trade-off modelling and the development of best practice guidelines would promote sustainable intensification and development of the northern pastoral industry.

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Scrub encroachment of productive grasslands: soil moisture balance

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Introduction

An enormous literature exists on the problems of combating scrub encroachment which replaces productive perennial grasslands that support domestic stock or big game. Up to the present solutions have focused mainly on the use of fire and mechanical and chemical means of eliminating unwanted scrub and/or by reduction of the numbers of grazing animals in the attempts to recover valuable grass pastures. For example, the many papers and their references in the 6th International Rangeland Congress Proceedings (Eldridge and Freudenberger 1999). Few of more recent works (e.g. Burrows 1993; van de Koppel *et al.* 1997) have realised that a key determinant is the edaphic change in soil moisture balance. Unless this balance is restored most efforts to counter the invasion of woody plants (better adapted to the change) will be in vain (Tinley 1982 and in Walter and Breckle 1986: 112–117).

Landscape and habitat dynamics

The focus here is on the productive grasslands that support large herbivores of stock or wildlife in the parallel (ecologically equivalent) seasonal tropical and subtropical zones of Africa and Australia. Included are perennial grasslands on black soil plains, cracking clays, floodplain mosaic soils, and the wooded grasslands (savannas) on duplex, gradational, clayey and sandy soils that are supported by seasonally wet or waterlogged soils and that are threatened with replacement by scrub encroachment.

Soil moisture balance is the amount of moisture required to support and maintain a particular kind of plant community in a state of dynamic equilibrium or balance. Anything that shifts this balance towards drier or wetter conditions sets in train inexorable changes in the plant cover's physiognomy and species make-up as adjustments to the altered edaphic condition develop. Michelmore (1939) and Tinley (1977, 1982) describe parallel examples from across central and southern Africa of the prime importance of terrain and soil profile characteristics on soil moisture balance determining the spatial patterns and types of vegetation across landscapes. That is, that climate, in a vegetation context, is expressed through its translation by the edaphic medium. .

The causative factors responsible for such changes in soil moisture are due primarily to the natural, or intrinsic, landscape surface cut and fill successional processes (at all spatial dimensions from the micro to the macro) that occur under unchanging rainfall regimes, let alone with climatic change (Tinley 1977, 1982, 1991; Cole 1982, 1986). This succession is either a spatial replacement of land surfaces by erosion (sheet and gully) and/or in-situ edaphic change due to increased runoff from bared soil, incised local base levels and headward migration of nickpoints, or a combination of these.

The converse examples of intensified waterlogging include removal of woodland and their evapotranspiring pump action, or blockages in drainage from deposition or damming (e.g. Tinley 1982, Burrows 1993). Superimposed factors that obviously alter soil moisture balance include baring of the ground from overgrazing, lack or excess of burning grassland and savanna, stock and wildlife pads, human footpaths, tracks and roads, draining of wetlands or damming drainage. All of these can act as initial causes of edaphic change as well as accelerator factors that sharply increase the velocity, intensity, and dimension at which landscapes become modified.

Earlier studies from south-west Africa (Namibia – Kalahari), biome equivalent to the Australian arid zone (< 600 mm isohyet), found that due to their contrasting root systems and physiology woody and grass strata have different water economies and hence occur together in a moisture tension state (Walter and Vlok 1954, Walter 1964, 1973). Savannas both of the arid and moist biomes thus occur as antagonistic strata, exacerbated by the fire factor, in what Walter calls a 'labile equilibrium' (Walter 1973). Anything that disturbs or changes the soil moisture balance results in a change of predominance between the woody and herbaceous layers and also in their species composition.

Grasses use only the topsoil and upper subsoil horizons, it is thus only under grassland that a high field capacity can be attained and maintained. Woody plants with their deeper reaching root systems 'pump' the soil profile dry. Conditions required to maintain the pure grassland habitat, i.e. seasonally high soil moisture balance, actually preclude woody seedlings. These are killed by excessive soil moisture in the wet season and again in the dry when the soils dry out developing fissures or the subsoils become indurated. This and the processes noted here answer the key questions posed by Brown *et al.* (1993).

Any factor that decreases the high or adequate soil moisture condition such as baring of the soils and increased runoff along paths or other incisions results in inadequate waterlogging to maintain the grassland and keep woody plants at bay. Of all the insidious factors at play the easily overlooked key factor is the development of a gutter or gully incision, initially often hidden by the grass cover. The incision nickpoints migrate headwards and literally 'pull the plug' out of the system so that it loses rain or floodwater down the drain and thus initiates and drives the change of an entire ecosystem (Figure 1).

On any slight, now drier, convexities in the grassland terrain such as the faint levee edges of the drain or gully, on the fan outwash of the gullies, on the microridges of gilgai, or micropediment of a termite mound, woody seedlings are able to become established. Typical examples are camelthorn (*Acacia farnesiana*), gutta percha (*Excoecaria parvifolia*), bauhenia (*Lysiphyllum cunninghamii*) and *Acacia nilotica*, (called prickly acacia in Queensland, and scented-pod acacia in Africa).

The typical give-away growth pattern exhibited by scrub encroachment is the different size/age cohorts, oldest and tallest on the first drying surfaces and youngest and smallest groups reaching out from each convexity as the flats and faint depressions become increasingly drier. Once established, exceptional flooding rarely kills mature scrub as the ebb is faster due to either increasing size of the 'plug hole(s)' and/or the woody plants pumping the soils free of excessive waterlogging. With further spread and maturation the woody plants occlude what was once an 'island' of treeless grasslands, homogenising the vegetation structure across the landscape to a savanna system (Figure 1).

Without blocking off the incision(s) that breach and overdrain planar or faintly convex terrain effective waterlogging of the perennial grasslands is lost and all other means of combating scrub encroachment are eventually in vain (e.g. Radford *et al.* 1999, 2000). In my experience merely blocking off the drains and restoring effective waterlogging is often sufficient to kill the scrub. However this leaves a habitat full of dead trees and scrub so that clearing is still a requisite to restore the pure grassland habitat.

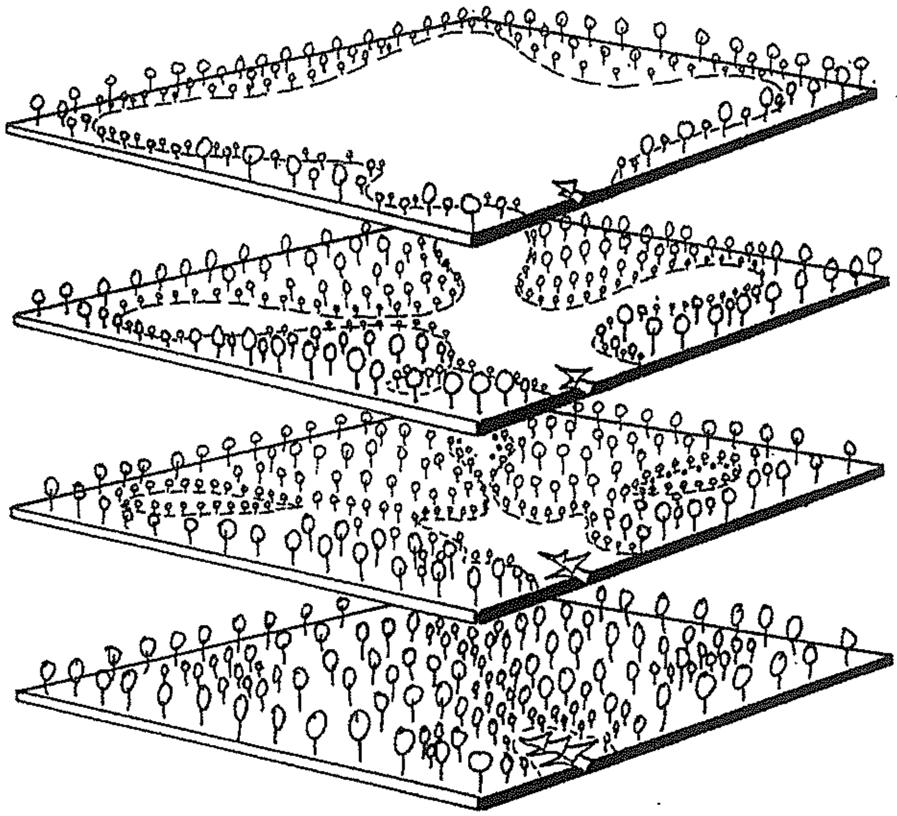

Figure 1. Ecosystem occlusion from gully incision.

The sequential replacement of duplex, black soil, cracking clay or floodplain grasslands by invasion of woody components from the margins as these surfaces dry out progressively from the canalising effect imposed when the sill responsible for their existence is breached by a nickpoint of any dimension.

As these grasslands can be reinstated by the simple expedient of re-blocking the original sill site, the diagram can be read in two directions showing the progressive die-off of woody components as the high watertable condition is restored (from Tinley 1977).

In landscape ecology the key geomorphic process is the development of an incision nickpoint which migrates headwards and by 'pulling the plug out of the system' alone alters the soil moisture balance of landscapes at all scales. These incisions also provide the outlet for rampant expansion of topsoil stripping by sheet and rill wash. Hence the presence of nickpoints are predictors of potential habitat change towards woody vegetation dominance.

Depressions of all kinds that flood and gradually dry out providing a green margin as the water ebbs are key drought buffering habitats. These are lost and replaced by woody plants where the ponding convexities responsible for their formation are breached by headward erosion of rills or gullies. While there is a focus on climatic change and over-extraction being the greatest threats to wetlands (Roshier *et al.* 2001), the primary threat is the breaching of the sill responsible for a wetlands existence. Unless 're-plugged' wetlands become extinct and are replaced by dryland systems. As important is to ensure the wetland's catchment is not bared and the depression silted or sanded up. The outline imprints of one time wetlands and treeless grassland areas now invaded by scrub or woodland are readily identifiable when viewed from the air or from aerial photograph stereo-pairs. Most proficient is the comparison of earliest available and most recent airphotos of the same areas (e.g. Tinley 1982, Figure 3).

Management

Some of the simple and effective landscape restoring and water management techniques include the following:

1. Gully heads are most effectively stabilised and blocked off by transplanting a spade-square-cut of coarse robust grass below the lip of the gully head and protected by a tight wad of brushwood. Effective grasses include reeds (*Phragmites* spp.) in the Top End, the umbrella cane-grass (*Leptochloa digitata*) and lemon-grasses (*Cymbopogon* spp.) in the arid rangelands. Where multiple gully heads occur belts of packed brushwood at right angles to the flow should be laid both above and below across the erosion cuts.
2. Where larger or wider sills need to be constructed soil should be pushed up from the downslope side and overflow spillways established with live filterbeds of reeds for example. Care must be taken not to overcorrect as too large a blockage will cause rainwater to pond for too long either damaging preferred pasture grasses or encouraging wetland plants.
3. Sheet eroded and scalded areas in the arid rangelands are known to remain bare for decades, yet the simple expedient, as noted by Ludwig *et al.* (1997), of laying brushwood parallel to the contour, particularly at bottleneck sites between island remnants of the original surface, results in the entrapment of silt, litter, seeds and moisture. Solid barriers such as gabions or soil ridges become undermined, breached or bypassed by overland flow. Sieve or net-like obstacles (e.g. rolls of ringlock when brush is not available) are far more effective and they help establish living plant impediments to sheet wash thus slowing its erosive power and directing moisture into the subsoil.

Summary

Landscape processes, both natural and those superimposed by human actions, change soil moisture balance, initiating and entraining land surface and vegetation successional changes. Though erosion changes over the long term are inexorable they are slowed down by the occurrence of rock bars, alluvial plugs, highly cohesive clays and dense plant cover. By reinstating the plugs or sills at key points in the landscape it is possible to prolong the survival and productivity of perennial productive grasslands and of wetlands that are the drought buffering habitats. Improved profitability thus needs perceptive management responses that include simple and subtle water harvesting and spreading, retention or drainage techniques (i.e. the role of water management in a particular terrain setting). In management for ecologically sustainable productivity it is not enough to manipulate vegetation and fauna alone. This approach forever misses the point – the nickpoint – which is a primary causal and orchestrating process in landscape change.

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An Environmental Management System (EMS) Pilot for the Beef Industry

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Summary

In cooperation with interested beef producers in southern and northern parts of Australia, Meat and Livestock Australia (MLA) has initiated a project asking beef producers to develop a workable Environmental Management System (EMS).

Since commencing in late 2000, four pilot groups from different parts of Australia are developing a system that will have international and Australian credibility with other beef producers, the wider community, and our markets.

What is an EMS?

An EMS is all about managing the impacts that our business has on the environment. It is a documented process, which can be audited by an outside independent auditor (if the producer chooses), which allows a commitment on the part of the land manager to continuous improvement towards best practice for the property in combination with his particular enterprise.

An EMS is a self-paced program, which provides direction and the process, and not specific environmental standards. The use of an EMS is voluntary and flexible, and insists on the gradual and continuous improvement of the environment.

About the groups

The four groups participating in the pilot scheme are from Gippsland in Victoria, the western Darling Downs of Queensland, the central mid-west of Queensland and the North Australian Pastoral Company.

The Gippsland group is made up of cattle producers reliant on winter rainfall with intensively developed and managed farms. The Darling Downs group is small with only four producers. This area is currently severely drought stricken. These properties run beef and grow some forage crop during the summer and winter.

The central western Queensland group is comprised of a mix of country types and enterprises. The participating properties include country in the north and east, which is in the Desert Uplands biogeographic region, and country in the south that is largely Mitchell grass downs. There are goat and sheep enterprises as well as cattle; one property operates organically.

The North Australian Pastoral Company has 11 properties in Queensland and the Northern Territory, and a feedlot in south-east Queensland.

Key objectives of the pilot scheme

With valuable assistance from NSW Agriculture and the Grains Research and Development Corporation, the pilot groups are firstly adapting a grains EMS generic model to make it relevant to their own situations. Each group will then produce their own generic model that will form the basis of an EMS for each individual group member.

The diversity of the groups will lead to somewhat different models, which is what MLA wants. The beef EMS models will be based on the ISO 14001 standard, as this standard is recognised worldwide by 170 countries.

At least five members within each group hope to attain ISO 14001 certification by June 2002. The EMS is being developed on a triple bottom line basis, will be promoted to the wider beef industry, and key elements will be documented so that they might contribute to a Code of Practice for environmental management for the beef industry. The aim is to establish an EMS template that will be available to all producers.

Why an EMS?

A number of factors point to the need to explore not only ways of better managing natural resources in Australia, but, at the same time, proving that they are being well managed. Carruthers (1999) notes in an international conference paper, that rural producers form approximately 2% of Australia's population yet they control approximately 75% of total land resources in Australia.

Producers are increasingly under considerable scrutiny from an increasingly environmentally aware community, not only locally but also from overseas. Australia markets itself as 'clean and green'. What proof is there that this is really happening? The adoption of an EMS, especially if audited by an outside independent auditor, provides real and transparent proof.

The need for a system that enables beef producers to document and defend their image, both at home and abroad, as clean and green, will increasingly become an element in defusing both real and opportunistic criticism of our environmental performance. An EMS will also help maintain or increase our markets in the future.

Potential benefits for producers, industry, wider community, and environment

- It clearly demonstrates a responsible 'Duty of Care' on the part of land managers towards the environment.
- It allows for a real demonstration of Duty of Care on the part of the wider community. Every consumer of food and fibre has an effect on the environment. Some 99% of all food is produced from the land. An EMS is one way the door can be opened for all consumers, both in Australia and overseas to demonstrate their Duty of Care through the direct payment of incentives or compensation, greater market access and premium prices for those products from audited enterprises.
- It would lead to much greater environmental awareness and knowledge, through sharing ideas and findings between neighbours, through monitoring, recording, and analysing the data collected. The more land managers are involved in environmental management the more aware they will become; the more they will observe and learn.
- As information filters through, the wider community will become more informed and more involved in natural resource management.
- It allows the adoption of a responsible, proactive and local approach to natural resource management, which is self-regulating by the grass-root producers for on-ground outcomes.
- It is a bottom-up approach, not the other way around as so often happens at present.
- Sharing will occur not only between land managers, but as holes in our knowledge emerge, there will be a need for research from scientists, government, agencies, universities, for answers.

- An EMS allows for a holistic approach with flexibility. It should allow land managers to tackle the most pressing problems on the property, and to seek out the most suitable solution for particular land types and regions. One size doesn't fit all. What is suitable environmental management for parts of Victoria might be most unsuitable for parts of north Queensland or the Kimberley.

Aims of individual groups

- To try to set the system up to serve the property manager, to help not hinder. We are aiming to make it as user friendly as possible, to keep it simple and realistic, focusing on the core issues.
- An EMS should integrate with other quality assurance systems such as Cattlecare, Organics, and European Union market requirements.
- An EMS should observe legislative requirements such as tree clearing legislation, and such management needs as Workplace Health and Safety and animal welfare guidelines.
- An attempt is being made to cover not only environmental management, but people and economic management as well. People have been part of the Australian landscape and have had a huge impact on it for thousands of years. It's no good creating a healthy environment and going broke in the process. We see sound financial management as an integral part of good environmental management. Poverty is a major cause of degradation worldwide.

Results so far

- The initial environmental review, the self-assessment guide, which is part of the early planning phase, is very time consuming but extremely informative.
- Groups are fortunate enough to be assisted by the grains template. However the beef EMS is ground breaking for the industry and requires a lot of time input from each group.
- Early negotiations with ISO 14001 auditors have revealed the cost of certification and auditing to be higher than expected and may be prohibitive for smaller enterprises. There is, however, scope to form clusters and reduce costs that way.
- There are currently no marketing or other financial benefits for being certified, though we are working on it!

The pilot project is aware of other work in this area and is communicating with these other projects, including:

- Australian Landcare Management System being developed by Jock Douglas and Tony Gleeson.
- Proposed framework for the Development of EMS in Agriculture by Agriculture, Forestry and Fisheries Australia.
- Designing EMS for Agriculture by CSIRO.
- Rangelands Accreditation by Agriculture Western Australia.

Conclusion

By the end of the pilot scheme MLA hopes to have a clear understanding of the merits, drawbacks, and prospects for an EMS based on ISO 14001 guidelines.

To be widely accepted an EMS must meet some basic and realistic producer standards, which include:

- In addition to environmental benefits, there must be tangible financial benefits, which may be in the form of a market premium for their product, access to a restricted market and/or a government or private enterprise incentive.
- A simple to manage system that does not involve an excessive workload.
- A minimal cost to reach and maintain certification.

Acknowledgments

The theme on which this paper is based was prepared initially as a project proposal by Mark Ritchie the former environmental officer for the Northern Australia Pastoral Company in association with a preliminary project steering committee. The author wishes to acknowledge input from each of the four pilot groups, and from Steve Banney, the project coordinator for MLA.

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Notes

The application of satellite-based information products in rangeland management

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Introduction

In Australia there has been long tradition of rangeland research and monitoring with operational systems in place since the early 1980s (e.g. Holm 1984). However it is now recognised that detecting changes in the broad landscape and determining the cause of such change can not be reliably and objectively determined by using ground-based monitoring systems alone (e.g. Holm 2000).

Fortunately, the availability of ground sensing satellite data such as from the Landsat series of satellites has provided a mechanism to view landscapes and detect change in a regular and consistent manner. An added advantage of using this satellite data is that one can look as far back as the early 1980s to appreciate how landscapes change in response to seasons and management regimes. By combining the extrapolative capacity of satellite data with the detailed information of landscape processes gained at monitoring sites, confidence to separate seasonal influences from anthropogenic impacts has increased.

The focus of this paper is on the tropical savannas of the Northern Territory where variable yet reliable annual rainfall occurs. Since satellite monitoring techniques have only recently been applied in this region during the 1990s, the challenge has been to integrate methods that have been conceptualised and tested mostly in arid environments.

The challenge now is to: refine monitoring methods over a wide range of environments; ensure adequate levels of ground data are collected and analysed for calibration of remote interpretations; adopt new technology as it becomes available; and importantly, inform stakeholders as to the capability and limitations of monitoring systems and their role in assisting decision making with regard to sustainable enterprises.

This paper briefly describes data requirements of rangeland monitoring systems and satellite information products currently being produced and their application for rangeland management.

Methods

Land resource inventory

For rangeland monitoring, the importance of land resource inventory and stratifying the landscape into 'like' land types has long been recognised. Land attributes such as lithology, terrain, soils and vegetation type need to be considered prior to any data interpretation. But in many areas this information is not available or mapped at coarse scales. This becomes most relevant when detail is required over an area (e.g. a watering point) or a single paddock. Hence one limitation of satellite monitoring systems is not knowing the nature of a landscape which is being analysed. Local knowledge and field inspections therefore become critical for improving interpretations from satellite data.

Infrastructure data

The location of fencing, tracks and watering points is needed for recognising grazing patterns (i.e. bare ground) from satellite data. Perceived grazing responses away from these features can normally be discounted and attributed to heterogeneous land surfaces or fire.

However, grazing due to seasonal waters persisting away from watering points or stock attracted to preferred pastures (particularly after being burnt) are other possible scenarios.

Historical satellite data

The degree of contrast between vegetative cover and the land surface determines the ability to detect land cover change using satellite sensors. As indicated above inherent landscape heterogeneity complicates this task. Because of the complexity interpreting the cover response from single image dates, multiple historical dates are used. In essence interpreting the vegetation response of precisely the same area over a period of a decade or more provides key information of change and probable condition.

Monitoring site data

While experience in Australia has indicated that it is difficult or impossible to identify land in similar condition and historical response based on extrapolation from ground sites, site measurements are required for understanding ecological processes. Landscape function of Ludwig *et al.* (1997) is the preferred ecological model for interpreting condition in rangelands from satellite data. Over the long term, functional sites comprised mostly of perennial plants are likely to recover quickly from the impact of grazing and fire, maintaining a more consistent cover through variable seasonal conditions. Whereas sites considered partially dysfunctional comprised mostly of annual plants may take longer to recover leaving more of the soil surface exposed in dry conditions (e.g. drought) and change dramatically in response to rainfall (Pickup *et al.* 1998). Since emphasis in landscape function is not on a complete inventory of species, the coupling of this ecological model is better suited to satellite monitoring than traditional range condition assessment as identification of species is generally beyond sensor capability.

Ancillary data

Discussion with land managers is important to rangeland researchers not only for selecting locations of monitoring sites and identifying causal factors that explain current land condition, but also to appreciate issues facing pastoral enterprises and understanding the attitudes of pastoralists in a region. Other sources of ancillary data including archived pastoral reports, photographs and bore hole records provide information on the establishment of infrastructure and offer anecdotal evidence of where concentrations of stock may have occurred.

In most cases land managers are the only ones that possess information about the type of wet season just passed, movement of stock, property access and occurrence of fire. Consequently they are in the best position to value add to satellite information products and use this intelligence for management decisions.

Results and discussion

Information products for rangeland management based on temporal satellite data have been previously described by Bastin *et al.* (1996); Chewings *et al.* 1998 using the Grazing Gradient method (GG) and for Landscape Cover Change Analysis (LCCA) by Wallace and Thomas (1999); Peel and Karfs (2000). GG uses an implicit model using the distance from water as a surrogate for grazing impact. The response detected from Landsat imagery after a significant rainfall event is compared to an image from a dry period to assess whether cover levels next to water have been restored. The LCCA approach is less prescriptive. Sequences of image dates are combined into a data set and the behaviour of cover change interpreted over time using statistical summaries. LCCA relies heavily on ground observations to refine the remote interpretations.

Both GG and LCCA use the same consistently processed temporal Landsat data to detect changes in the broad landscape. In the tropical savannas of the NT, satellite coverage and associated data sets have been established using GG for the Barkly Tablelands (130,000 km^2) and LCCA for the Victoria River District (125,000 km^2) and the Sturt Plateau (25,000 km^2). Descriptions of common satellite information products summarised in Table 1 are presented below.

Table 1. Summary of common satellite information products

Product	Method	Scale A = area; S = sub-paddock; P = paddock; R = region	Map	Graphic plot
1. Grazing Gradient	GG	S P R		X
2. Time Trace	LCCA	A S P R		X
3. Vegetation Resilience	GG	A S P R	X	
4. Trend Summary	LCCA	A S P R	X	

1. Grazing gradient

Grazing gradients from individual waters can be examined to assess utilisation by stock in comparison with other waters in a paddock. Plots representing the average response over a whole paddock allow comparison with other paddocks and identifying those having a greater potential to recover from grazing following rainfall. Regional assessments indicate land types containing a high proportion of palatable forage and those most affected by grazing.

2. Time trace

Graphical plots of satellite response through time of monitoring sites or specific areas allow comparison of long-term landscape change. Dissimilarity between time traces of good and poor condition landscapes can be used to understand differences in perennial and annual pastures and interpreting causes which result in these conditions. At the paddock scale, comparing paddock histories with knowledge of past management practice can lead to an evaluation of the effect of management over time. Regional products help assess seasonal differences for evaluating management within the context of prevailing conditions.

3. Vegetation resilience

Vegetation resilience maps are used for assessing the response of vegetation cover to rainfall on a spatial basis for determining whether it is above or below what might be expected given little or no grazing impact. Below-expected response can indicate areas with reduced pasture productivity. Above-expected response indicates a resilient landscape which may be in good condition, recovers well from removal of plant matter by grazing and is likely to be productive. Since vegetation resilience maps are a spatial product, the location and extents of land in different condition may be calculated.

4. Trend summary

Trend summary maps indicate the landscape response relative to the regional average and trend. The response over time is interpreted to infer condition with combinations of above average response and positive trend indicating perennial cover. Prolonged below average response and negative trend is indicative of annual cover. At regional scales detailed information of a site or area becomes less significant.

Implications for land management

Satellite monitoring information products can be a powerful tool for land management. Through synoptic and retrospective coverage of pastoral enterprises, areas may be identified that call for management that encourages pasture regeneration (e.g. of perennial species) or conversely that optimises productivity (e.g. piping water to lightly grazed country). But ultimately land managers must weigh up many options and their consequence.

It must be stressed here that satellite monitoring information ... Simply put, there is no easy push button solution for understanding all the land types and seasonal variations that occur in rangelands. Landscape processes are complex and correct interpretation of condition and cause and effect requires work and ongoing refinements. What is certain is that progress has been made in devising and implementing satellite monitoring systems that are scientifically sound with very encouraging results returned on some pastorally productive land types in many different regions. To further this progress, partnerships must be formed between those who directly observe landscape change over time (i.e. land managers) and those who produce information products based on sound science (i.e. researchers). Without this cooperation it will be difficult to maximise the real benefit of monitoring systems enabling the pursuit of economic opportunity whilst satisfying government policy to ensure ongoing sustainable use for future generations.

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Heytesbury Beef's views on more intensive cattle management for the future – opportunities and challenges

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Heytesbury Beef runs 190,000 head of cattle over 33,000 square kilometres in the Northern Territory and Kimberley. Since entering the industry in 1989 it has made significant gains in both animal productivity and range condition through the introduction of improved management and a conservative stocking policy. This has flowed through to an improved profitability.

Although gains have been made, Heytesbury Beef (and the rest of the pastoral industry) faces ongoing challenges. These include:

1. **Cost price squeeze:** Like any commodity industry the pastoral industry is facing declining terms of trade. Although prices are at an all time high the cost of running a pastoral business are also at an all time high. The impact of the cost price squeeze will only be combated by continued innovation and change.
2. **Environmental sustainability:** The native pasture resource is the basis of the pastoral industry and its future is dependent on maintaining it in the best condition possible. The current conservative stocking rate used by Heytesbury results in an overall low level of pasture utilisation (8%–10%), however this system is not considered environmentally sustainable because of the large number of cattle concentrated on each watering point. This creates significant grazing gradients with the areas near the waters being heavily utilised. Future grazing systems will need to increase the proportion of pasture utilised while maintaining the pasture base in the best possible condition and will require some system of intensification. Such intensification may also impact on conservation and biodiversity and this must be considered as part of any future grazing system development.
3. **Social sustainability:** A viable pastoral industry in the future will be dependent on a viable community working in the industry. The ability to attract and hold good people in the industry will be greatly influenced by the productivity of the business and the quality of the environment in which it is operating and only businesses with a focus on long term sustainability will be able to achieve this.

Heytesbury Beef is focused on developing strategies to address these issues. Given the large number of variables that interact to determine the performance of a pastoral business, modelling is the best approach to identify the key opportunities that will help address the challenges listed above. A sensitivity analysis of all key production and economic variables has been undertaken using the Heytesbury model. Each variable was examined over what was considered a realistic range. The results of this analysis indicates the three most critical factors driving the profitability of the Heytesbury pastoral businesses and that management have the ability to influence are:

- Stocking rate.
- Cost structures.
- Animal productivity (branding percentage and weight gain).

Opportunities and challenges

1. Increase stocking rates

Economic modelling and anecdotal evidence suggests increasing the stocking rate will have a significant positive impact on the profitability of a pastoral business. But is this a sustainable increase in productivity?

A widely accepted principle for stocking rates, is 'as stocking rate increase the individual animal production declines' and there is some optimum stocking rate between the optimum production per animal and the optimum production per hectare (see solid lines in Figure 1). This principle suggests there is an animal production penalty from increasing the stocking rate.

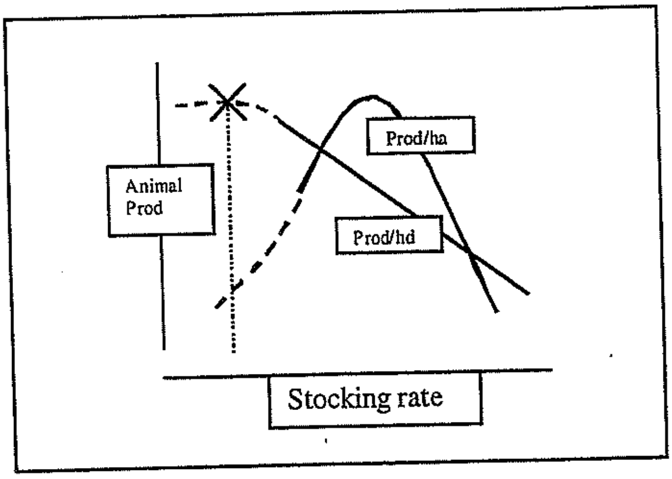

Figure 1. The general relationship between stocking rate and animal production.

Data collected by the DPI&F at their experimental site on Mt Sanford on black soil pastures, suggests that there may not always be an animal production penalty to increasing stocking rates. These data show no significant change in animal production with increasing stocking rates from 10 to 21 DCUs/km^2 and levels of pasture utilisation from 11 to 20% (McDonald *et al.* 2001). This may suggest that the current levels of pasture utilisation are relatively conservative and that the stocking rate can be increased further before animal production declines (see dotted lines in Figure 1). This is a very exciting opportunity as the average commercial stocking rate implement by Heytesbury Beef on this pasture type is 8 DCUs/km^2.

Obviously these results can not be directly related to commercial paddocks. The key difference between these smaller experimental paddocks (4–8 km^2) and the larger commercial paddocks (70–150 km^2) is the uniformity of grazing that is achieved in the smaller paddocks due to the water distribution and fence location. Therefore to implement higher stocking rates more intensive water development and infrastructure development needs to be implemented. The key questions that require further research are:

- Can uniform grazing be achieved in commercial sized paddocks and in paddocks with multiple watering points?
- What is the optimum level of pasture utilisation for the dominant pasture types (i.e. 20–30%)?
- What levels of utilisation cause pasture degradation?
- What is the optimum water distribution (grazing radius) and paddock size to minimise the piophere effect?
- What strategies can be implemented to minimise patch grazing?

Risk management

The implementation of higher levels of pasture utilisation significantly increases the risk of pasture degradation. Monitoring and risk management tools are required to manage this risk. There are few practical monitoring tools that provide annual spatial and temporal data of pasture condition or pasture condition trend. Most of the existing monitoring systems are point based systems that provide very little annual data on the spatial variation in pasture utilisation and pasture condition trend. These monitoring systems are more focused on providing longer term gross changes in paddock pasture condition.

Satellite based monitoring systems such as the Landsat based system developed by Bob Karfs (Lands Planning and Environment) appear to hold the most promise as a base for a practical producer focused monitoring system. If more intensive pasture management systems are introduced, further research is required to develop a practical monitoring system that provides annual spatial data on a paddock basis.

Impact of conservation and biodiversity

The key requirement to achieve higher levels of pasture utilisation on a commercial scale is to achieve a more uniform grazing distribution. The current grazing system with limited waters and fences has resulted in a pasture community, with sites with 100% pasture utilisation by the cattle at the watering points and sites with 0% pasture utilisation on sites remote from watering points. This heterogeneity has provided environments for species that prefer heavily grazed habitats and species that prefer lightly grazed habitats. Imposing a system where the pastures are more uniformly utilised will remove the lightly grazed habitats and may have a negative impact on the biodiversity (Fisher *et al.* 1999).

Practical and realistic strategies are required that allow biodiversity and conservation objectives to be integrated into the whole station management system without having a significant negative impact on the profitability of the business.

2. Cost structure

One of the major factors that drives the profitability of a pastoral business is the cost of production (cost/kg beef produced) or the efficiency of a business. To reduce the cost of production either costs have to be reduced or the productivity increased. It is well recognised that mastering this balance is the key to developing a profitable pastoral business.

In a pastoral business a relatively few items account for the majority of the costs of the business (the 80:20 rule). The biggest single cost is labour, which is generally between 40 and 50% of the total annual operating costs. The majority of this labour is employed in the stock camp. Other significant items are fuel, aerial mustering and supplementation. Strategies that reduce these key costs without decreasing the herd productivity have a significant positive effect on the cost of production.

Intensive paddock development will result in more bores, more fences and more cattle. Strategies are required that maintain or reduce the operating cost per head and the cost of production. Any new technology that increases the efficiency of the business needs to be investigated. Potential examples include:

- UHF bore monitoring equipment to increase the efficiency of the boreman;
- more efficient paddock complex designs, that reduce the labour requirements;
- pneumatic drafting systems in yards to reduce the labour required to draft;
- rationalisation of yard placement to reduce the walking to yards;
- laneways to reduce the cost of droving mobs of cattle.

The integration of these and other technologies into a commercial management package will require a significant amount of effort, planning and research.

3. More intensive herd management

Increasing the herd productivity will also impact the cost of production of the business. The development of smaller paddocks and smaller mob sizes provides an opportunity for more intensive cattle management. The implications of more intensive cattle management practices need to be carefully considered in the whole station perspective to ensure the strategies are practical, targeted to the high impact areas and reduce the cost of production. Examples of some of the factors driving the productivity and efficiency of the pastoral businesses are:

- *The timing of conception.* This impacts the subsequent fertility of the breeders, the weight gain of the progeny, the timing of mustering, requirement for supplementation and the timing and weight of the sale stock.
- *Strategic management.* The ability to strategically manage smaller groups of animals (e.g. supplementation, weaning and vaccination) will significantly reduce the operating costs of the businesses.
- *Genetic improvement.* Smaller paddocks will allow the segregation of animals with different genetic potential, providing the opportunities for significant genetic progression through selection, crossbreeding and strategic culling.

Summary

There are significant opportunities to increase the profitability and efficiency of the northern pastoral industry through improvements in average stocking rates, reduction in operating costs and more intensive cattle management. The realisation of these opportunities will require additional knowledge and technology. Traditional research approaches while providing information on specific components of the system will not provide information on the whole system. This can only be achieved through a systems approach where all the components can be measured/monitored within a total management framework. Heytesbury Beef aims to develop a more sustainable pastoral management system by carrying out an integrated research and development program within a 'Whole Station' framework. It is proposed that this project will be a cooperative project between Heytesbury Beef, MLA, TSCRC, DPI&F, LP&E and the CSIRO. This project is currently past the conceptual stage and well into the planning stage. Heytesbury Beef will be using Pigeon Hole station (1900 km^2 and 20,000 DCUs) as the 'whole station' on which to carry out the project.

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ECOGRAZE: Developing guidelines to better manage grazing country

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Introduction

Tropical tallgrass rangelands occur across northern Australia from the Kimberley region of Western Australia to the central coast of Queensland. Open eucalypt woodlands with a herbaceous understorey of perennial tussock grasses dominate the vegetation. A highly variable climate means that forage supply varies greatly from year to year and this coupled with relatively infertile soils creates an environment where perennial grasses, the key component of production and landscape health, are susceptible to over utilisation. The only practical management options available to producers to manage perennial grasses are grazing, spelling and fire. With this in mind Meat and Livestock Australia initiated the ECOGRAZE project in 1992 to improve our understanding of the effects of grazing, spelling, fire and climate on the condition and productivity of open eucalypt woodlands in north-eastern Queensland.

Importance of perennial grasses in maintaining land condition

Maintaining land in good condition is essential for a reliable forage supply and for the long-term well-being of grazing enterprises. Perennial grasses are the key to maintaining land in good condition. Changes in land condition in grazing lands can include both gradual change, like the steady loss of perennial grasses, to rapid change arising from infrequent but major disturbances. Sometimes changes in vegetation can occur gradually until some threshold is crossed and then change is rapid, e.g. gradual loss of perennial tussock grasses in response to overgrazing followed by a rapid invasion of Indian couch grass.

'State-and-transition' models provide a framework for describing these gradual and rapid changes by using a series of vegetation 'states' with transitions between states being driven by grazing, climate, fire and weeds. A generalised example of a state-and-transition model for the grassy component of open eucalypt country in northern Queensland is highlighted in Figure 1. This framework was used in studying the interaction between grazing management and land condition in the ECOGRAZE experiments.

The ECOGRAZE study

Study sites were established on three important land types identified in north-east Queensland for this work; the infertile red and yellow earths (Lakeview/Allan Hills), the moderate fertility Goldfields country (Cardigan) and the fertile red basalt soils (Hillgrove/Eumara Springs). Grazing plots were established on each of the three land types with land in condition States I and II (see Figure 1). State I was dominated by desirable perennial grasses such as black spear grass, desert blue grass, kangaroo grass and Qld blue grass. State II still had desirable perennial grasses present but there were more increaser perennial grasses such as wire grass and annual grasses such as fairy grass and button grass.

States I and II were chosen using fence-line contrasts reflecting historical grazing pressure, i.e. State I land had received relatively low grazing pressure in the preceding decade while State II land, through higher grazing pressure, showed significant loss of desirable perennial grass species but was still amenable to 'improvement' via grazing management. At each site and in each land condition three different utilisation rates were imposed; 25%, 50% and 75%.

Utilisation means the percentage of forage grown in a year that is consumed, e.g. for 25% utilisation, one-quarter of the forage grown in that year is consumed. In addition to continuous grazing, wet season spelling treatments were also included to see if resting could aid recovery of deteriorated pastures. Paddocks were spelled for eight weeks and then the cattle were reintroduced. At the end of each growing season (April–May) full botanical surveys were conducted in each paddock at each locality.

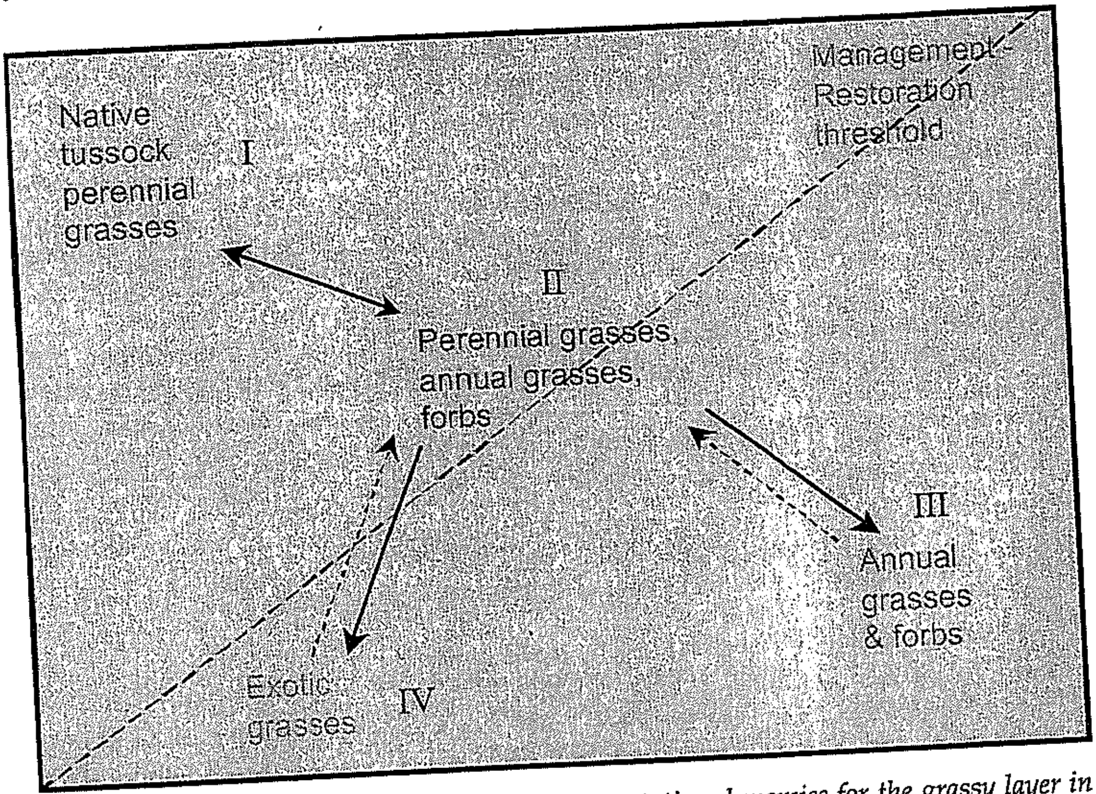

Figure 1. A state and transition framework of vegetation dynamics for the grassy layer in open eucalypt woodlands in north-eastern Queensland.

The findings

Severe drought was experienced for the first four years of the study. These drought years (1992–96) were followed by an 'average' year and then three good wet seasons were experienced from 1998–2000. This sequence of dry and wet years provided a good contrast for evaluating different grazing management strategies.

Maintaining 3P grasses in good condition pastures

For land that was in good condition (State I) at the start of the study two grazing strategies were able to maintain the dominance of desirable perennial grasses. These were: continuous stocking at 25% utilisation or spelling the pasture for the first 6–8 weeks of the wet season and then utilising 50% of the pasture.

Despite severe drought conditions for the first four years of the study desirable perennial grasses remained dominant in these grazing treatments. However, the vigour of these grasses declined during the drought and this was evident by a rapid decline in tussock basal area.

Based on previous studies in the region we expected the 25% utilisation continuous stocking treatment to be the grazing strategy most capable of maintaining the desirable perennial grasses. However, the wet season spelling regime followed by moderate utilisation also proved to be very effective at maintaining perennial grasses. This option provides some good opportunities to increase productivity whilst maintaining pasture health. The challenge for managers is to design and implement a wet season spelling program into their grazing operation.

Loss of desirable perennial grasses

Desirable perennial grasses, which dominated pastures in good condition at the start of the study, were greatly reduced under high levels of utilisation (75%). When high levels of utilisation were first imposed the desirable perennials were resistant to this grazing pressure but after a couple of years their populations declined dramatically. Associated with the loss of perennial grasses was a rapid decline in pasture productivity. The loss of perennial tussocks and ground cover results in much higher run-off and low infiltration rates which effectively 'desertifies' the soil–pasture system. This is highlighted by pasture production data in Figure 2 which shows the relative pasture productivity in the 75% utilisation paddocks compared with 25% utilisation paddocks at the Cardigan site. High grazing pressure resulted in a 50% decline in pasture productivity during both dry and wet years.

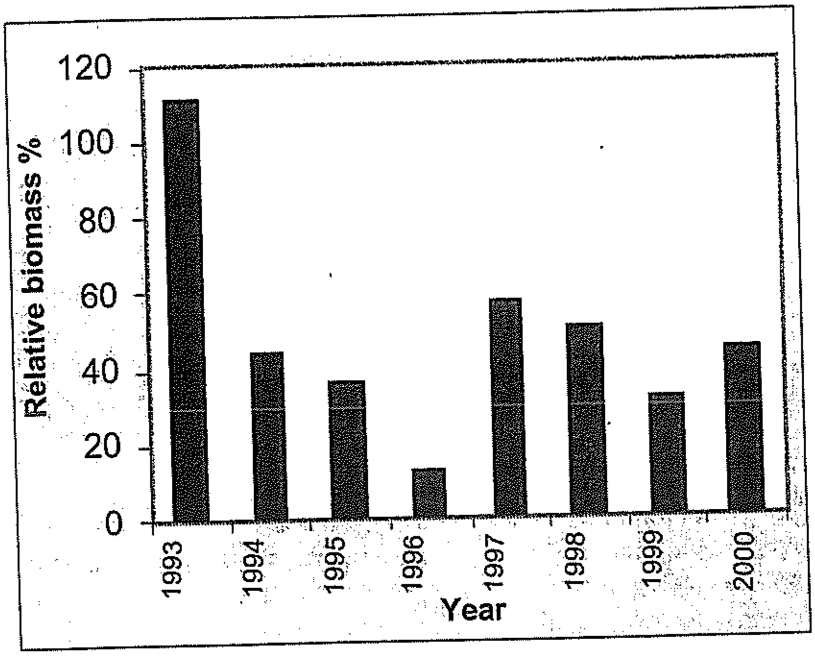

Figure 2. Relative pasture production in heavily grazed paddocks compared with lightly grazed paddocks at the Cardigan ECOGRAZE study site.

Recovery of 3P grasses in deteriorated pastures

Recovery of desirable perennial grasses in pastures that were in poor condition at the start of ECOGRAZE in 1992 was achieved with the same grazing strategies that maintained desirable perennials in good condition land, i.e. conservative stocking (25% utilisation) or wet season spelling followed by a higher level of utilisation (50%).

The recovery of desirable perennial grasses was significant even during the drought years of 1992–96. This highlights that grazing management-, not climate, is the most important determinant of pasture condition and the retention of perennial grasses. Climate markedly influences the amount of pasture grown from year to year and the vigour of individual plants but it is grazing pressure that largely determines pasture composition. After five years of either 25% utilisation or 50% utilisation with wet season spelling there appeared to be full recovery of forage biomass and pasture composition at the paddock scale (Figure 3).

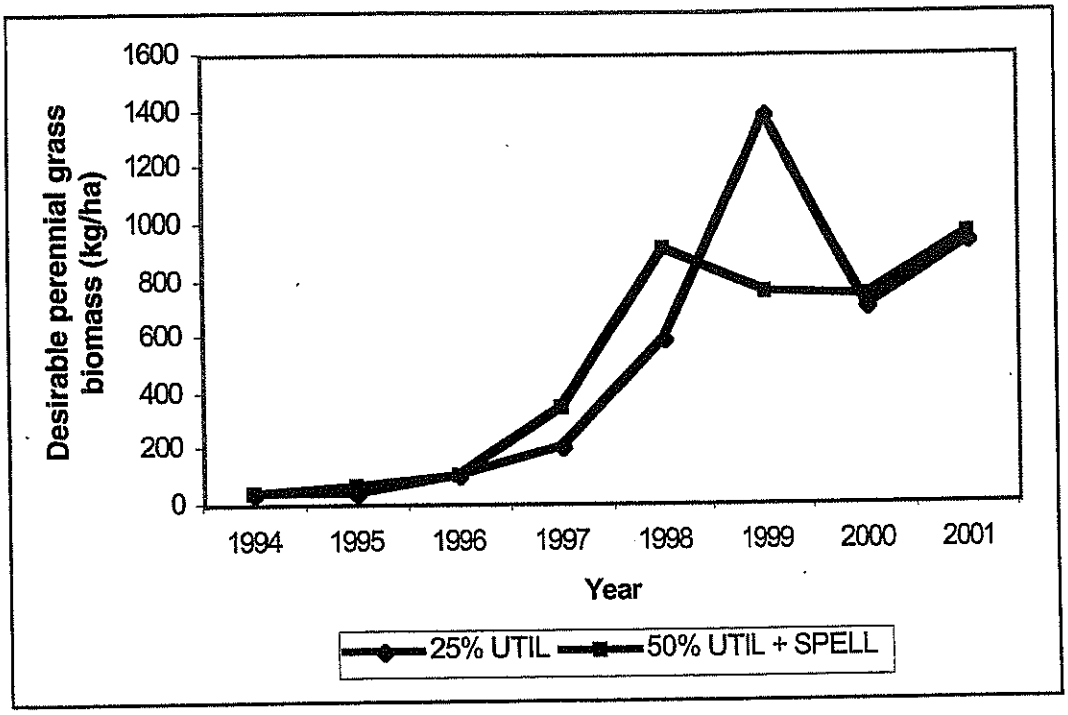

Figure 3. Recovery of desirable perennial grasses at the Allan Hills site where land was in a deteriorated condition at the start of the study.

Developing practical grazing strategies

If the aim of grazing management is to maintain desirable perennial grasses then the two key principles to emerge from the ECOGRAZE study are conservative stocking with continuous grazing or a rotational grazing system that includes some wet season spelling. Based on the results of ECOGRAZE wet season spelling may also provide some opportunity for a modest increase in overall carrying capacity without negatively affecting land condition.

Regardless of grazing system used the most important driver of animal production and land condition is the overall numbers of stock carried. Calculation of carrying capacity is the first important step in devising grazing strategies to meet production and land condition goals. The next decision is to determine the grazing system which will meet both production and resource management goals. For many pastoralists, a continuous grazing system with conservative stocking rates may be the most appropriate strategy for their enterprise. The main disadvantage in continuous grazing systems is that uneven animal distribution can lead to overgrazing in certain parts of paddocks that may be lightly stocked overall. This is especially a problem in paddocks that have diverse land types which differ markedly in grazing preference. Animals repeatedly graze the preferred land types or species in the paddock so that over time these areas begin to degrade even though overall stocking rates are conservative.

In contrast, rotational grazing systems provide some rest to all areas of the paddock. Rotational grazing systems range from fairly simple large paddock rotations to highly intensive time controlled grazing systems of which cell grazing is the best known in Australia. Based on the ECOGRAZE results we believe fairly simple rotational grazing systems (e.g. three or four paddock systems) that have good water distribution and incorporate a wet season rest can achieve healthy pastures and good animal productivity.

Land condition, grazing strategies and economics

If producers are to adopt grazing management recommendations to help sustain the native pasture resource it is important we assess the consequences of such recommendations for enterprise economics. We assessed the economic implications of managing land in various land condition classes by linking the forage production model GRASP to a spreadsheet model of farm economics. In GRASP we used 100 years of historical climate data for Charters Towers to predict annual variation in pasture and animal production for various grazing management and land condition scenarios. This production data was used to drive branding and mortality rates and sales in a spreadsheet model of enterprise economics. The assumptions associated with this economic modelling for a case study property are shown in Box 1.

In the first series of simulations we assumed that land condition remained constant for the 100 years in each of three land condition states, i.e. the feedback loop of grazing pressure on land condition was switched off:

Good condition (State I) – dominated by palatable perennial grasses

Fair condition (State II) – dominated by less palatable perennial grasses, annual grasses and forbs

Poor condition (State III) – dominated by annual grasses and forbs

***BOX 1*. The test beef enterprise used in the modeling scenarios**

Property size: 28,000 ha
Country type: Moderate fertility, e.g. Goldfields country, with intact woodland
Average rainfall: 650 mm
Usable area of property for grazing: 24,000 ha
Land value: $70/ha
Improvements: $400,000
Overhead Costs: $150,000 per annum
Non-cattle income: $15,000 per annum
Non-family labour: $32,000 per annum

Herd management
Bull/breeder ratio: 3%
Target steer/bullock weight: 580 kg
Target weight of surplus heifers: 350 kg
Weaning weight: 170 kg
Cow culling age: 6 or 7 years depending on season
Supplementary feeding: Initially M8U but in extended dry spells fortified molasses

While State I was considerably more productive than State II in terms of pasture growth, differences in animal production or economic performance were smaller. Yearly cash flow for enterprises with State II paddocks was more frequently negative and these enterprises were exposed to a much higher risk. However, the main disadvantage of State II condition land is that with further inappropriate management it can shift to State III, which is highly unproductive and economically unsustainable.

We also evaluated the economics of different grazing strategies. At the long-term safe utilisation of 25%, continuous grazing was more profitable than rotational grazing though rotational grazing did lead to better resource management outcomes (less soil erosion). However, with an average utilisation of 35% the continuous stocking strategy was not sustainable because there were sequences of years when utilisation rates were high and the pasture deteriorated to the point where it did not recover in subsequent years. Deterioration in paddock condition and loss of perennial species resulted in a crash in economic performance. In contrast, the rotational grazing system at 35% utilisation was sustainable because the rest provided to paddocks every third wet season allowed recovery of perennial grasses. This rotational grazing system was more profitable than continuous grazing at 25% utilisation though both systems return reasonable cash flows. To be successful, rotational grazing systems may require more active management and construction of fences and watering points. With proper planning to accommodate changing conditions, these systems can provide for sustainable and profitable beef enterprises in Northern Australia.

However, rotational grazing systems do require more management inputs and may require some capital infrastructure development so they need to be well planned with options for flexibility and change if they are to be successful.

Acknowledgments

The ECOGRAZE project is part of Meat and Livestock Australia's North Australia Program and we acknowledge the support MLA have provided to the project. We also thank the Mann family (Hillgrove), the Axford family (Eumara Springs), the Ferguson family (Cardigan), the Bredden family (Lakeview) and the Pemble family (Allan Hills) for providing us with the land and support to undertake these studies.

Notes

Reducing sediment and nutrient export from grazed land in the Burdekin catchment for sustainable beef production

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Introduction

The loss of sediment and nutrients from grazing lands can have impacts downstream on the river and the marine environments that receive this material. In low input grazing systems such as those typical of the northern beef industry, the bulk of nutrients, including phosphorus and nitrogen, are transported with suspended sediment. There is growing concern that high grazing pressures and grazing land management have resulted in increased flows of sediments and nutrients through and out of grazed catchments. Apart from the detrimental and often permanent effects of nutrient and water loss on pasture productivity, there is particular concern that the off-site effects may impart negatively on water quality in rivers, health of in-stream ecosystems, productivity of estuarine breeding grounds of commercial fisheries and in the case of the North-East Queensland coast, the ecology of near-shore reefs and seagrass beds.

In order to address some of these issues, in 1999 MLA, CSIRO and QDPI initiated a major new project in the Burdekin catchment to provide a better process understanding of grazing impacts on catchment response as the basis for refining guidelines and recommendations for improved grazing management.

Objectives

The project has been structured into four components. Specific objectives relative to each of the four research components are:

1. *Regional patterns*: to survey the Burdekin catchment at a reconnaissance scale to identify crucial sub-catchments appropriate for more detailed investigation, to assess the most significant processes of soil erosion as they relate to grazing management, and to provide a framework for reviewing and integrating information currently available in the catchment.
2. *Monitoring at sub-catchment scale*: to construct a detailed sediment and nutrient budget for a sub-catchment identified as having significant actual erosion hazards in order to assess sediment and nutrient transport and storage mechanisms in relation to grazing pressure at sub-catchment scale.
3. *Spatial patterns of grazing pressure*: to improve our understanding of animal dynamics in relation to spatial variation of grass species and fodder biomass over larger areas, the interactions with surface condition and the resultant changes in surface hydrology and sediment transport, for varying soil types and landforms.
4. *Hillslope processes*: to quantify the principal determinants of sediment and nutrient generation, redistribution and export from hillslopes with varying configurations of grazing management induced variations of soil surface condition.

Results

Regional patterns

This component of the project has been completed and results will be published shortly in Prosser *et al.* (2001). In summary, the results show that surface erosion varies by three orders of magnitude across the catchment. Only 25% of the catchment has high surface wash or hillslope erosion potential. Much of this is in the Bowen River sub-catchment, the area below the Burdekin Falls Dam and parts of the Upper Burdekin catchment. The Suttor and Belyando R. catchments have low hillslope erosion potential. Gully erosion is also a significant process contributing approximately 30% of the total sediment load carried by streams. We predict gully erosion to be most pronounced in granitic (particularly the granodiorite or 'Goldfields' country around Charters Towers) and ancient sedimentary landscapes in the central part of the catchment. Gully and stream bank erosion are the dominant sediment sources in the drier parts of the catchment where delivery of sediment to streams from surface wash erosion is low. The sediment budget predicts that only 13% of the total sediment delivered to the river network in any year is exported from the river mouth to the Great Barrier Reef Lagoon. The rest is stored within floodplains, as sand and gravel deposits on the bed of streams, and in reservoirs. This is typical of large river systems and much of the sediment remains stored for hundreds to thousands of years. We predict that the mean annual export of suspended sediment to the coast in 2.4 Mt/y.

Monitoring at sub-catchment scale

Two small, grazed sub-catchments near Mingela (about 12–15 km^2) are being monitored for runoff, sediment and nutrient discharge with the help of automated gauging and sampling sites. These are complemented with hillslope and gully erosion monitoring sites to determine the relative importance of hillslope and gully erosion. To date, we have monitored two seasons. Total discharge has been determined for the wet season 00-01, which was comparatively dry, with evenly spread rainfall and few high intensity storms. Total sediment discharge was 0.3 t/ha, which is a very low value, reflecting the dry conditions. Data from the wet season 99-00, which was characterised by a cyclone and above average rainfall, is yet to be fully analysed and is expected to yield a significantly higher sediment discharge. Currently, additional monitoring sites are being established to determine sediment discharge for larger sub-catchments (Station Ck, ~ 150 km^2, and Upper Burdekin at Macrossan).

Spatial patterns of grazing pressure

Identifying and quantifying the key vegetation (e.g. type, amount of forage), landscape (e.g. topography) and management (e.g. distribution of watering points) attributes that determine the distribution of cattle in the landscape is critical to be able to refine our predictive capacity of where likely sources for sediment and nutrients might be located in relation to where cattle graze. To achieve this, we are employing three approaches:

- Extensive review of past work on cattle distribution to formulate a conceptual model of cattle behaviour.
- Regular aerial surveying of cattle distribution in three selected paddocks.
- On ground determination of key vegetation attributes in the surveyed paddocks.

Data obtained in the year 99-00 indicates that in a year of good rainfall, cattle distribution is essentially random. As conditions dry out, there is a tendency for cattle to prefer riparian areas, which has significant implications for sediment delivery, as degradation of riparian zones through overuse by cattle will reduce the buffering function of riparian vegetation, increasing sediment delivery ratios of hillslope derived sediments. It is expected that the dryer wet season 00-01, followed by a very dry winter, will provide a better data basis for analysis in this project component.

Hillslope processes

Rainfall simulation was the tool mainly used to determine which soil surface conditions had the strongest influence on infiltration, sediment generation and nutrient mobilisation. We examined 70 individual micro-plots covering a broad range of grazing, fire and vehicle induced disturbances on five sites across the Upper Burdekin catchment. At some of these sites, we were able to compare grazing induced changes to soil surface condition to exclosure sites. In general terms, total ground cover (grass, forbs and litter) had a pronounced effect on sediment and nutrient concentrations in runoff, corroborating earlier work on similar soils (McIvor *et al.* 1995; Scanlan *et al.* 1996). However, the effect on infiltration was far less pronounced (Figure 1). Considerable scatter was observed in infiltration rates for ground cover levels > 75% cover (Figure 1A); while scatter of sediment concentration values was pronounced for cover values < 25% (Figure 1B).

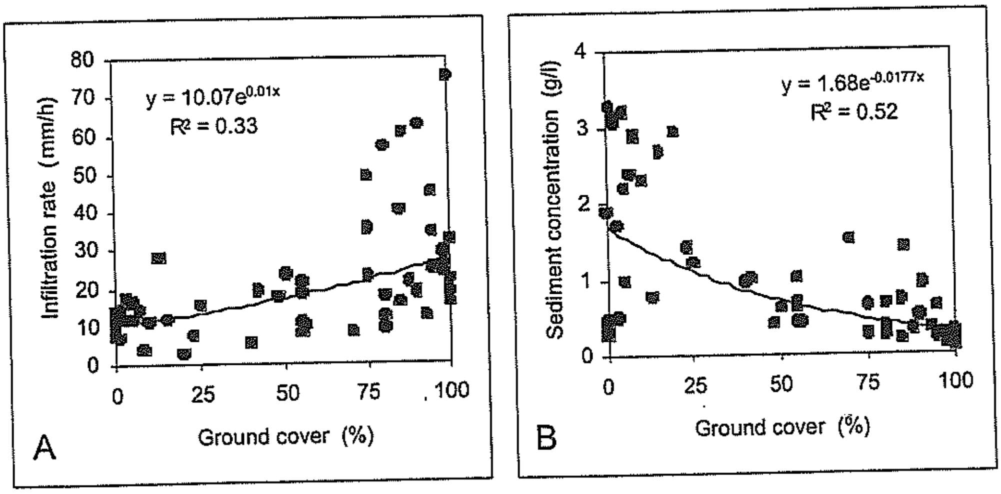

Figure 1. Relationship between ground cover and rainfall infiltration rates (A) and concentration of suspended sediment in equilibrium runoff (B) after 30 mm rainfall.

A closer scrutiny of the data in the cover classes < 25% and > 75% indicates that morphological features characterising the soil surface help explain the variation. Depending on whether the soil surface is erosional, depositional or cryptogam in nature will greatly influence sediment concentration (Table 1) in the cover class < 25%, while the intensity of soil biological activity in the class > 75% cover is a significant discriminator of infiltration rates (Table 1). Discrimination using soil morphological features in the cover class 25–75% was less pronounced, but followed similar features as for the class < 25%.

The significance of earthworm activity in recovering soil hydrological function by clearly constituting a major factor in increasing infiltration is not generally recognised for north Australian savanna woodlands. However, in all instances the plots with high earthworm incidence had a history of intensive cattle grazing and previous soil degradation, with time since the plots had last been grazed ranging from 15–20 years. Rainfall ranged from 900–580 mm and was not seen as the critical factor explaining earthworm activity, but rather the build up of biomass and the lack of hoof compaction over prolonged periods were seen as the main causes. Trampling and hoof compaction has been recognised as an important factor in runoff generation and soil loss from pastures (Greene *et al.*, 1994). However, further investigations on a wider range of sites across northern Australia are required to fully assess the relevance of earthworm activity in moderating soil hydrological function, which is expected to take place within the auspices of the Savanna CRC over the next four years.

Table 1. Soil surface characteristics influencing rainfall infiltration, and sediment and nutrient concentration in equilibrium runoff (values in italics = standard deviation)

Cover class and soil surface condition	Infiltration rate (mm/h)	Suspended sediment concentration (g/l)	Concentration of Ntot (mg/l)	Concentration of Ptot (mg/l)
Cover class < 25%				
Erosional surfaces, dominated by structural crusts; hard; active sheet erosion; formation of terracettes	11.4 *4.2*	2.5 *0.7*	0.85 *1.14*	1.57 *1.86*
Depositional surfaces, covered by 5–20 mm thick deposits of loose sandy sediments	7.9	0.5	n.d.	n.d.
Pavement surfaces; > 50% gravel cover, loose or semi-embedded	12.1 *2.8*	0.3 *0.1*	0.31 *0.07*	1.03 *0.39*
Cryptogam surfaces; > 50% intact cryptogamic crusts; few signs of sheeting or deposition	17.8 *10.0*	0.9 *0.5*	1.03 *0.53*	2.60 *0.57*
Cover class > 75%				
Residual crusts beneath litter; no incorporation of litter, no castings	19.9 *8.8*	0.3 *0.1*	0.30 *0.23*	1.26 *0.49*
0–50% of litter incorporated; single macrofaunal pores, some castings	31.2 *6.1*	0.4 *0.3*	0.52 *0.34*	1.73 *0.40*
> 50% litter incorporated; < 50% of surface covered by earthworm castings	60.6 *9.6*	0.6 *0.5*	0.77 *0.37*	2.78 *1.45*
> 50% of surface covered by earth- worm castings; surface uncrusted	> 75	n.d.	n.d.	n.d.

Conclusions

Whilst the project has only run for 2½ years, we have made some significant progress:

- Hotspots of soil erosion hazard in the Burdekin catchment are highly localised, offering an important opportunity for the beef industry to significantly reduce sediment and nutrient export by targeting action on the ground by graziers and landcare groups as well as resources from programs such as the National Action Plan for Salinity and Water Quality or NHT Mk2 at these areas.
- Hillslope erosion and gully erosion constitute important pathways of sediment delivery; both require different sets of management guidelines effectively targeting the predominant form of soil erosion in any particular hotspot area.
- Hillslope erosion can be more readily minimised than gully erosion, by improved grazing management; our results from work at the hillslope scale indicate that a significant reduction in runoff can only be achieved by ensuring prolonged soil cover at levels > 75% to enhance soil biological recovery of soil hydrological function.
- Thresholds for significant reduction in sediment loss are lower (~ 40% cover), but will still incur high runoff losses, leading to a higher frequency of flood flow in rivers, which is associated with bank erosion and enhanced delivery of sediments through the stream network.

Ultimately, we believe that the outcomes of this project will be critical to support the northern beef industry's ability to:

- ensure its long-term economic sustainability by retaining or improving the productive capacity of the soil resource base by reducing on-site water and nutrient loss;
- meet national and international standards of sustainable beef production by reducing detrimental off-site impacts due to sediment and nutrient delivery;
- enhance its capability of modelling grazing management impacts on the soil and water resource base across a range of scales to respond to broader community concerns.

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Notes

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A process for re-assessing the Potential Carrying Capacity of Kimberley pastoral leases

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Abstract

Changes in the production system and availability of new techniques warrant the re-assessment of Potential Carrying Capacity estimates for Kimberley pastoral leases. Factors considered in re-assessment included accessible proportion of pasture types per lease, annual grass growth of various pastures in various locations, 'safe' utilisation rates and forage intake. Validity of the process was tested using resource monitoring information and other station records. Generally, re-assessed estimates are supported by the validation system. Further validation will be sought from long-term pastoralists' experience.

Introduction

Limited understanding of rangeland processes and the extensive, uncontrolled cattle production system led to occurrences of soil and pasture degradation, particularly in the west Kimberley (Bolton 1951, Payne *et al.* 1979). In response, range condition guides were compiled by Payne *et al.* (1974) and used to identify good quality and good condition pastures and also to estimate an 'optimum cattle unit capacity' for pastoral leases. Government agencies, particularly the Pastoral Lands Board used 'optimum cattle unit capacity' as the annual average long-term number of stock a lease could sustainably carry.

Although 'optimum cattle unit capacity' was replaced by 'Potential Carrying Capacity' (PCC), range condition guides are still used in the same context today. That is, PCC is only a guide to the long-term average annual number of stock, which a given pastoral lease can carry without degrading the pasture or soil resource. PCC presumes good range condition and full development. PCC is not a minimum or maximum stocking rate to be adhered to in every season. In fact it is expected that during a run of good seasons a fully developed pastoral lease with rangeland in good condition could safely carry significantly more stock than suggested by the PCC.

Several issues exist with estimating PCC (Smith and Novelly 1997), including factors associated with the original calculations by Payne *et al.* (1974) as well as impacts of the changes to the production system and increased information concerning components of the estimate. This suggested a need to incorporate into the PCC more recent information to make them more relevant to current knowledge and systems. This paper outlines the process currently underway to review these levels using information and tools not available when first estimates were made. A process of general validation is also described.

Methods

Variables determining PCC for Kimberley pastoral leases can be represented as:

$$\text{PCC (CU/sq km)} = \frac{\text{Sum (accessible area of pasture type * average annual forage growth per type) * 'safe' utilisation rate of each type) [for each pasture type on the lease]}}{\text{average annual forage intake/CU}}$$

Accessible area of pasture type was obtained from a combination of available station surveys and CSIRO land system descriptions. Poorly accessible land units and some pasture types having not been quantified were addressed by analysis of CSIRO land systems descriptions.

Average annual pasture growth was estimated using the grass growth model WinGRASP (Timmers *et al.* 1999), with long-term average annual growth for different pastures at different locations calculated from historic climatic records, validated using existing quantitative data.

Applicable *'safe' utilisation rates* were determined through a literature review of reports dealing with northern Australian pastures.

Average annual forage intake/CU was investigated by reviewing relevant literature, seeking expert opinion and output from the computer package, GrazFeed.

Final calculations were validated using station rainfall and stock records, rangeland monitoring information and pastoral lease reports. This information was used to gauge whether the resource base on the lease can, or is likely to, sustainably support stock numbers equivalent to that of the 'new' PCC.

Results

Accessible area of specific pasture type

West Kimberley land system descriptions (Speck *et al.* 1964) quantified the proportion of each unit (and therefore the pasture type) within the land system. This was unavailable for the North (Speck *et al.* 1960) and East Kimberley (Stewart *et al.* 1970) where a simple relative size class was indicated for each unit. To quantify this information, each unit within the East Kimberley land systems was assigned a percent value based on the information provided in the land system description and an analysis of the range of values within each relative size class conducted. The mean value of each unit was then used to calculate the pasture area for stations lacking this information.

The land systems of the North and East Kimberley considered similar to those listed by Payne *et al.* (1974) in the West Kimberley as poorly accessible were grouped, the poorly accessible units of each described and a percent value assigned to them. The combination of land system mapping, station survey reports and information derived allowed the accessible area of each pasture type to be estimated for each lease.

Average annual pasture growth

Estimated pasture growth varied between years and pasture types, and between locations for the same pasture type. However, validation of estimates against actual observations from Kimberley monitoring sites showed acceptable similarity (Figure 1). Although total standing dry matter (TSDM) was recorded at these sites and thus TSDM was the desired WinGRASP output to illustrate the model's accuracy, average annual growth was also predicted by WinGRASP.

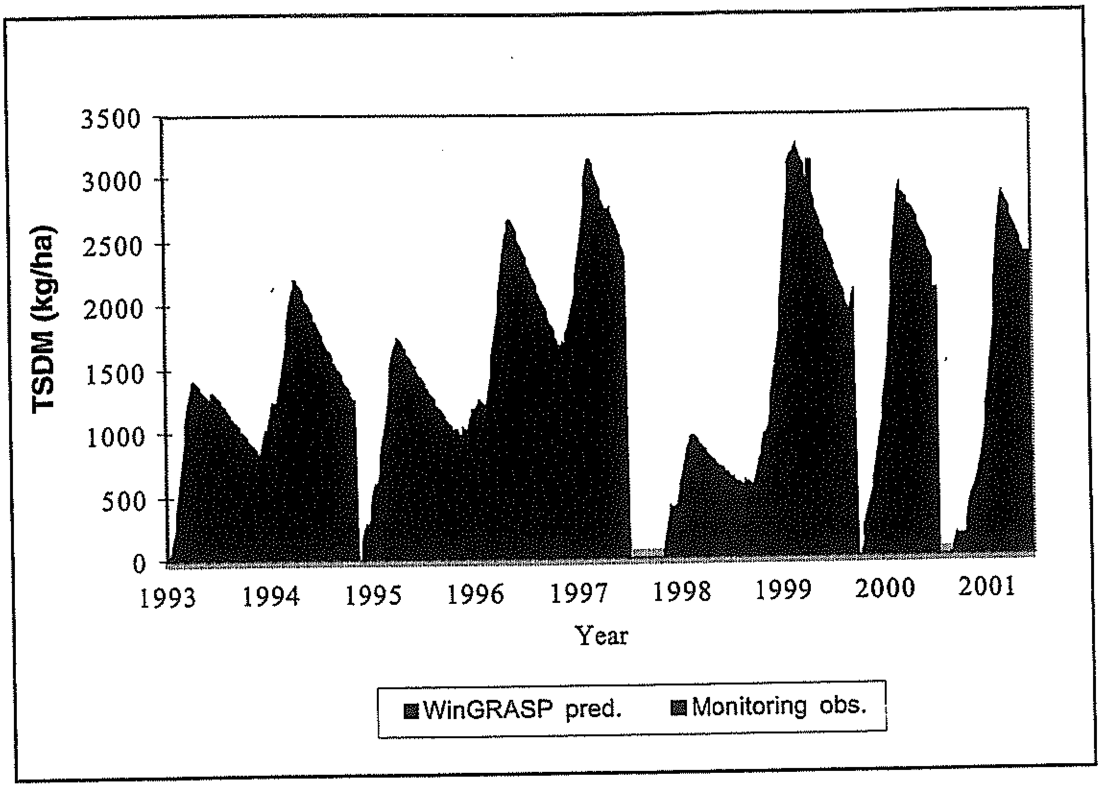

Figure 1. Total standing dry matter (TSDM) as predicted by WinGRASP and observed at monitoring sites on an alluvial grey soil.

For both an alluvial grey soil (equivalent to a 'black soil pasture') and calcareous red soil using model developed parameters for the Victoria River District, average annual pasture growth increased linearly with average annual rainfall (AAR) up to about 750 mm (Figure 2).

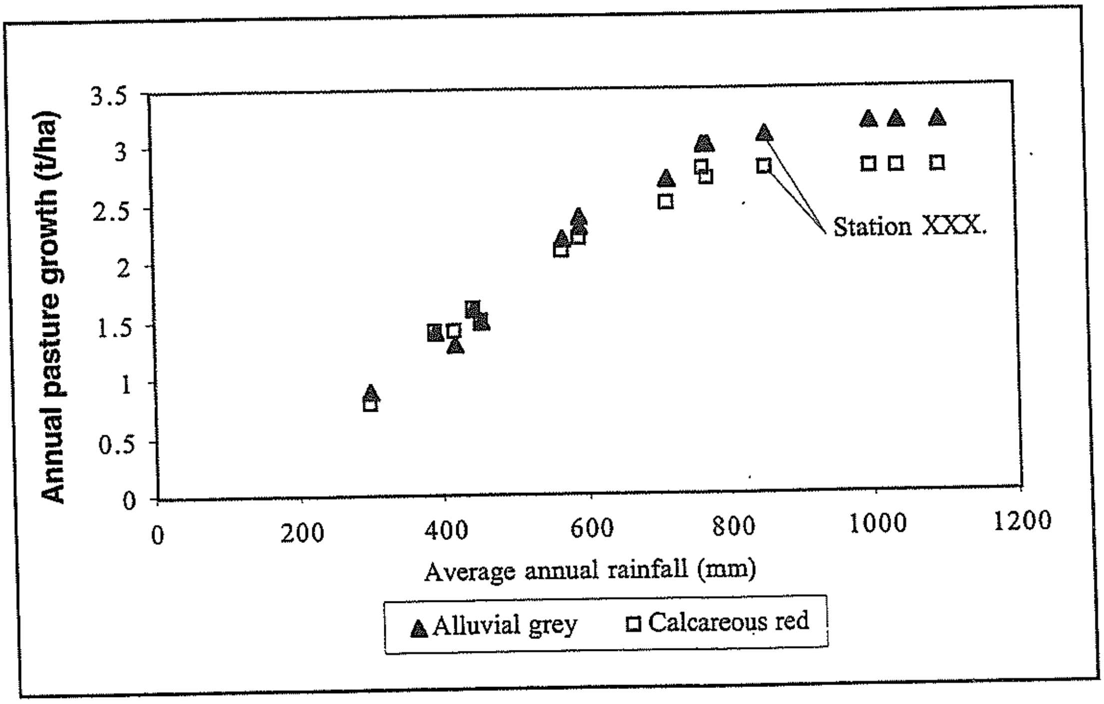

Figure 2. Relationship between average annual rainfall and average annual pasture growth as predicted by the WinGRASP grass growth model.

WinGRASP allowed production differences between various pasture communities to be quantified at any location. An example of this is shown in Figure 2 where Station XXX, with an AAR of 854 mm, has two soil types, an alluvial grey soil growing 3.1 t/ha/yr of pasture while the calcareous red soil only grows 2.8 t/ha/yr of pasture.

Recommended utilisation rates

Although defined for some Queensland pastures (Beale 1985; Orr *et al.* 1993), recommended utilisation rates are a proportion of total standing dry matter measured or predicted at some point during the year (Johnston *et al.* 1996). However, recommended or 'safe' utilisation levels, which pertain to average annual growth predicted by growth simulators, are used in this paper.

Queensland trials suggested utilisation rates of 23% for Mitchell grass (*Astrebla* spp.), and 26% for Gidgee (buffel grass – *Cenchrus* spp.) pasture, while 'expert consensus' for alluvial plains (open) was 20% and 15% for Mulga zone grass species (Johnston *et al.* 1996). Ash *et al.* (1997), in a grazing trial near Katherine, NT suggested 10 to 15% for tropical tallgrass pasture. Work in Queensland estimated utilisation rates of 8 or 12% for Queensland spinifex and 6% for Northern *Aristida* pasture communities as 'safe' (Hall *et al.* 1998). These figures have been used as a guide to set 'safe' utilisation rates for the many Kimberley pasture types (Table 1).

Table 1. 'Safe' utilisation rates assigned to the various Kimberley pasture types

Pasture type	'Safe' utilisation rate (%)
Buffel grass	25
Mitchell grass	20
Blue grass	15
Love grass	15
Frontage grass	15
Ribbon grass (AAR < 800 mm)	15
Arid short grass	15
Littoral pasture	15
Fringing pasture	15
Mid-height pasture	15
Bunch spear grass	15
Curly spinifex pindan	10
Tallgrass	10
Ribbon grass (AAR > 800 mm)	10
Spinifex	10
Three-awn	6
Coastal pasture	0

Average annual forage intake/CU

Payne *et al.* (1974) defined a cattle unit as an adult steer or dry cow in excess of two years of age (assumed to be about 450 kg live weight) with intake estimated as 11.2 kg/day. While not necessarily reflecting much of the modern Kimberley herd, this weight and age definition was used during PCC re-assessment to allow comparison of results with historical figures.

Current intake estimates range from 5.5 kg/day for a 400 kg beast consuming pasture with a dry matter digestibility of 50% (Poppi 1996), to 10.5 kg/cu/day consuming pastures with a dry matter digestibility of 60% (GrazFeed* 1993) (Table 2.). Although variable, Kimberley pastures generally have an average annual dry matter digestibility of between 50 and 55% (M.J. Bolam *pers. comm.*). The computer package GrazFeed (SCA 1990) was used to estimate intake values for pastures with a range of dry matter digestibility (Table 2). In light of the information reviewed the daily forage intake per cattle unit was estimated as 8 kg.

Table 2. Daily forage intake figures for dry adult cattle between 400 and 450 kg live-weight grazing pastures with a dry matter digestibility between 40 and 60%

Reference	Beast weight (kg)	Dry matter digestibility (%)	Daily intake (kg)
Poppi (1996)	400	50	5.5
Mac Donald *et al.* (1997)	420	50	7.5
Payne *et al.* (1979)	450		11.2
Minson and McDonald (1987)	450	50	7.3
GrazFeed* (1993)	450	40	2.7
"	450	45	4.7
"	450	50	6.7
"	450	55	9.4
"	450	60	10.5

'New' PCC estimates were compared with existing PCC estimates and reported stock numbers for each lease. Additionally, range condition trend was determined for each lease using station monitoring sites, Western Australian Rangeland Monitoring System (WARMS) sites and pastoral lease reports and this was related to reported stock numbers and estimates (Figure 3).

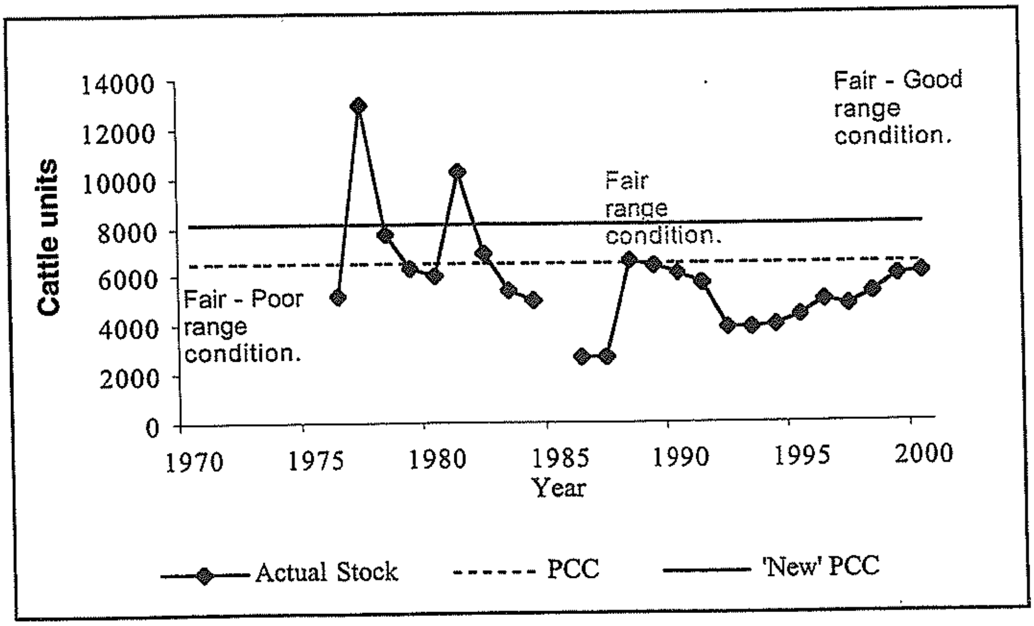

Figure 3. Declared (actual) stock numbers, original and 'new' PCC with notes about range condition trend (1972, 1990 and 2001) taken from a typical lease profile.

Conclusion

The process of deconstructing estimation of PCC for Kimberley leases into component parts to permit more recent and accurate input for each component has overcome issues associated with production changing as rainfall increases, variation in production between years, poorly accessible land units and uncertainty about forage intake. Station 'profiles' demonstrated that rangeland condition would generally support the 'new' PCC. There is a need for further assessment of plant and animal interactions in the high rainfall (> 800 mm) zone where the station profiles do not provide as much support for the new PCC.

It must be stressed that PCC is only an estimate of long-term average annual carrying capacity for a given lease and in most years will differ from the appropriate stocking rate based on seasonal conditions.

This process will continue using the long-term experience of Kimberley pastoralists to finally validate components.

Acknowledgments

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Notes

Notes

Landholders designing with nature: an approach to off-reserve conservation in the Gascoyne–Murchison Strategy area, Western Australia

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1. What is 'the EMU process'?

The 'EMU process' is a major activity within the Gascoyne–Murchison Strategy's Regional Environmental Management Program. It aims to help pastoralists understand more intimately the critical ecological processes occurring across their stations and to respond in a way that uses, rather than opposes those processes. The underlying principle of the EMU process is 'working with natural processes, not against them'.

The process has been developed in shearing sheds, kitchens and on vehicle bonnets in the field. Pastoralists are legitimate (rather than token) partners in the process. These partnerships underpin the success of the process: we are struggling to meet demand, despite not having formally advertised our services. Demand is being driven by word of mouth.

The EMU process is based on capturing local expert information on clear overlays on top of land system maps of stations. We then use simple questions to help pastoralists recognise the driving ecological processes and areas requiring concentrated management effort, be that to seize opportunities or to address problems (or both). The first mapping exercise produces a base line against which ongoing monitoring results are assessed. The process is entirely voluntary and all outcomes (e.g. overlay maps) belong to the participants.

Indigenous heritage values are included in the process, and play a major role when dealing with Aboriginal stations. Some non-Aboriginal pastoralists have also requested that local Aboriginal representatives' values be included in developing informal cultural management strategies for their stations. The process readily accommodates multiple land use objectives.

We have also developed monitoring techniques for initiating close dialogue with managed landscapes. Locating monitoring effort is strongly influenced by the overlay mapping procedure such that it is located at critical 'finger on the pulse' locations and with specific issues and objectives in mind. Features monitored include a mix of retrospective 'impact' attributes (e.g. soil erosion) and early warning (hazard or opportunity) variables (e.g. utilisation rates and recruitment).

The long-term objective of the EMU process is to empower individual managers and local pastoralist communities to take ownership of environmental management, recognise and address the critical issues together, and develop firm foundations for a sustainable future.

2. The 'EMU' vision of ecologically sustainable rangelands

Managing biodiversity

Formal nature conservation is accommodated through a CAR reserve system and a network of smaller priority areas under formal conservation agreements. Some of these smaller areas excised from pastoral leases and have legally binding conditions, particularly if public funds are involved. However, many small areas remain within pastoral leases and are managed sensitively. They remain important parts of stations (Pringle 1995). Three important types of 'station reserves' exist:

1. *Ecojunctions*: Areas where many types of land come together. These areas are disproportionately highly representative of local biodiversity. They contain many ecotones supporting biodiversity adapted to 'edges' and reveal linkages between landscapes. Sensitively managed ecojunctions can thus make a major contribution to conservation of local biodiversity, serve as 'landscape laboratories' and may provide benchmark context for similar landscapes more widely spread across stations. Ideally they are protected from grazing by livestock and feral animals. Ecojunctions typically occupy little area of any station.
2. *Grazing refuges*: These are areas remote from natural and artificial sources of water. Refuges are used as benchmarks to understand monitored changes in similar, but more widespread and conventionally grazed landscapes. They are also likely to contain local biodiversity ill adapted to grazing management (James 2000).
3. *Specific biodiversity values*: These are local 'jewels in the biodiversity crown' that require particular management not usually provided by conventional grazing management. Examples include particularly fragile landscapes susceptible to erosion (e.g. coastal dunes and breakaways), important wetlands and other drought refuges, or populations or rare species and their local habitats (Morton *et al.* 1995). These areas are identified from databases and importantly, by local experts; pastoralists.

Managing the pastoral matrix

The more conventionally grazed matrix is regularly monitored, particularly at critical control points and sensitive (rather than representative) areas of stations. Pastoralists have their fingers on the pulse of the land, manage variability in time (e.g. climate) and space (e.g. mixes of country types) with increasing effectiveness. This 'learning pastoralism' (or ESPM) features:

1. Management priorities identified by mapping and assessing salient features on clear overlays.
2. 'Strategic management focused on driving processes at critical control points across stations, sub-catchments and catchments.
3. 'Regular monitoring on the ground and from the air and mapping of results on clear overlays.
4. '(At least) annual reviews in a never ending and systematic learning process.
5. Regular meetings with neighbours to discuss landscape management and coordinate and review catchment management issues.

ESPM will not only benefit biodiversity; it will also strengthen pastoral landscapes, businesses and communities by:

1. increasing rainfall efficiency as canalised drainage systems are gradually rehabilitated, thereby restoring soil moisture regimes and, as perennial plant cover is improved/ maintained;
2. increasing production through more efficient use of landscape toposequences (strategic use/rest);
3. improving flock/herd structure using Total Grazing Management systems (strategic use of infrastructure);
4. decreasing cost of production through more strategic, rationalised infrastructure;

5. improving prices through environmentally certified production and strategic eco-branding;
6. socialising station management as management issues are discussed and mapped together;
7. increasing self-reliance among station enterprises as pastoralists realise their management potential and consciously wean themselves of government advice;
8. environmental reporting conducted by pastoralists, with inspectors spending more time helping pastoralist groups than undertaking regulatory activities;
9. increasing local cohesion as government dependence gives way to local inter-dependence and innovation, realising landholder potential.

Important features of this framework for ecological sustainability include:

1. Physical or psychological barbed-wire fences do not separate management of biodiversity and grazing management. Rather, emphasis varies across stations and regions in a shifting balance that is locally flexible and regionally effective (Morton *et al.* 1995). Biodiversity management becomes an opportunity for pastoralists, who are rewarded in the market place with assured access and price premiums.
2. ESPM is based on base-line maps of salient features and intimate dialogue with managed landscapes. The outcomes of those regular discussions are recorded visually. This mapping approach can be employed at a range of scales and accommodate multiple value systems. It allows changes to be assessed in terms of previously recorded salient features and dialogues as part of a learning process.
3. ESPM provides a framework for increased social cohesion at enterprise and community levels. Pastoralists become increasingly self-reliant and inter-dependent at enterprise and community levels, and government officers become more focused on auditing station Environmental Management Systems and reports, as well as providing technical input on request. Apart from regulatory activities, government services are provided to meet demand, rather than on the basis of perceived pastoralist needs.

3. Is the 'EMU process' a dream, hallucination or emerging reality?

ESPM is an emerging reality in the Gascoyne–Murchison Strategy. Despite budget cuts in the region, government departments are currently organising additional resources to meet demand from pastoral communities for 'the EMU process'. Over 20 stations involving more than three million hectares have already commenced the 'EMU process'. At least that many stations have formally requested participation in the next year. Pastoralists and government departments from other regions have also expressed interest in spreading the project beyond the current region.

The Murchison Land Conservation District Committee has engaged the EMU to help them with a catchment management initiative focused on recovering the health of the riverine plains and riparian habitats through coordinated and strategic catchment action. This innovative, catchment-level approach is underway.

Two formal off-reserve agreements have been developed and several are under negotiation. They include a major bioregional junction area occupying well over 100,000 ha on two adjoining stations, a nationally listed wetland of less than 5000 ha and a population of rare and endangered plants on a single breakaway system occupying less than 2000 ha. Formal agreements being considered include covenants with the National Trust, Section 16A Agreements or legal contracts between pastoralists and the Department of Conservation and Land Management, Indigenous Protected Areas, and caveats on pastoral leases.

Experience shows that it is far easier to identify potential areas and plan their future management than it is to seal formal agreements. Pastoralists seem nervous about the implications of 'signing away' land, and government is anxious that public funds should provide lasting outcomes. A simpler outcome might be to leave agreements informal. This is happening, but sensitive management of biodiversity may be replaced at the whim of the pastoralist or at sale of the lease. Informal arrangements also rely on altruism from pastoralists, who have been suffering from severe financial stress in recent years.

The 'EMU process' is changing pastoral management. One station has drastically reduced the number of watering points it maintains, another is developing a rotational grazing system based on spelling fertile bottom-lands (saltbush country) for 18 months of every two year period using trap yards at strategic locations. Several pastoralists have renegotiated their grants to install watering points so as to protect fragile landscapes. Several stations have installed EMU Landscape Monitoring Level 1 sites and our first aerial monitoring has been conducted with the Rangeland Fibre and Produce group near Mt Magnet. One station is requesting permission to destock for a few years after realising how badly the majority of landscapes need rest. The owner of an eco-branding enterprise has expressed interest in incorporating the 'EMU process' into requirements for certification of participating producers.

The 'EMU process' is no hallucination!

4. Wider context: systematic regional management

The grassroots focus of the 'EMU process' is complemented by a GIS-based information system, which provides wider context for local initiatives. Information in the system includes land system and vegetation maps, distributions of watering points and natural surface water features, rare flora and fauna, wetlands, and so forth. These data can highlight and place some regional priority on local conservation values.

The system is *not* used to produce spatially explicit scenarios that may threaten participants. Rather, the information is presented to participants for consideration. Pastoralists have been quite interested in the information, and keen to incorporate these issues into their station management. This voluntary and unthreatening approach seems to be working.

5. Concluding comment: institutional arrangements

Most participants in the 'EMU process' are adapting to a changing world. Yet they confront significant institutional barriers to change. Diversification is fraught with red tape, and government departments are only just emerging out of institutional apartheid in rangelands. Public funding of off-reserve conservation is negligible. Government maintains a major controlling interest in the sandalwood industry. Couldn't exclusive access to sandalwood and other resources (e.g. tourist resources) be contingent on *quid pro quo* arrangements for formal off-reserve conservation? Disturbingly, the legal requirement to graze vast areas of rangeland in the face of financial, social and environmental forces seems anachronistic and defies contemporary models of sustainable rangeland habitation, which emphasise regional differences in opportunities and risks (Stafford Smith, Morton, and Ash 2000).

It might be argued that progressive elements in the pastoral industry are being brought back to the pack under current institutional arrangements. Hopefully, a recent State Government initiative to review these institutions and provide a new model will address this problem.

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Notes

Notes

Northern
Australia
Beef
Industry
Conference
2001
Kununurra - 8 & 9 November

Meeting market specifications

Notes

Supply chain management systems or strategic alliances in the live cattle export industry

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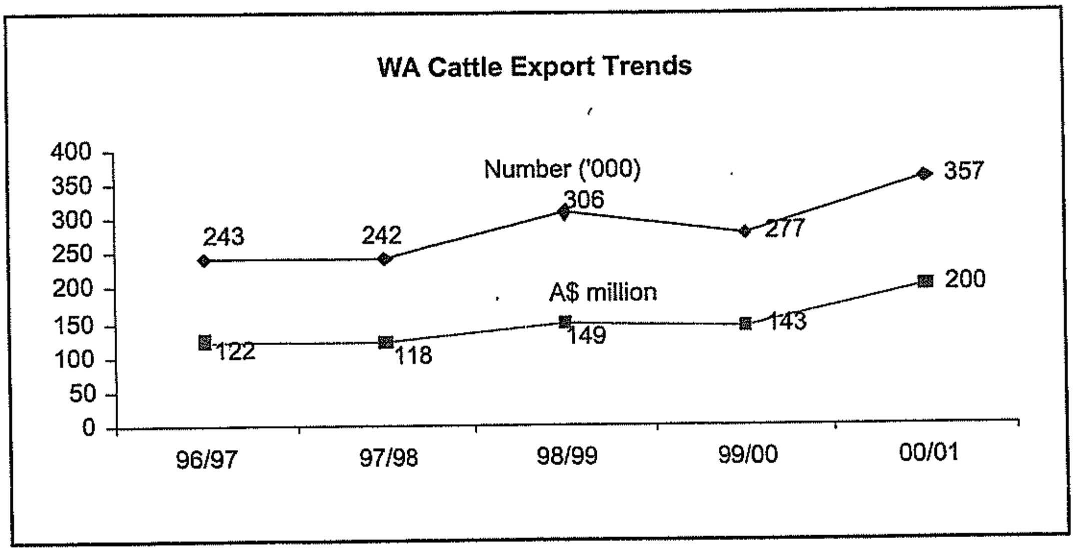
Introduction

Western Australia is the largest exporter of live animals in the world. Total meat and live animal exports in 2000/01 were valued at $680 million with live animal exports of cattle and sheep comprising 58% or $395 million. The live cattle component was valued at $200 million (51%) with the live sheep trade a further $195.3 million (49%).



The reliance of the north on live cattle exports

Total numbers from the Northern Pastoral areas have fluctuated over the past five years according to market pressures. In 1996/97 some 135,429 (56%), of the cattle exported from WA came from the Northern ports of Wyndham, Broome, Port Hedland and Darwin. Most of these went into Indonesia and Malaysia. In 2000/01 following the South East Asian decline of 1997/98 this had stabilised at about 52.4% (187,054).of the total exports of 356,892 head but the majority went to the Egyptian market. This has indicated a major market swing and the introduction of larger ships carrying above 8000 head aimed at economy of scale in shipping costs.

Northern ports

1996/97	135,429 (56%)
1997/98	109,289 (45%)
1998/99	150,974 (49%)
1999/00	121,472 (44%)
2000/01	187,054 (52%)

Some cattle from the north of Western Australia are transported south for sale and eventual shipment through Fremantle and Geraldton. However, given relative cattle population numbers between the North and South, the reliance of northern producers on the live cattle market is significant.

Such reliance on the live cattle sector has come about because of the reduction in processing options, road transport costs, reduced beef export returns and the difficulty of finishing cattle in a rangeland environment.

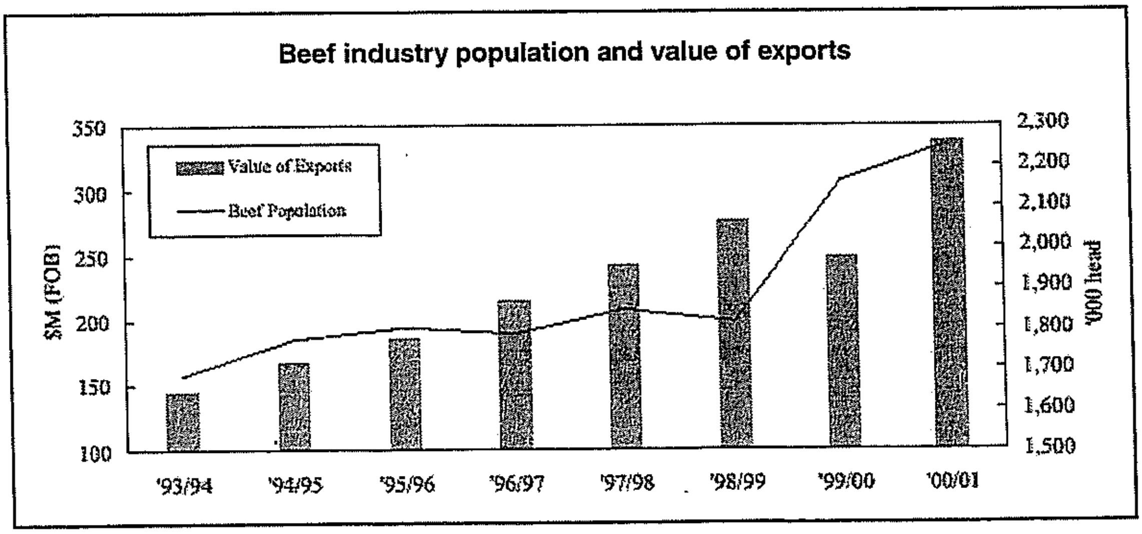
Kimberley cattle numbers and industry turnoff

	Abattoir	Stores	Live export	Gross turnoff	Total Kimberley cattle no.
1990	67,000	10,000	19,000	96,000	600,000
1991	70,000	20,000	10,000	100,000	510,000
1992	46,000	50,000	15,000	111,000	550,000
1993	36,554	25,331	27,135	89,020	500,000
1994	26,896	19,358	51,332	97,586	470,000
1995	11,552	27,680	42,427	81,659	450,000
1996	10,964	26,327	56,926	94,217	
1997	18,354	20,370	72,294	111,018	
1998	26,175	13,684	75,884	115,743	
1999	9,394	15,698	116,075	141,167	
2000	5,990	26,513	107,048	139,551	

Source: Department of Agriculture.

The live cattle export markets over the past five years have been marked by the volatility of demand and prices. However the pleasing feature has been the development of a broader base of countries importing Western Australian cattle. We now have seven major markets and three or four minor markets with the possibility of this base expanding into countries such as China, Vietnam, Mexico, USA, Korea and Thailand in the future.

Despair and gloom apparent early in 1998 has been replaced by a sense of optimism as market demand has grown to the point where the supply of cattle to meet this demand has now become critical. Improved seasonal conditions in Northern Western Australia have allowed producers to grow out cattle to meet the stringent market requirements in the Middle East and North Africa and enable access to higher returns through prices and individual cattle weights.



What are strategic alliances or supply chain management systems?

It is time to break with tradition. Up until now, most Australian primary producers have been satisfied to supply agricultural products into domestic and export markets with very little understanding of anything other than price.

Australian agriculture has been traditionally based on the production of commodities where the total value to the production chain is fixed by prices set by others. The main task then becomes to divide the pie between the participants and historically primary producers under this system have been getting less and less share. This fight for share naturally leads to a serious adversarial environment that can only get worse.

It is therefore not surprising that in commodity markets information flow is very limited and participants remain locked in a production driven world in isolation from their customers.

The solution is to differentiate products to make the pie bigger. As producers differentiate their products and add a service component there is more opportunity to add value. Once this process is commenced there is an environment created that encourages an acceleration of the process.

Many producers now recognise the need to add value to their products by tapping into more specific consumer demands.

Today customers demand, and are prepared to pay a premium for, quality, consistency and service. This new consumer can only be identified and satisfied by an understanding of the market and very close cooperation between all sectors in the supply chain.

In response to this change many producers are recognising the need to work more closely with the people that market their products.

Alliances can be defined as a formal relationship between different sectors of the supply chain to utilise the combined resources, information and skills of the partners, for the mutual benefit of the group.

Strategic Supply Chain Alliances between producers and other sectors in the chain are becoming very common right around the world. In Western Australia we have a number of examples of very successful alliances marketing agricultural products on domestic and export markets.

Once a strategic supply chain alliance is in place information received directly from the market place can be used to develop strategies to more effectively and profitably meet consumer needs. Technical assistance and research can be much more consumer focused and rewarding if delivered within the framework of an alliance.

Alliances are about quality, customer satisfaction, exchange of information, efficiency, improvement and mutual trust. They are aimed at ensuring the demands of the customer are fully met, establishing long term trading commitments, each participant sharing in the collective wisdom of the group, participants benefiting from market certainty and higher long term returns.

These benefits do not accrue straight away and it may take some considerable time before the necessary level of trust is achieved. As the level of investment in the alliance increases then the level of interdependence grows. Investment can be people, time, reputation, skills or capital. Supply chain alliances in the agricultural sector are usually management intensive rather than capital intensive. This growing dependence on each other tends to cement the alliance over time.

There are a number of key elements to the formation of a successful supply chain alliance.

- **Vision.** There must be an agreed long term strategic vision for the alliance.
- **Conflict.** The long and short term goals of the partners must be compatible.
- **Investment required.** Time, reputation, skills or capital.
- **History.** A previous relationship of conflict is not a good foundation for a successful alliance.
- **Acceptance of change.** Both parties need to accept that change from traditional methods is necessary.
- **Risk.** Understanding and managing risk is important.
- **Sharing rewards.** Win-win is critical but systems need to be in place to manage this issue.
- **Practical performance.** Vision is important but equally so is the ability to perform all the practical tasks of the business on a daily basis.
- **Culture.** The relationship must change from buyer seller to one of partnership trust.
- **Management.** The robustness of the management system is the key to the functioning of the alliance and the building of trust.

Debate and discussion about the benefits of supply chain alliances has been overtaken by the development of fast response supply chains. The key is now not that you have to respond to customers' needs but how quickly this can be achieved.

Agriculture Western Australia has a Strategic Alliances Program specifically designed to assist all sectors of industry develop alliances and opportunities in domestic and export markets.

Assistance starts with an initial consultation meeting to explore an idea or need.

Further assistance then depends on the circumstances of the project but may include:

- alliance formation;
- market research;
- market contacts;
- group formation;
- sourcing technical assistance;
- sourcing funding assistance;
- management and strategic planning assistance.

Strategic alliances are being developed throughout the world by leading companies with like minded partners in Europe, USA, and premium Asian markets. In a globally competitive environment such cooperation produces successful long term market positioning enabling a continual process of product development.

Efficiency gains within these supply chains are quoted at around 5–7% which is significant in the international trade arena.

We have all been made very aware of the volatility of the live export market with the downturn in the Asian economy and hence the live cattle demand in late 1997 and early 1998. Producers who had spent the previous five years fine tuning their breeding and productivity to this market suddenly had nowhere to market their cattle. Fortunately it was a relatively short market correction which will in reality have long term benefits to the trade.

Alternative markets have developed in the Middle East, North Africa, Mexico, Vietnam and possibly China.

Developing a long term relationship with a trading partner, understanding the trends and directions of the market and gaining an insight into the costs, returns and margins of all components of the supply chain will assist in removing this volatility and bring stability to the industry for those producers prepared to position their businesses into the 21st century.

What has been done to date

For the past three years Agriculture Western Australia has been actively seeking suitable Asian trading partners to begin the process of establishing supply chain systems. The importance of selecting the prospective trading partner and matching them to producer groups cannot be over emphasised.

The reasons behind this pursuit of supply chain partners arose from the inability of producers to access vital feedback information on their livestock performance from the established exporters in the system. Exporters jealously guarded this information and utilised it to maintain their market share but refused to share it with the producer base. Producers were being paid for cattle on the 'averaging' system regardless of the quality or performance of their cattle in the feedlots.

At the same time importers in Indonesia were complaining about the failure of exporters to supply all cattle in a consignment to specification. Approximately 15–20% of most consignments did not meet the contractual specifications and as a result failed to perform in the feedlots. Importers had no knowledge of the producers supplying them, no information about their production systems, breeding programs, where they were located, variation in seasonal conditions or other constraints/opportunities that might exist.

Some of our producers had visited these feedlots and importers/feedlotters had visited some producers properties' but still no information flowed between the groups.

After a couple of failures at targeting feedlotters in Indonesia and in utilising broad based producer meetings to put the Alliance concept across we were approached through a previous overseas contact by a relatively new company in Indonesia interested in pursuing Supply Chain Partnerships.

Manana Alliance

Manana Alliance consists of a group of seven Kimberley and Pilbara stations who formally committed to work together in 1999 to establish long term supply chain systems in the live cattle export market.

The group have a Supply Chain Alliance with PT Santosa Agrindo (Santori) a major Indonesian feedlotter with feedlots in Lampung (Southern Sumatra) and Probolinggo near Surabaya in north eastern Java. Santori imported 74,000 head in 2000 (28% of the Indonesian total imports) and expect to import 85,000 head in 2001.

Why build an alliance?

- Producers wanted to know who they were dealing with.
- Producers wanted performance feedback information.
- Producers were being paid on the 'averaging' system regardless of quality or performance.
- Importers were getting 15–20% of shipments out of contractual specifications.

- Importers wanted repeat business with producers of quality cattle that performed in the feedlots.
- Importers wanted 'security of supply'.

Market opportunities

To be able to access market opportunities producers require some basic background information:

- they need to have an intimate knowledge of their cost of production;
- have a capability statement of what they produce;
- have a production timetable;
- become involved past the Farm gate through marketing groups or supply chain alliances;
- have a capacity to leverage the market;
- find out who are their customers and what they want.

Market research

This should be aimed at:

- identifying potential markets;
- identifying special periods of market demand (Ramadan, Id Ul Fitr, Hajj, Chinese New Year, Northern Hemisphere seasons);
- go and investigate potential markets;
- build linkages with the end user/consumer/feedlotter;
- begin to supply in small volumes;
- build performance base, negotiate profit sharing;
- be prepared to accept some risk (no pain, no gain).

Changes to the production cycle, the efficiency of production and type of product produced will open up opportunities for producers to access new and possibly higher value markets. These opportunities will be closely linked to the cost of production so it is vital that production efficiencies are maximised to give producers profitable returns.

Results to date

- 1999 shipped 4700 head ($1.65 million).
- 2000 shipped 10,000 head ($4.2 million).
- 2001 anticipate supplying 15,000 head.
- Feedback performance information supplied on all shipments.
- Performance bonuses of up to $12 per head paid to members (4 cents per kg).

Feedlot performance parameters

- 1999/2000 – 1.35 kg/day for steers on 120 day feed, 1.25 kg/day for heifers on 90 day feed.
- In 2000 achieved 1.44 kg/day for steers on 102 day feed and 1.33 kg/day for heifers on 90 day feed. This includes deaths and salvage slaughter.

- For 2001 will be 1.6 kg/day for steers on 90 day feed and 1.5 kg/day for heifers on 70 day feed.

What happens now?

- Continue to develop the Manana/Santori Alliance focusing on quality and performance.
- Diversify our market base into Malaysia.
- Seek markets to increase flexibility of specifications to include those specifications not handled by Santori.
- Build the Alliance membership and supply volumes.
- Tighten the supply chain to achieve efficiencies and hence returns for all components of the chain.

Conclusions

- There are no premiums in the market place.
- Premiums are in 'profit sharing' and must be earned through performance and supply chain efficiencies.
- Remember whatever you do must fit into your farming system.
- You **must** be committed and have ownership.
- You **must** have adequate supply volumes or the capacity to grow the supply volumes.
- You **must** become involved further down the supply chain.

'INSANITY IS DOING THE SAME THING AND EXPECTING THE RESULT TO BE DIFFERENT NEXT TIME.'

Reference

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Notes

Notes

Toorak live export link project

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Abstract

Since 1997, 1200 steers in 48 separate groups have been monitored as they progressed through the pasture growth, transport, and feedlot phases of the live export chain. The steers were grazed in five separate intakes at Toorak Research Station, Julia Creek.

Factors influencing pasture performance, apart from seasonal variation, were the number of days weaned prior to delivery, weaning age, and condition at delivery. The importance of managing cattle to take advantage of wet season pasture growth was demonstrated. Copra meal supplementation was implemented with one intake. The benefit cost ratio was 4:1.

The live weight loss of steers trucked from Toorak to wharves at Karumba and Townsville varied from 5.7 to 9.9%. Feedlot gains in the Philippines ranged from 0.95 to 1.8 kg per head per day for different intakes. Overseas comment on the suitability of cattle and their carcases was positive.

A sub group of steers too heavy for export gained 1.53 kg per day in a central Queensland feedlot.

Background

Interest by North West Queensland Beef Improvement Association members in a grow out trial, and the development of the Queensland Beef Industry Institute project 'Live Export Link', were key elements initiating this project at Toorak in 1997.

Toorak is a Department of Primary Industries Research station located 50 km south of Julia Creek. The landscape is gently undulating. The soils are mostly grey cracking clays with a dominance of Mitchell grass and associated plant species.

Project objectives were:

- provide feedback to producers on the performance and suitability of their cattle progressing through the live export chain;
- provide a forum for industry sectors to advance their knowledge of the live cattle trade;
- provide opportunity for industry to identify and subsequently develop and participate in research activities for the live export trade;
- contribute to the development of baseline weight change information on cattle as they progress through the live export chain.

Methodology

There have been five intakes of weaner steers from North Queensland properties. Intakes were assembled over a two to three week period, prior to the commencement of wet season pasture growth. In an attempt to minimise gut fill influences due to travel and property of origin factors the initial weighing was planned for two weeks after all cattle had arrived. This was not always possible due to unpredictable weather and other factors.

For each intake, producer participants in consultation with QBII developed specifications for the delivery of steers. Specifications included live weight, age, HGP status, number and delivery period.

Weighing on a wet overnight curfew basis, as well as condition scoring and faecal sampling, occurred at two monthly intervals. This information was used to plan supplementation strategies and marketing. When weight dropped to near maintenance, supplementary feeding was undertaken with urea salt loose licks and on one occasion copra meal.

During the transport and overseas feedlot phases steers were weighed:

- individually prior to departure from Toorak (no curfew – 2–6 hours prior to transport);
- in half deck lots (Karumba) or individually (Townsville) over the wharf weighbridge;
- on an individual basis shortly after the public weighbridge weighing (Karumba);
- in half deck lots prior to loading on the boat (if possible);
- in mixed groups on trucks after unloading from the ship;
- individually upon arrival at the Asian feedlot;
- individually at the feedlot every month (no curfew);
- individually prior to departure from the feedlot;
- individually prior to slaughter;
- individually as carcases.

The extension model for the project was based on the Participatory Action Research (PAR) model where producers are involved in setting up and implementing the research. Contact with the owners in decision making was consistently maintained and information exchange was frequent.

Results

A complete data set has been obtained from four intakes of steers. A fifth and final intake, not yet marketed, remains at Toorak. A sub group of steers from Intakes 3 and 4 that were too heavy for the live export trade were monitored through a central Queensland feedlot.

Pasture phase

Initial weight, final weight, total gain and daily gain for each the first four intakes are shown in Table 1.

Table 1. Steer performance at pasture – Intakes 1 to 4

Intake	Initial weight (kg)	Final weight (kg)	Weight gain (kg)	Average daily gain (kg/hd/day)
Intake 1	194 (Nov 97)	349 (Sep 98)	141	0.48
Intake 2	345 (May 99)	378 (Oct 99)	33	0.20
Intake 3	222 (Aug 99)	424 (Aug 00)	202	0.56
Intake 4	212 (Dec 99)	390 (Aug 00)	178	0.68

The major influence on performance, was time of arrival at Toorak closely followed by seasonal conditions. Intake 2, arriving at Toorak in May 1999, had no opportunity to utilise wet season pasture growth. Intakes 3 and 4 had the benefit of above average seasonal conditions.

The importance of utilising wet season pasture growth was further demonstrated with Intake 5 in 2000/01. The wet season commenced prior to all groups arriving at Toorak. With subsequent disruption to mustering and road closures assembly took five months. Growth rate of steers until August 2001 is shown in Table 2.

Table 2. Growth of steers – Intake 5

Entry month	Entry weight (kg)	Final weight (kg)	Weight gain (kg)	Average daily gain (kg/hd/day)
Dec. 00	182	342	160	0.65
Jan. 01	251	336	85	0.43
Feb. 01	192	257	65	0.39
Apr. 01	307	335	32	0.27

Other factors to influence performance were the number of days weaned prior to assembly, age at weaning, condition at delivery and soil type of the property of origin. Generally older steers, especially those in lower condition from forest country, which had been weaned for several months prior to delivery, out-performed younger freshly weaned steers in better condition from properties with more fertile soil. Due to these factors breed or property comparisons were not possible.

From mid August 1999 through to sale in October 1999, Intake 2 steers were fed copra meal. Intake averaged 319 g/hd/day at a supplement cost of 11¢/hd/day. Live weight gain during the feeding period was 0.37 kg/hd/day to return a benefit cost ratio of 4:1.

Transport and shipping phase

Weight loss from property to wharf ranged from 5.7 to 9.9%, while live weight change during the shipping phase ranged from –0.027 to +0.015%. No transport mortalities were recorded although two steers from Intake 1 were slaughtered off ship due to injury.

Intake 1: Steers were trucked overnight from Julia Creek to Karumba on 17 September 1998. They were shipped the following day to Subic Bay in the Philippines; a 12 day journey. Transport weight change is outlined in Table 3.

Table 3. Transport weight change – Intake 1

Toorak full weight	17 Sep. 98	349 kg
Empty weight off trucks Karumba (mob weight)	18 Sep. 98	327 kg
Average weight loss – Toorak (full) - Karumba (mob weight)		6.3%
Individual fasted weight at Karumba	18 Sep. 98	321 kg
Average weight loss – Toorak (full) - Karumba (individual weight)		8.1%
Average weight at Subic Bay Public Weighbridge in truck lots*	30 Sep. 98	332 kg
Average weight at Subic Bay Public Weighbridge in truck lots*	30 Sep. 98	332

* Curfew status unknown.

Intake 2: Steers were trucked overnight from Toorak to Townsville on 19 October 1999. They were shipped five days later and arrived in General Santos in the Southern Philippines after a nine-day journey. Transport weight change is outlined in Table 4.

Table 4. Transport weight change – Intake 2

Toorak full weight	19 Oct. 99	394 kg
Empty weight off trucks at Townsville	20 Oct. 99	355 kg
Average weight loss – Toorak (full) – Townsville		9.9%
Full weight prior to shipping	25 Oct. 99	364 kg
Weight into feedlot, General Santos	3 Nov. 99	349 kg

Intakes 3 and 4: Intake 3 arrived at Toorak in August 1999 and Intake 4 in November 1999. Steers were subsequently managed as one group. An early start to the wet season, followed by good rain for several months in early 2000 meant that 53% of steers were too heavy (over 380 kg) for the cooperating overseas feedlot. These 212 steers were transported to a central Queensland feedlot on 18 October 2000. Steers (192 head) meeting live export specifications were sold on 9 September 2000.

Table 5. Transport weight change – Intakes 3 and 4

Toorak full weight	8 Sep. 00	386
Empty weight off trucks Karumba	9 Sep. 00	364
Average weight loss – Toorak (full) – Karumba		5.7%
Full weight prior to shipping	10 Sep. 00	358
Weight on arrival at feedlot	18 Sep. 00	354

Overseas feedlot phase

Details of the feeding programs are summarised below:

Intake 1: After arrival at Subic Bay near Manilla, Philippines, steers were fed for an average of 61 days on chopped corn and wet spent grain.

Intake 2: After arriving at the port of General Santos in the southern Philippines steers were fed for 88 days before transport to a slaughterhouse in Manilla. The ration consisted of corn chop, pineapple pulp and a cattle concentrate.

Intakes 3 and 4: Steers marketed to the Philippines were sent to the same feedlot as Intake 2 and fed for 91 days.

The cattle performed well in the feedlots with average daily gains of 0.95 to 1.83 kg/hd/day (Table 6).

Table 6. Summary of overseas feedlot gains

	Intake 1	Intake 2	Intakes 3 and 4
Entry date	30 Sep. 98	5 Nov. 99	18 Sep. 00
Initial weight (kg)	332	334	354
Final weight (kg)	390	495	487
Average daily gain (kg/hd/day)	0.95	1.83	1.46
Carcase weight (kg)	210	253	274
Dressing percentage	53.8	53.3	56.3

Performance of Intakes 3 and 4 in a Central Queensland feedlot

The performance of cattle in the central Queensland feedlot is shown in Table 7.

Table 7. Performance of steers in central Queensland feedlot

Final Toorak weight (full)	18 Oct. 00	442 kg
Initial feedlot weight	20 Oct. 00	396 kg
Final feedlot weight	10 Oct. 00	569 kg
Average daily gain (kg/hd/day)		1.53
Carcase weight	14 Feb. 00	323 kg
Dressing percentage		56.7

Live export link project activities

A highlight in project activities was visits to Toorak by a group of Asian feedlot owners as well as a group of Vietnamese dignitaries on an Austrade organised visit. Ross Dodt (project leader), Jeff Forster and Damien Terry (two of the owners) visited the Philippines. Other activities included field days involving keynote speakers and meetings with cattle owners. Numerous phone links have been held with the owners to develop strategies for the direction of the project and to discuss marketing issues and project progress.

Conclusions

This project has established benchmark information on cattle performance during the pasture, transport and feedlot phases of the live export chain. The pasture phase information reinforced the necessity for good nutritional management of younger freshly weaned cattle and the importance of managing cattle to take advantage of wet season pasture growth. It also demonstrated that a wide range in financial returns would have been evident had the steers been purchased to grow out at Toorak..

The transport information demonstrated that north Queensland cattle can safely endure domestic and international travel. The implication of gut fill on transaction weight is significant and variable. Management and husbandry practices were also highlighted.

The overseas feedlot information reinforced the range in performance between animals, the importance of quiet tractable cattle and the difficulties of meeting market requirements. The favourable comments about suitability of project cattle to overseas clients has not yet been exploited.

The project also demonstrates how 'adult learning principles' can be successfully incorporated into a research project. Changes to property use and management by participants occurred as a result of involvement in the project. An improved understanding of the live export trade has been gained by all associated with the project.

Notes

Notes

Estimating age from weaning weights of cattle in Northern Australia

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Abstract

In northern Australia the large size of properties and the vast numbers of cattle make recording the birth date of all calves born each year impossible. However since age is a key element in any system of trading cattle by specification, it would be beneficial to have some method of determining it. One such method was proposed and studied.

Birth dates and weaning weights were recorded for male calves in the stud herd of a large commercial property (on Mitchell grass in the NT). From this it was possible to examine the relationship between an equation that predicts calf age from weight, and actual age. It was found that the correlation between estimated calf age and actual age was significant ($P < 0.001$) and had a R^2 of 0.794. The accuracy of this equation was tested on this data set and found to be acceptable (±1.5 months).

Data collected at Kidman Springs Research Station over several years was then used to see whether one calculation of growth rate to use in the equation would suffice or if the growth rate of calves between years was too variable to allow this. It was found that sex, year, and season (wet or dry) had a significant effect on growth rates ($P < 0.001$) and that although wet season calf growth rates were quite constant over years, that dry season calf growth rates varied significantly ($P < 0.001$) from year to year.

This means that for most accurate prediction of calf age, a growth rate should be calculated each year. However data from this study and from work in north Queensland shows that it would be reasonable for practical purposes to assume that growth rates for calves in northern Australia are 0.8 kg/day in the wet season and 0.65 kg/day in the dry season. At least a once off calculation of growth rate on a property would be advisable to see how the growth rates achieved there compare to these figures.

The way this information could be used in the identification and management of calf age groups is briefly discussed.

Introduction

The Northern beef industry continues to develop rapidly. At some stage in the future the emphasis will move from supplying a commodity to producing a product that meets market specifications. Markets such as feedlots in South East Asia will continue to develop and begin to recognise the types of animals that are most profitable for them to finish (Quenby 1999). It follows that they will know the specifications of the animals that they prefer and that they will pay premiums for these animals. When this will occur is uncertain, but once the decision is made, the changes (such as paying premiums for suitable cattle) could happen overnight. It is in the interests of northern Australian cattle producers to be in the position to meet the demand for these animals as buyers will look elsewhere if they can't find them in northern Australia (Sid Parker 2001). There are also opportunities to strengthen market ties and enter into forward selling contracts if north Australian producers can produce animals that meet the market specifications.

Identifying the likely market specifications and methods of producing animals that meet them is a challenge. But it is likely that one of the key market specifications in any system of selling cattle by description, will be the age of animals. Obviously on the large properties in Northern Australia it is not possible to record the birth date of all the animals that are born. This is especially the case on properties where cattle are continuously mated as most are in

Young weaner [illegible] may have been born on [illegible] 25th Oct.

the Northern Territory. This paper outlines a method of estimating the age of weaners that is accurate (±1.5 months) and practical for extensive situations.

Methods

Predicting age from weaning weight

Date of birth was recorded for male calves born in a Brahman stud herd grazing predominantly Mitchell grass pasture on a large company property in the Northern Territory (the manager of the property has requested that the origin of the data be kept confidential).

The weight at weaning of these calves was recorded in March/April 1999. Growth rates from birth to weaning were calculated for the calves with the assumption that the birth weight of the calves was 30 kg.

This data set was used to test an equation that predicts age from weight and the herd average growth rate. The equation was:

Age (days) = Weaning weight (kg) – Birth weight (30 kg)/Average growth rate (kg/day)[1] *Equ. 1.*

Using Statistica (StatSoft 1995), Pearson's correlation was then used to examine the accuracy of the relationship between predicted age and actual age (the data were found to be normally distributed using the Shapiro-Wilk's W test).

Variation in growth rates

Data collected between 1993 and 2000 at Victoria River Research Station ('Kidman Springs' – 16°7'S., 130°57'E.) was used to examine whether the growth rate of calves was consistent over years, seasons and between sexes (site details of 'Kidman Springs' have been reported by Sullivan and O'Rourke (1997)). Data for 1994–95 was not available.

At 'Kidman Springs' there are two rounds of weaning each year. The first round (R1) muster and weighing is usually done in April and the second round (R2) in October. Calves are weighed at each of these rounds and those that are heavier than 100 kg are weaned while those that weigh less than 100 kg are returned to their dams and weaned at the next weaning round.

The data from calves returned to their dams was used to calculate average growth rates between the two dates on which they were weighed[2]. Growth rates calculated over the period from R1 to R2 (April to October) measure growth over the dry season and are subsequently called dry season growth rates. Similarly growth rates calculated over the period from R2 to R1 (October to April the next year) measure growth over the wet season and are subsequently called wet season growth rates.

The ANOVA/MANOVA module within Statistica (StatSoft 1995) was used to examine the differences in average growth rates to weaning between seasons, years, and sexes.

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[1] The method used to calculate growth rate in this equation was slightly different to the way it would normally be calculated. In this instance the two weights available were birth weight (30 kg) and weaning weight. Normally the weight measured before an unweaned calf was sent back to its dam would be used instead of birth weight.

[2] The equation used was:

Growth rate (kg/day) = (Weaning weight – Weight1)/Number of days between weighings *Equ. 2*

Where Weight1 is the first weight recorded for a calf.

Results

Predicting age from weight

The age/weight data was found to be normally distributed showing that it was a suitable data set on which to test the equation.

The average weight of the calves at weaning was 238 kg (Max. = 321 kg, Min. = 157 kg and N = 44).

The accuracy of the equation in estimating age was tested by comparing the estimated ages to the actual ages. The correlation between them was found to be highly significant ($P < 0.001$) and the R^2 was 0.794 (see Figure 1).

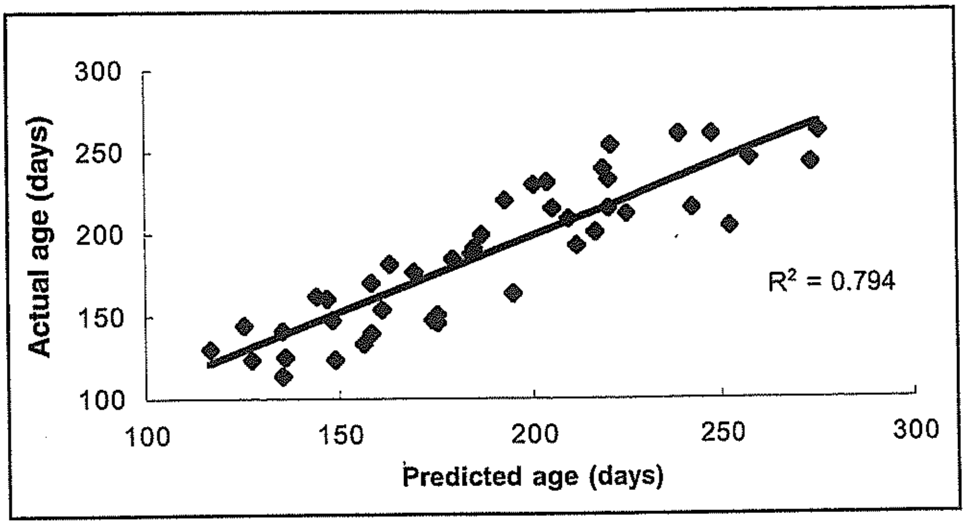

Figure 1. Correlation of predicted age with actual age for male Brahman weaners.

The source of the variation between the estimated age and the actual age for an animal is the difference between that animal's actual growth rate and the herd average growth rate (the denominator in equation 1). The difference between the actual age and the estimated age varied from -34 to +47 days (i.e. ± a maximum of 1.5 months) with the average difference being 17 days (see Figure 2).

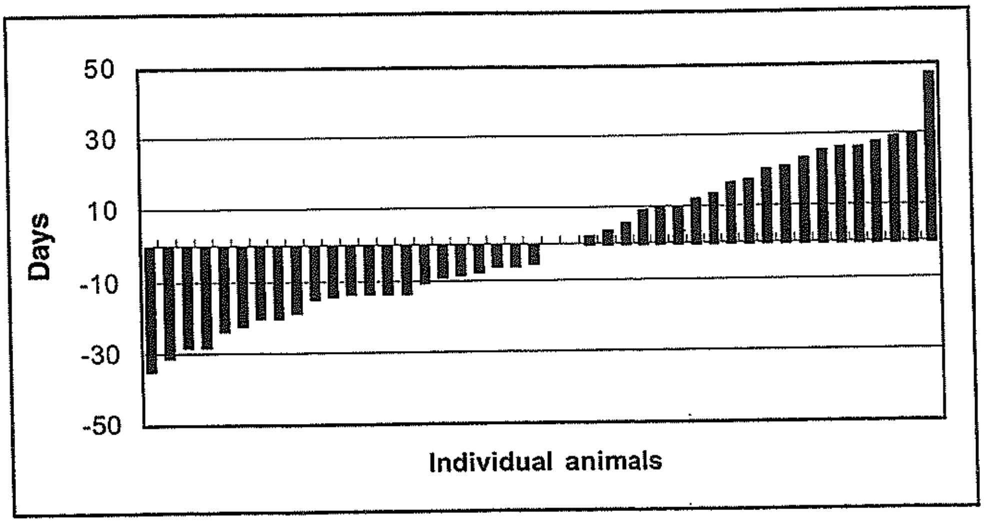

Figure 2. Number of days predicted age varied from actual age (N = 44, max. wt. = 321 kg, min. wt. = 157 kg).

Variation in growth rates

Sex, year and season (wet or dry) were all found to have a significant effect ($P < 0.001\%$) on calf growth rates (see Table 1). In summary males on average grew at 0.05 kg/day (7% faster than females). In the wet season calves grew at 0.2 kg/day (24%) faster than in the dry season. The average growth rate in different years varied by up to 0.18 kg/day (22%).

When the year effect on average calf growth rates in the different seasons (wet and dry) was examined, it was found that while there was a significant ($P < 0.01$) effect of year on average dry season growth rate, there was no significant effect of year on wet season growth rate (see Table 1).

Table 1. Average daily growth rates at 'Kidman Springs'

Factor	Variable	Average growth rate (kg/day)	N
Sex	Male	0.76 $_{B}$	327
	Female	0.71 $_{A}$	377
Season	Dry	0.64 $_{A}$	375
	Wet	0.83 $_{B}$	329
Year	93–94	0.75 $_{C}$	142
	95–96	0.65 $_{A}$	54
	96–97	0.65 $_{A}$	99
	97–98	0.64 $_{A,B^*}$	99
	98–99	0.69 $_{A,B^*}$	82
	99–00	0.82 $_{D}$	131
	00–01	0.81 $_{D}$	97
Wet season over years	93–94	0.85 $_{A}$	74
	96–97	0.83 $_{A}$	17
	97–98	0.85 $_{A}$	26
	98–99	0.83 $_{A}$	39
	99–00	0.84 $_{A}$	76
	00–01	0.81 $_{A}$	96
		Average = 0.83	
Dry season over years	93–94	0.64 $_{B}$	68
	95–96	0.64 $_{B}$	53
	96–97	0.64 $_{B}$	82
	97–98	0.57 $_{A}$	73
	98–99	0.55 $_{A}$	43
	99–00	0.79 $_{C}$	55
		Average = 0.64	

Averages with different letter subscripts are significantly different ($P < 0.01$) (except for those marked * where $P < 0.05$).

The effect that using different growth rates has on estimating age using the equation was examined. It was found that for each 0.10 kg/day increase in the growth rate used, there is on average a 12% decrease in the estimated age of an animal at the same weight (see Figure 3). This means that the variation in estimated age associated with using a different growth rate in the equation, increases as the weight (and age) of the animal increases (see Figure 4).

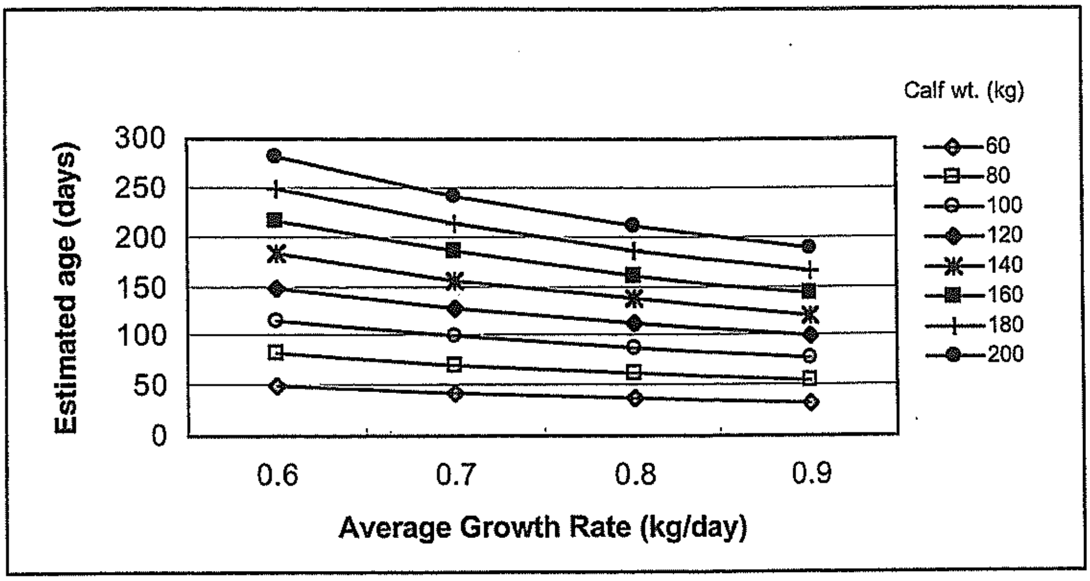

Figure 3. Estimated ages from calf weights using different growth rates.

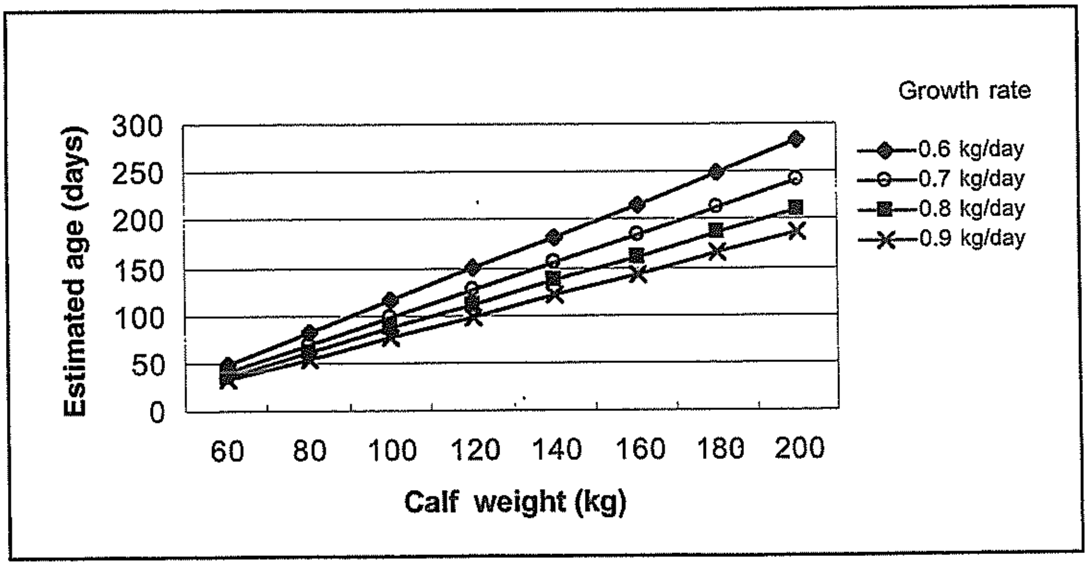

Figure 4. The effect on estimated age of using different growth rates in the equation.

Discussion

The strong correlation between the actual and estimated age of weaners demonstrates that it is possible to use the equation proposed in this study to predict calf age with confidence in its accuracy if the average growth rate is known.

The calf growth rates measured at Kidman Springs are similar to those reported by Holroyd *et al.* (1979), Holroyd *et al.* (1983) and Winks *et al.* (1978) in north Queensland. The 6% advantage in growth rate of males over females is also consistent with the findings of Holroyd *et al.* (1979) and Winks *et al.* (1978).

The findings of this study that average dry season growth rate varied significantly between years while average wet season growth rate did not, is likely to be due to the nutrition available to the calf during each season. In the wet season, nutrition is less likely to be limiting and an adequate milk supply from a calf's dam would be likely to buffer a difference in pasture conditions between years. However in the dry season nutrition is more likely to be limiting both for calf growth and cow milk production (Winks *et al.* 1978). The extent to which the nutrition is limiting due to the seasonal conditions each year would be reflected in the calf growth rates. This would be expected to result in greater variation of growth rates from year to year than occurs in the wet season.

Figure 4 shows that the earlier a calf's age is estimated, the more accurate that estimate is. Obviously the difference in an animal's actual growth rate from the herd average (which is the source of error in the estimation of age using this equation) will have less of an effect on the estimated age of a small calf than a big one. For example the estimated age of an 80 kg calf is nine days less when 0.8 kg/day rather than 0.7 kg/day is used as the average growth rate. However for a 200 kg calf the estimated age is 30 days less (see Figure 4). In practice this means that for more accurate estimations, a calf's age should be estimated as soon as possible (the first time it is weighed).

Figure 4 also shows the effect in absolute terms (days) that using different growth rates in the calculation has on age. This information can be used to decide how accurately growth rate needs to be calculated. For most accurate predictions of age a growth rate should be calculated for males and females each season. However the data from this study and work done in north Queensland (Winks *et al.* 1978) shows that for practical purposes it would be quite reasonable to use assumptions such as that the average growth rates are 0.8 kg/day in the wet and 0.65 kg/day in the dry, and that males usually grow 6% faster than females.

The actual average growth rates over the years in this study were 0.83 kg/day for the wet season and 0.64 kg/day for the dry season. These are quite similar to the values found by Winks *et al.* (1978) at 'Swans Lagoon' (north Queensland) who found that calves born early in their calving season (approximately November to March) grew at 0.79 kg/day and calves born late in the season (and therefore likely to be weaned at the second round having grown through the dry season) grew at 0.66 kg/day.

In the data collected over six years from 'Kidman Springs', the 95% confidence intervals for the average wet season growth rate was 0.82 to 0.85 kg/day. The corresponding 95% confidence intervals for average growth rate over the dry season were 0.62 to 0.65 kg/day.

The small range between the upper and lower confidence intervals (0.03 kg/day), gives good reason to be confident in the accuracy of the equation to predict age (as the source of error in the equation is the difference between an animal's actual growth rate and the herd average). Although Figure 2 showed that a few animals (in part 1 of this study) had a difference between their actual and estimated ages of about 1.5 months, the fact that 95% of animals in a much larger data set (the 'Kidman Springs' data) had a growth rate within a range of 0.03 kg/day (0.015 kg/day of the average) shows that in the majority of cases the error in the predicted age will be small (about six days in a 180 kg weaner). In practice to be able to estimate age to within ±1.5 months is quite adequate. Note that Figure 3 showed that a 0.1 kg/day difference in growth rate changed the estimated age by 12% which was only nine days in 80 kg calves and 30 days in 200 kg calves.

Practical application

The age of animals is an essential part of a description system for the selling of cattle. Since it is impractical to record the birth date of all calves born in northern Australia, a method of estimating their age is required for use in description systems. The technique described in this paper can be used to estimate the age of calves from their weight. Once a calf's age is estimated it could be identified by a method such as ear tagging and allocated to a management group according to its age. A simple, practical way of doing this might be as follows.

1. Calculating growth rate

A growth rate for use in equation[1] needs to be either calculated or assumed. Calculation of the growth rate can be done as follows.

A wet season growth rate would be calculated at round one (R1) from the calves that were weighed, tagged and returned to their mothers at round 2 (R2) the previous year. The equation for this calculation is:

Growth rate (kg/day) = (Weight at R1 – Weight at R2 previous year)/The number of days between those 2 weighings.

The growth rates of all the calves with two weights would then be used to obtain an average.

If this method of calculating growth rate is deemed to be too labour intensive then the assumed growth rates of 0.8 kg/day for the wet season and 0.65 kg/day for the dry season could be used to give reasonable estimates as they are close to the average growth rates over a number of years found in this study and by Holroyd *et al.* (1979) and Winks *et al.* (1978) in north Queensland.

2. Estimating and identifying age

The age of calves can be quickly estimated from their weight using the equation proposed in this study. Actual estimates of age for individual calves could be kept on a data base, but on most properties in northern Australia this would be too laborious and a simple system of identifying age where records do not have to be kept is possible. This would involve tagging calves as they are weighed with an ear tag, the colour of which signifies an age range.

Rather than do a calculation each time an animal is weighed, several quick calculations would be done before the cattle come into the yards to give weight ranges that correspond to age ranges that could become management groups. For example if the average growth rate is assumed to be 0.8 kg/day, calves weighing 60 kg are estimated to be 38 days old and calves weighing 100 kg are estimated to be 88 days old. Any calf whose weight falls in this range would be tagged with the same colour ear tag identifying it as a part of this management group. At any stage later in life, such an animal's approximate age can be known from its year brand and the colour of its ear tag. Groups of calves with the same colour ear tags can then be marketed as animals of a known age and weight, and if required, be managed differently to meet market specifications.

Table 2. A tagging system to identify the age of calves

Weigh date	Weight range	Tag colour	Age (+ or – 2 months)	Month born	Brand this year	Brand next year
R1	< 60 kg	White	< 38 days	Mar.'01 to Apr.'01	1	2
e.g. 7/4/01	60 – 100 kg	Yellow	38 to 88 days	Jan.'01 to Feb.'01		
	101 – 140 kg	Green	89 to 138 days	Nov.'00 to Dec.'00		
	141 – 180 kg	Red	139 to 188 days	Oct.'00 to Nov.'00	0	1
	181 – 220 kg	Blue	189 to 238 days	Aug.'00 to Sep.'00		
	221 – 260 kg	Orange	239 to 288 days	Jul.'00 to Aug.'00		
R2	< 60 kg	Blue	< 38 days	Aug.'01 to Sep.'01		
e.g. 20/9/01	60 – 100 kg	Orange	38 to 88 days	Jul.'01 to Aug.'01		
	101 – 140 kg	Black	89 to 138 days	May'01 to Jun.'01	1	2
	141 – 180 kg	White	139 to 188 days	Mar.'01 to Apr.'01		
	181 – 220 kg	Yellow	189 to 238 days	Jan.'01 to Feb.'01		
	221 – 260 kg	Green	239 to 288 days	Nov.'00 to Dec.'00	0	1

Table 2 summaries one such system of identifying animals' ages. In effect this system gives a colour tag for the time of year a calf is born as the time line below shows.

Orange	Blue	Red	Green	Yellow	White		Black		Orange	Blue	Red	Green	Yellow							
Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
		'00								'01									'02	

Note that this involves a change to the year branding system that is used. Currently the most commonly used system runs off the financial year where, for example all calves branded at R2 2000 are branded with a 1, as are all calves branded at R1 in 2001. In the proposed system, calves are given the year brand that corresponds to their age (calculated from their weight and designated by the colour of the tag in their ear). A similar system could be devised where, as well as a year brand, calves are branded with a number designating the time of year that they were born.

This is a simple and efficient way of recording and identifying calf and weaner ages. The only extra work involved at weaning is weighing the calves first and placing the appropriate coloured tag in their ear. The colour tag then designates which year number a calf is branded with when they are processed. Weaners can then be drafted into different management groups according to their age (ear tag colour) and managed differently to meet market specifications.

Acknowledgments

I thank the NT DPIF staff who were involved in collecting the data from 'Kidman Springs' and Michael Cobiac for collating it and making it available. Also Robyn Cowley (NT DPIF) for her assistance with the statistics.

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Breeding herd efficiency of alternative breeder genotypes

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Objectives

To compare the breeding herd efficiency (BHE) of Brahman (B), Droughtmaster (DM) and first-cross Charolais x Brahman (F_1) cows.

To provide B, DM and $^1/_4$ Charolais x $^3/_4$ Brahman ($^1/_4$ Ch) weaners for post weaning efficiency comparisons.

Background

The project was established in 1995 by selling all except 100 randomly selected adult DM breeders (≥ 1 calf weaned) and 30 pregnant heifers from the Kidman Springs herd. Simultaneously 260 pregnant purebred adult commercial B cows were purchased in Queensland and 130 pregnant adult F_1 cows were acquired from Newcastle Waters Station (NT).

The breeding herd in the northern half of the NT at this time still contained approximately 25% ($^1/_4$) Shorthorn genes, and the B cows represented the genetic destination of most of these cattle. The DM breeders provide a genetic link with past research at Kidman Springs. The DM and B cows were perceived to be of similar (medium) mature size.

Over-fatness at turnoff from SE Asian feedlots was emerging as a problem as a consequence of improved weight-for-age in exported NT-bred feeder cattle. The problem was greatest in 'wet' markets in Indonesia. Indonesia was the NT's most important feeder steer market in 1995.

The use of $^1/_4$ large late-maturing breed genes (e.g. Charolais) was seen as one option to alleviate this problem. In the long term a self-replacing rotational cross-breeding system involving the use of F_1 and then B bulls on alternate generations was seen as likely to evolve. The Charolais content of such cattle would vary between $^1/_6$ and $^1/_3$. These larger breeding cows would tend to reduce the sustainable stocking rate (number of cows grazed per unit area) through increased grazing pressure (kg of cow weight) per head.

For this reason it was seen essential to compare the BHE of all four breeder genotypes (DM, B, $^1/_6$ Ch, $^1/_3$ Ch).

Both the increase in mature size and the displacement of adapted B genes was greater in F_1 cows than the eventual rotational cross-breeding system's $^1/_3$ Ch cows. The use of F_1 cows provided:

- an early indication of the impact of the displacement of Brahman genes and later maturity on BHE;
- the opportunity to generate $^1/_4$ Ch progeny (Table 1).

Half of the B cows were also used to generate $^1/_4$ Ch progeny (Table 1) for post weaning evaluation.

It was not feasible to replicate the four experimental breeding herds shown in Table 1. To assess their relative planes of nutrition, a small group of weaner steers (indicator steers), each of the same weight and genotype composition, were allocated at random to each project paddock shortly after the first weaning round each year. The growth of the three sets relative to the industry standard set (i.e. those from the paddock generating B weaners) was expressed as a ratio to rank the relative plane of nutrition (Table 2) of each project paddock.

Only adult cows (≥ 1 calf weaned) are run in the four project paddocks and all herds are run under the DPIF's Best Bet management package (Sullivan and O'Rourke 1997).

Selected results (raw data means)

Table 1. Breeding herd efficiency (BHE) and its components (average of 1996/1997 to 2000/2001)

Cow genotype	Calf genotype	Average wean wt (kg)	Average wean rate (%)	Average cow livewt (kg) +	Average BHE * (kg weaner per 100 kg cow)
Brahman	Brahman	183	75.8	444	31.2
DMaster	DMaster	181	83.9	434	35.0
Brahman	1/4 Ch	186	80.2	441	33.8
1/2 Ch (F_1)	1/4 Ch	185	82.1	470	32.3

DMaster = Droughtmaster
1/2 Ch = 1/2 Charolais x 1/2 Brahman (or F_1)
1/4 Ch = 1/4 Charolais x 3/4 Brahman
+ Cow Wt = Empty live weight at the first weaning round (May)
* BHE = $\frac{\text{Weaning weight (kg) x Weaning rate (\%)}}{\text{Cow weight (kg)}}$

Table 2. Indicator Steer Growth (1996/1997 to 2000/2001)

Cow genotype	Calf genotype	Weight gain July–May (kg/head)					Ratio*
		1997/98	1998/99	1999/00	2000/01	Average	
Brahman	Brahman	120	131	141	143	134	1.00
DMaster	DMaster	141	125	123	157	137	1.02
Brahman	1/4 Ch	121	116	112	143	123	0.92
1/2 Ch (F_1)	1/4 Ch	111	122	112	171	129	0.96

* Ratio = Growth of the indicator steer groups relative to those in the industry standard (Brahman x Brahman) paddock.

Table 3. Fat corrected empty live weights (FCELW)

Cow genotype	ELW prediction equation	Significance	FCELW (kg)	
			P8 = 0 mm	P8 = 10 mm
Brahman	3.5 c + 400	P < .001	400 (100)	435 (100)
DMaster	3.2 c + 410	P < .001	410 (102)	445 (102)
1/2 Ch	3.6 c + 461	P < .001	460 (115)	495 (114)

ELW = Empty live weight (kg) at the first weaning round in April/May.

Figures in brackets are percentages relative to the Brahman.

The regression coefficients above are not significantly different and the working equations for calculating FCELW all used 3.5 as their regression coefficient.

NOTE: No attempt has been made in Table 3 to correct for ELW variation due to conceptus weight. Foetal aging data is available and the work of O'Rourke et al (1991) provides the necessary information on the foetal age versus conceptus weight relationship.

P8 = Ultrasonic fat depth at the P8 site in mm.

Some preliminary discussion

Statistical analysis of the data will be undertaken and reported when the data sets are complete.

The apparently higher BHE of the DM herd (Table 1) may have been affected by:

- the herd's previous history, being run under the Best Bet Management package for some years prior to the beginning of this trial relative to the more recently introduced genotypes (i.e. Brahman and F_1);
- the possibly higher plane of nutrition provided by its paddock (Ratios in Table 2);
- its potentially superior selection background, the purchased cows (as always) being predominantly the best of someone else's culls.

The difference in BHE between the DM herd and the other herds has tended to decline over the five year period reported here.

The regression equations in Table 3 linking empty live weight (ELW) and P8 ultrasonic fat depth have enabled the calculation of fat corrected empty live weight (FCELW). This variable for adult cows provides a very useful first approximation for:

- mature size for the existing DM, B and F_1 cows;
- mature size of the 1/3 Ch and 1/6 Ch cows of the future;
- adjusting paddock stocking rates (number of stock/unit area) to give equal notional grazing pressure (weight of FCELW/unit area) when cows of different mature size are being compared in a production system context.

This approach to estimating genotype mature size:

- confirms that the B and DM cows have similar mature size (400 kg and 410 kg FCELW respectively, Table 3); and
- indicates that the mature weight of the F_1 cows is approximately 15% greater than that of the B cows.

$$\frac{460 - 400}{400} \times 100 = 15\%$$

Given that FCELW for B cows is 400 kg and for $^{1}/_{2}$ Charolais x $^{1}/_{2}$ Brahman cows is 460 kg, then for full Charolais it can be estimated as 400 + (2 x 60) = 520 kg. The approximate mature size of the $^{1}/_{3}$ and $^{1}/_{6}$ Charolais cows of the future can then be calculated as follows:

$$^{1}/_{6}\ \text{Charolais} = 400 + (520 - 400) \times {}^{1}/_{6}$$

$$= 420\ \text{kg (or 5\% larger than B cows)}$$

$$^{1}/_{3}\ \text{Charolais} = 400 + (520 - 400) \times {}^{1}/_{3}$$

$$= 440\ \text{kg (or 10\% larger than B cows)}$$

giving an average of 7.5% greater mature size for the future cross bred herd, than the B herd which it would replace.

Given that the mature size of the F_1 cows is approximately 15% greater than the B cows, it is likely that their performance (Table 1) has been adversely affected by the initial decision to run all four experimental paddocks at the same stocking rate.

When the information required for the calculation of FCELW became available, the stock numbers in the F_1 paddock were reduced to 113 in May 1999 using the following calculation:

$$\text{Initial No. per pdk} \times \frac{\text{B FCELW}}{\text{F}_1\ \text{FCELW}}$$

$$= 130 \times \frac{400}{460}$$

$$= 113$$

Using relative indicator steer performance between paddocks to adjust or correct the respective BHEs is a point of much contention and a suitable approach has yet to be determined.

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A new description system for feeder cattle?

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Introduction

We live in a time of rapid change. Changes in our trading environment in the next decade are likely to be significantly greater than in the past decade (Shamus O'Reilly pers. comm. 2000).

As our markets increase in sophistication we will move towards a pricing environment in which relative prices at any point in time will more closely reflect the value adding potential and end-use suitability of what we have to sell.

Value-adding potential = weight gain before market weight or fatness specifications are exceeded.

End-use suitability = target market weight and fatness specifications and age as it affects meat tenderness.

Marketing languages or description systems will be based on objectively determined specifications. The reliability of these specifications to deliver expected value adding within the context of the customer's:

- target plane of nutrition;
- target carcase weight range; and
- target carcase fatness range.

will determine both market share and access to any price premiums for the feeder cattle producer.

There will be strong interest in a significant shift towards forward trading arrangements aimed at:

- security of supply (of feeder cattle);
- securing price premia;
- reducing price volatility (for feeder cattle);
- stabilising carcase specifications of feedlot turnoff.

If the buyer and the seller do not share the same objective specifications when describing the value-adding potential and end-use suitability of feeder cattle then the prospects for long term forward trading arrangements are not encouraging.

A reliable set of shared specifications will enhance:

- pricing efficiency *(less guessing about value adding potential);*
- market intelligence *(everyone talking about the same thing);*
- long term forward trading arrangements *(capacity to objectively describe/understand what is wanted).*

Today I want to talk about some R&D results from the NTDPIF Pastoral Division's Meeting Market Specifications Sub-Program that have an important bearing on this issue.

Maturity-type (MT) growth curves

By definition, later maturing cattle are heavier than earlier maturing cattle at any given age and fatness.

Maturity type growth curves allow a feedlotter to work backwards from his target slaughter weight and fatness specifications, to identify the age, weight range and maturity-type of feeder cattle suitable for both his planned plane of nutrition (growth rate) and his market end-use suitability criteria (age, weight and fatness). What is the justification for this statement and what are MT curves?

Maturity-type (MT) growth curves are best described as weight-for-age graphs at constant fatness.

Cattle of different maturity-type have different MT growth curves, but all such curves have the same general shape. For later maturing (larger mature sized) cattle (e.g. steers vs heifers), the curve moves upwards (see diagram 1) and vice versa.

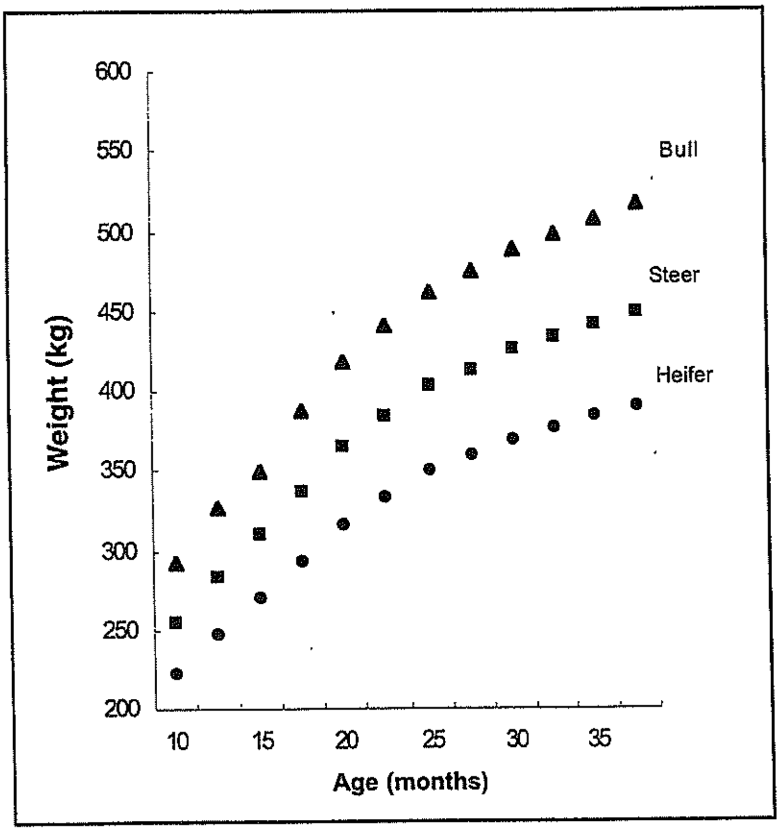

Diagram 1. MT growth curves. Brahman bulls, steers, heifers at P8 = 10 mm.

As cattle within a maturity type get fatter, the shape of the MT curve remains the same, but also moves upwards (see diagram 2) and vice versa (c. 3.5 kg/mm P8) .

A research project at Katherine Research Station in the NT has enabled the construction of MT growth curves (see diagram 1) for bulls, steers and heifers from the Brahman herd at Kidman Springs. This herd of commercial purebred Brahmans was imported from Queensland in 1995 and is part of the Kidman Breeder Genotype Comparison. The common level of fatness of these particular three curves in diagram 1 is P8 = 10 mm.

This is the mid-point of the target fat range for much of the supermarket trade in SE Asia.

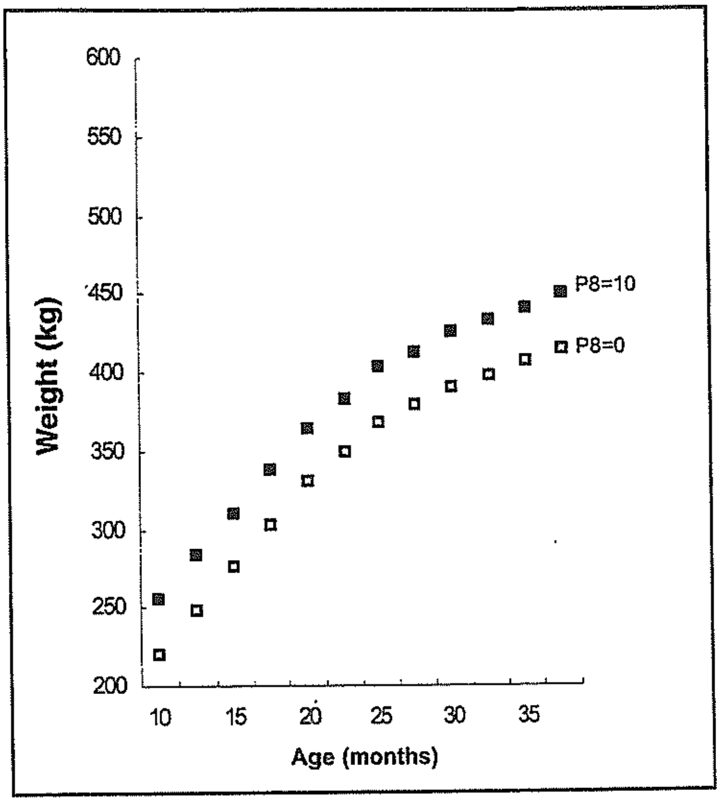

Diagram 2. MT growth curve. Brahman steer at P8 = 0 and P8 = 10.

The P8 site for fat measurement is shown in diagram 3. It can be measured either ultrasonically *in vivo* or on the dressed carcase. This measurement is closely related to carcase fat %.

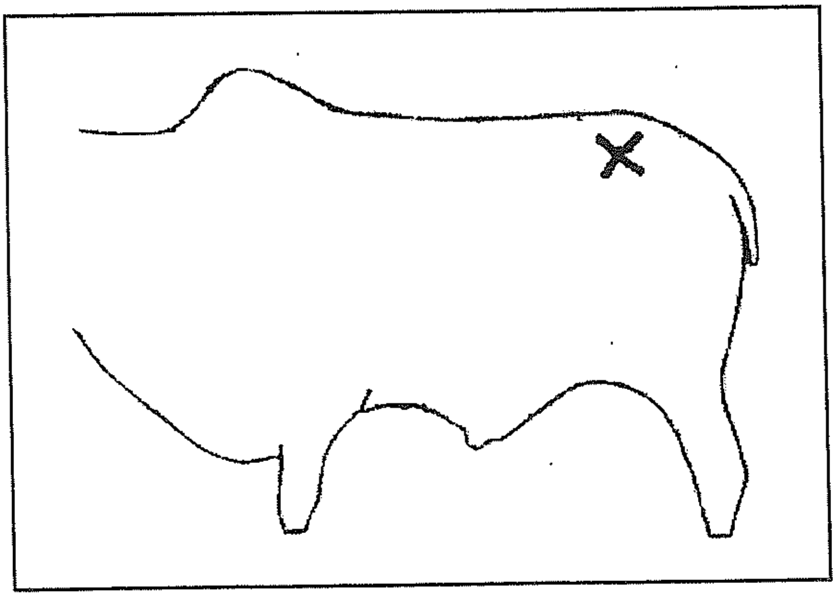

Diagram 3. Location of P8 measurement site.

The Katherine Research Station's MT curves have been tested by feeding randomly selected groups of 8–12 bull, steer or heifer progeny of known age from the Kidman Brahman herd (age estimated as earlier described by Tim Schatz). Each group was slaughtered at an average fatness of P8 = 10 mm (estimated ultrasonically). Groups were slaughtered at a range of ages between 10 to 33 months. Carcase measurements were taken to verify the ultrasonic estimates of P8 fat depth.

The closeness of fit of these groups is shown in diagram 4.

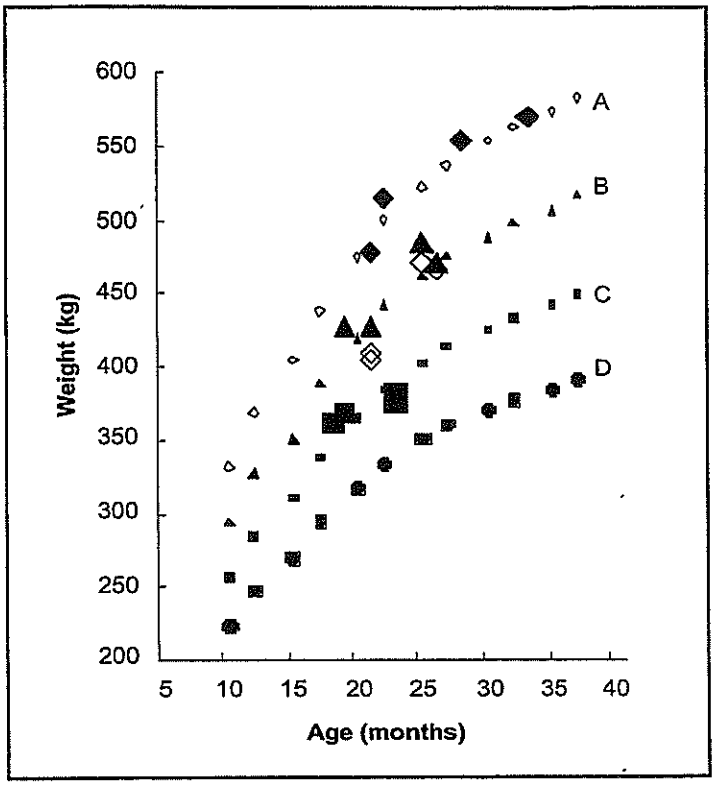

Diagram 4. Testing of MT growth curves, 4 maturity types, P8 = 10 mm.

MT growth curves were also tested for 1/4 Charolais x 3/4 Brahman cattle.

The cattle in this project were progeny from the genotype comparison project previously described by Michael Cobiac. When I measured his adult Brahman breeding cows at the first weaning round, the statistically significant regressions between ultrasonic P8 fat depth and empty live weight provided an arbitrarily defined estimate of fat adjusted mature weight (maturity type) for each genotype.

The table below shows how P8 fat depth in mm (x) was related to empty live weight (ELW kg) in the three different cow genotypes at Kidman. The relative fat corrected mature size (when P8 fat depth is exactly zero) of the three genotypes was 400 kg, 460 kg and 410 kg respectively.

Genotype	ELW (kg)
Brahman	3.5 (x)+ 400
Brahman x Charolais	3.6 (x)+ 460
Droughtmaster	3.2 (x)+ 410

These ELWs were taken at the first weaning round (April/May) and were not corrected for conceptus weight. Appropriate corrections can be effected using the values published by O'Rourke *et al.* (1991).

This and other data suggests that 3.5 kg/mm P8 fat depth is a useful relationship for adjusting MT growth curves for fatness in these three genotypes.

The proposed new description system therefore provides a simple basis for:

- estimating breeding herd mature size in large herds (> 300 adult breeders) both within and between genotypes; and
- matching the MT growth curves for bulls, steers and heifers to individual herds within a genotype.

In the case of the adult Brahman cows at Kidman, their fat corrected mature size is 400 kg, the weight of mature sized females at P8 = 10 mm is 435 kg. On average this herd's young steers at P8 = 10 mm are about 15% larger than its young heifers at a given age and its young bulls at the same age and fatness are about 15% larger again.

I have data that suggests that the variation in fat corrected mature size between Brahman adult breeding herds of quite different background in the NT, is small (< 10 kg).

It appears that the sex difference in the $^{1}/_{4}$ Charolais x $^{3}/_{4}$ Brahman cattle at Kidman is also about 15% (i.e. bulls vs steers).

Utilisation of MT curves by the feedlotter – an example

Take the case of a feedlotter wishing to slaughter at 420 ± 20 kg and P8 = 10 ± 5 mm and feed a ration that will support 1 kg/day gain, for 100 days.

Diagram 5 shows MT curves for four different maturity types (A, B, C and D). The horizontal line through 420 kg cuts three of these curves at the age (horizontal axis) at which these maturity-types provide the desired slaughter specifications. One (D) is clearly unsuitable for this end-use.

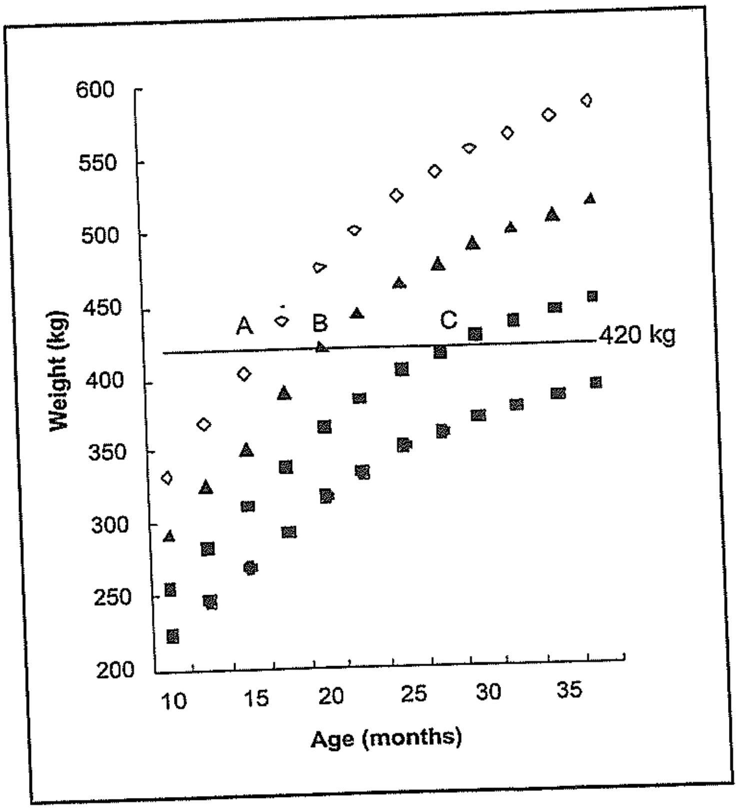

Diagram 5. Determination of age and weight specifications at target fatness (P8 = 10 mm).

If lines with a slope of 1 kg/day are drawn downwards through A, B and C until they cut a horizontal line from 320 kg (see diagram 6). The age and weight of feeder cattle of the three candidate maturity-types can now be read off the graph. Setting this process up on an office PC would be a simple task.

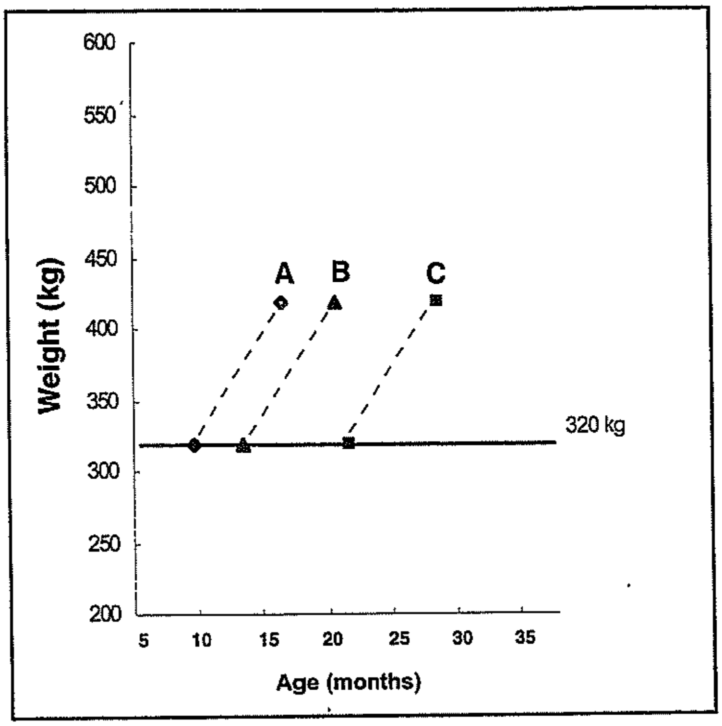

Diagram 6. Determination of feeder age and weight specifications from MT curves (P8 = 10 mm).

Given that adequate live animal fatness appraisal skills are available at the feedlot, then feeder cattle that meet his given age, weight, maturity-type and *Bos indicus* content specifications will ensure that a high proportion of carcasses meet the feedlotter's target fat and weight specifications on time.

Diagram 7 shows this feedlotter's supply-contract specifications for feeder maturity-type, weight and age, derived from the MT curves in this example.

Maturity-type growth curves of this type need field-testing in SE Asia on a commercial scale from weaning to slaughter. Producer and feedlotter involvement will be of crucial importance to ensure the credibility of the results.

Maturity type	Wt/age specifications	Start feeding period	
		Short 50 days	Medium 100 days
A	kg months	370 ± 20 13.4 ± 2	320 ± 20 11.7 ± 2
B	kg months	370 ± 20 21.4 ± 2	320 ± 20 18.7 ± 2
C	kg months	370 ± 20 27.2 ± 2	320 ± 20 28.9 ± 2
D	kg months	370 ± 20 49.4 ± 2	320 ± 20 47.7 ± 2

Diagram 7. Feedlotters supply contract specifications.

Some scientific detail

In an experiment at the Katherine Research Station feedlot, aimed at evaluating the interrelationship between weight, age and fatness, the range in these variables at slaughter in 29 Brahman steers was:

- Age: 10.5–21.6 months
- Empty live weight (ELW): 230–410 kg
- P8 fat depth: 1.0–17.0mm

Their ELW could be predicted from the equation:

$$ELW\ kg = 3.3\ (P8\ MM) + 10.8\ (age, months) + 115.9$$

$$R^2 = 0.9\ (P < 0.001)$$

These cattle came from the Kidman Breeder Genotype Comparison from the first weaning round 100–140 kg weaning weight range, in successive years.

Similar results were obtained with Brahman heifers in the same experiment. The two sexes differed by 15% in liveweight at the same age and fatness over the whole range of age.

It was assumed that these Brahman steers were 15% larger (later maturing) than Brahman heifers.

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Northern Australia Beef Industry Conference 2001
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Improving breeder herd efficiency

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Improving breeder herd efficiency

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Summary

Stanbroke Pastoral Company joins approximately 220,000 breeders annually. These breeders are of varying genetic composition, and are situated in country of varying nutritional quality and quantity, from the reliable rainfall and poor quality pastures of the Southern Peninsula in North Queensland to the unreliable rainfall and high quality pastures of the south-west corner of Queensland. The Stanbroke breeding properties on the Barkly Tablelands are probably between these two extremes.

The common links between all these breeding properties is their large geographic and herd size, the distinct wet and dry seasons, and the varying *Bos indicus* content in all the herds. As explained below, these 'common links' make the traditional Southern controlled joining programs impractical in Northern Australia. However, to maximise weaning rates and weight of turn-off, a pseudo-controlled mating regime should be implemented to encourage calving immediately prior to the wet season.

The large geographic size of the properties naturally includes a variation of land types and pasture composition which also vary in their response to the seasons. The nutritional requirement of cattle also varies considerably from birth to maturity and at different physiological states during maturity. Therefore, combining a pseudo-controlled mating regime with a cattle/pasture rotation and placement system will maximise profitability and sustainability of these large northern calf factories (most Stanbroke breeding properties transfer their weaner steers to fattening depots).

Stanbroke managers currently implement different versions of this program on three stations in the Queensland Gulf and two stations on the Barkly. This involves approximately 75,000 breeders or > 30% of the Stanbroke breeding herd.

Breeder herd performance and management

Prof. Keith Entwistle and other prominent northern Australian veterinarians and cattlemen, have repeatedly shown that herd profitability is maximised with a 75% weaning rate. In order to achieve this, cows must have an annual calving interval of 14 months or less (allowing for 10% loss between pregnancy and weaning), and, therefore, conceive within five months after parturition.

The Northern Australian environment dictates a genetic profile of at least 50% *Bos indicus* in most cattle herds. Lactation anoestrus is a survival feature of the *Bos indicus* breeds and its length is dictated by nutrition, breeder age and lactation. The distinct and unreliable wet and dry seasons in Northern Australia influence carrying capacity, nutritional quality and quantity, bull control and time of weaning. These management variables exacerbate the impact of lactation anoestrus on reproductive benchmarks, and prevent the implementation of a successful traditional Southern controlled mating program.

A 12 to 14 month inter-calving interval in a predominantly *Bos indicus* breeding herd in the Northern Australian environment can only be achieved if the majority of the breeding herd calves one to two months before there is a > 80% chance of receiving significant rain. This breeder herd control must be achieved without bull removal.

To quote another prominent Northern Australian cattle veterinarian and Stanbroke employee, Dr John Armstrong, *'pregnancy is the best form of contraception'*. The breeder management system to be discussed here has been developed by John O'Kane and Ian Braithwaite, and is based on

- segregating cows according to their pregnancy status;
- running them in country that is appropriate to their nutritional and mustering requirements; and
- placing empty cows in bull-free paddocks for the two to three months which, if they conceive, will produce the lowest value weaner and the longest inter-calving interval.

Nutritional requirement

The nutritional requirements of a cow varies according to its age, weight, weight gain and physiological status. This is quantified in LSU (livestock units) / DSE (dry sheep equivalent) / AE (adult equivalent) tables, for example a dry 400 kg beast maintaining weight may be equal to one LSU compared to a pregnant, lactating 400 kg cow being equal to 2.4 LSU or requiring > twice the area to satisfy her nutritional requirements. Property carrying capacity and stock performance is optimised if nutritional quality is matched to physiological requirements, and stocking rates are calculated according to LSU, not head.

Rangelands

There is generally considerable variation in land types and vegetation within a property, and even within a paddock. These different land types and vegetation naturally have different carrying capacity and exhibit optimum nutritional quality at different times of the year. Maximising profitability in a breeding herd may require rotating cows between paddocks during the year in order to match nutritional quality with physiological requirements.

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John O'Kane (pers. comm. 2001) Helen Springs Station, CMB 8, Tennant Creek, NT, 0861.

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Developing breeder management systems in North West Queensland

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Abstract

Managing breeder body condition is important because of its impact on fertility and survival. Cows, which calve by the beginning of the wet, have more opportunity to build condition and re-conceive. They also produce heavier weaners.

Heifers are the priority group, with tighter control over growth, selection and management, producing major increases in conception rates. Timing of joining and pregnancy testing can be used to ensure all heifers are weaned on the first round and high re-conception rates achieved. Pregnancy testing of first calf cows identifies superior animals, which are better able to handle the stress of lactation.

In non-control mated herds, pregnancy testing and segregating first round dry cows is the most efficient way to identify less productive animals for sale and allows management based on nutritional requirements. Animals, which will be at risk in dry seasons, can be readily identified and the problem of aged cows calving out of season avoided.

What drives breeder performance?

Breeder fertility and mortality is principally determined by body condition at the end of the dry season and the timing of the seasonal break (Dixon 1998). Figure 1 shows the factors, which control body condition and provides a sound basis for planning management.

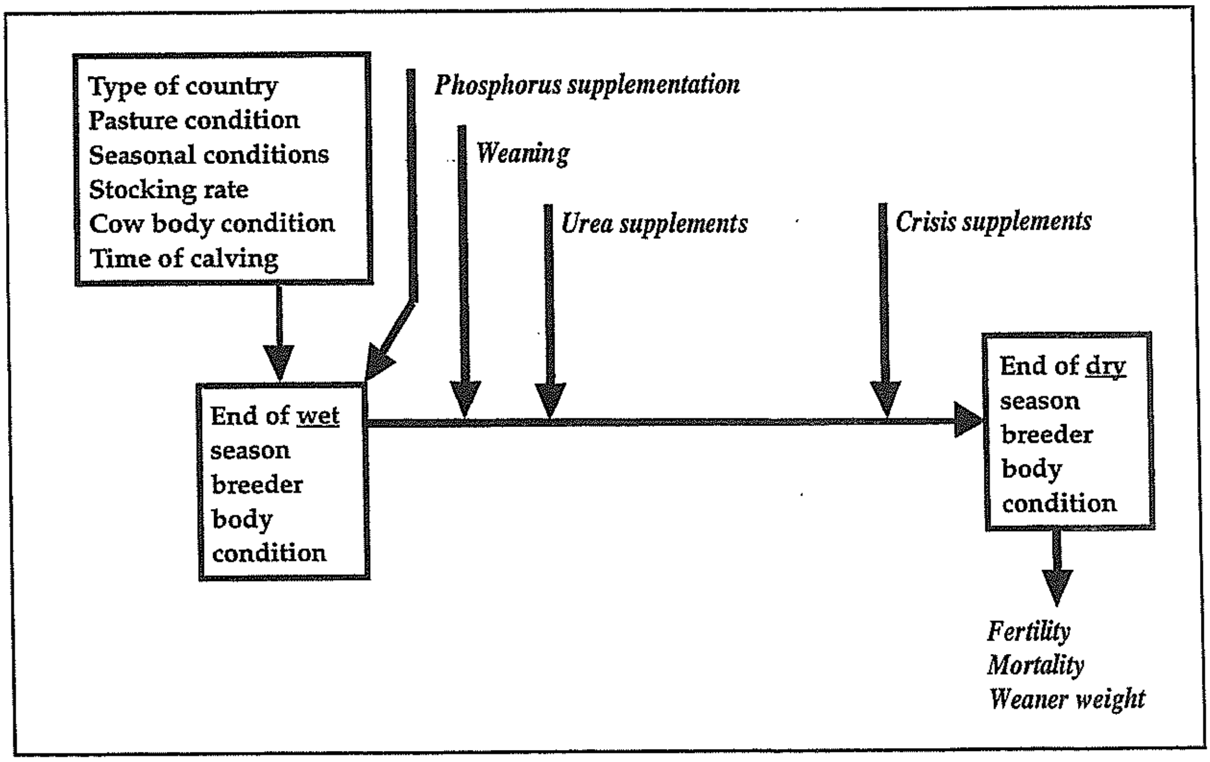

Figure 1. Representation of factors influencing breeder productivity in a semi arid environment (Dixon 1998).

Effective management of breeder body condition depends on maximising condition at the end of the wet and minimising weight loss during the dry season. Weaning is the most effective way to minimise dry season weight loss. Crisis supplementation of breeders is generally not an option in northern Australia due to the cost of high-energy supplements and feeding logistics.

The focus of this paper is strategies, which improve performance by matching animals' nutritional requirements to seasonal conditions and enable the identification of superior animals.

Seasonal conditions

Seasonal conditions are critical because of their impact and in particular the timing of the seasonal break on body condition. Median rainfall is the best guide to the likely pattern of seasonal conditions (Table 1).

Table 1. Mean and median rainfall for selected north west Queensland sites (Clewett *et al.* 1994)

Location	Rainfall (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Cloncurry	Mean	117	115	62	18	15	12	8	4	7	15	31	67	471
	Median	88	86	40	3	3	1	0	0	1	6	23	48	430
Gregory Downs	Mean	155	129	90	15	10	8	4	2	3	18	48	95	577
	Median	128	113	77	0	0	0	0	0	0	6	38	69	547
Wondoola	Mean	187	161	87	10	10	8	5	1	3	13	52	102	637
	Median	149	148	64	0	0	0	0	0	0	4	35	84	628

For North West Queensland the critical climatic features are:

- Feed quality and quantity is most likely at its highest from November to March.
- December to February is the most reliable period for feed quantity and quality.
- There is little chance of rain from April to September and pasture quality will decline until the season breaks.

Time of calving

If calves are born by the start of the wet, both cow and calf can make best use of the available feed. This in conjunction with March–May weaning enables the cow to build body condition and re-conceive early. November–December joining has played a major role in improving conception rates in first calf cows (Table 2).

Table 2. Reproductive status of first calf cows on a North West Queensland property in July 1998, 1999 and 2000

Year	First calf cow age group	Joining date	First weaning muster	Wet (%)	Dry (%)	Pregnant (%)
1998	No 5s	24/12/96	March 98	57	43	66
1999	No 6s	1/12/97	April 99	10	90	85
2000	No 7s	1/11/98	May 00	4	96	83

Although, few properties are completely control mated, most can control their initial heifer joining. This combined with good breeder management maximises the number of cows, calving within the desired period, despite individuals moving in and out during their lifetime.

While there is concern about calves arriving in August–September it must be remembered that:

- The majority will not arrive till October–December.
- Animals, managed to calve at a particular time are at less risk than those calving unplanned.
- There is five months from the end of the wet to plan feed allocation and supplementation prior to calving.

Early calving herds are less drought prone and easier to manage because they have fewer animals lactating over the dry season. Where large numbers of calves are born after January, mustering often has to be delayed to allow calves to reach a suitable size for handling. January–March born calves are more likely to suffer losses from heavy rain and flooding.

Another important consideration is that it is easier to distribute bulls in November–December. Late heifer joining often results in the wrong bulls, getting in when fences are down. This affects breeding programs and presents a disease risk.

Early calving maximises weaning weights because the lactating cows and their calves have more time on high quality feed. A month of calf age typically equates to 25 kg of weaner weight.

Heifer management

Heifer growth and selection

Weaner heifer growth is important because it affects future reproductive performance (Fordyce *et al.* 1988a). The impact of heifer growth and selection strategies on pregnancy rates and the value of culls in commercial herds is shown in Table 3.

Table 3. Pregnancy rates and weights of cull heifers for three North West Queensland herds in July 1997

Herd	A	B	C
90 day conception rate (%)	51	48	87
120 day conception rate (%)	64	62	88
Mean weight of culls (kg)	316	332	386
Culls < 370 kg (%)	93	83	26

Herd C had better grown heifers, resulting in both superior reproductive performance and heavier culls. Data from Herd B demonstrates the improvements, achieved with increased supplementation in both the weaning and yearling year and selection for a minimum joining weight of 260 kg (Table 4).

Table 4. Pregnancy rates and weights of cull heifers for a North West Queensland herd (Herd B) in 1997 and 1999

Herd	1997	1999
90 day conception rate (%)	48	71
120 day conception rate (%)	62	78
Mean weight of culls (kg)	332	405
Culls < 370 kg (%)	83	22

Heifer pregnancy testing

Pregnancy testing enables the most fertile heifers to be identified and the calving pattern controlled for maximum productivity. Retaining only heifers, which will calve by the end of December, ensures all calves can be weaned on the first round and maximises re-conception rates.

Tagging or notching the year tag of wet heifers, at pregnancy testing enables those that are weaned to be distinguished, in the following year, from heifers that are dry due to losing a calf.

First calf cow management

Weaning first calf cows in March–April maximises their opportunity to put on condition and re-conceive. Under drought conditions, radical weaning can be undertaken in late February. Cows, which are dry, and not identified, as having been wet in the joining year, should be culled as they have lost their calf.

Good performance makes it feasible in some herds to apply further pressure for fertility. Pregnancy testing, first calf cows in June–August identifies animals, which are better able to handle the stress of lactation. If numbers permit, early pregnant animals can be culled to maintain a tight calving pattern on the second calf.

The culling implemented under the heifer and first calf cow management programs, increases herd efficiency, because poor performers are removed sooner (Table 5). The reductions in grazing pressure help maintain body condition.

Table 5. Likely cull rates under heifer and first calf cow management programs

Joining year pregnancy test (%)	Cull at first weaning for failure to raise calf (%)	Cull at second joining year pregnancy test (%)
15–20	10–12	10–20

Herd modelling with *Breedcow/Dynama* (Holmes 2000) is valuable for determining the number of heifers to be joined and culls available for sale.

Mature breeder management

Managing cows, based on their reproductive status improves the efficiency of handling, feed allocation and supplementation. In extensive herds this can be achieved by implementing a dry cow management program from the breeders' second calving onwards.

At the first round, dry cows are drafted off for pregnancy testing when convenient. The wet cow group will comprise freshly weaned cows, and those to be weaned on the second round. In some situations, it may be advantageous to segregate cows with calves at foot. Bull numbers are adjusted to the desired joining percentage in the wet group. Spare bulls can be reallocated to reduce bull requirements and or increase culling.

Dry empty cows are culled and pregnant cows drafted into a management group or groups (Table 6). The composition of management groups is based on the pregnancy status of the mob, paddock availability and seasonal conditions. Paddocking on pregnancy status, enables better feed allocation and targeting of supplementation.

Table 6. Possible management groups for dry cows at 1 May

Group	Pregnancy status (months)	Expected calving date
1	1.5–3	10 Nov.–9 Jan.
2	4–6	12 Aug.–11 Oct.
3	7+	14 May.–13 Jul.

Group 1 These cows will calve last and have the lowest earning potential. They are generally in good order and often sold with the empty cows.

Group 2 This group will not wean a calf in the current year unless radical weaning is undertaken. Calves can be branded at the end of the second round, to avoid large cleanskin weaners in the following year.

Group 3 These cows can be weaned during the second round and earlier weaning undertaken, if necessary to reduce the stress on these cows.

Rejoining, retained dry cows in November–December enables them to reconceive at the optimum time.

Cows that fail to raise calves can be easily identified, as they will be dry when the rest of their group is wet.

Culling for age

Because the dry cow management program is continuously removing animals with poor reproductive performance, the aged cows will be animals, which are well adapted and fertile. Many of these animals have the potential to be kept beyond 10 years under normal seasonal conditions if desired.

The most appropriate way to deal with animals when they reach the traditional culling age of eight to ten years is to assess their condition and pregnancy status in relation to seasonal conditions and cull accordingly. Since the high-risk animals will be in the first round, dry cow group, they can be identified and sold early in the year. This system provides maximum herd flexibility.

Conclusion

Because of the impact of body condition on breeder performance, managing herds so that their nutritional requirements match seasonal conditions is critical. Cows, which calve by the beginning of the wet, have the greatest opportunity to build condition and re-conceive. They will also produce heavier weaners. Heifers are the priority group for implementing tighter control over growth, selection and management. Timing of joining and pregnancy testing can be used to ensure all heifers are weaned on the first round and high re-conception rates are achieved.

Pregnancy testing of first calf cows identifies superior animals, which are better able to handle the stress of lactation. Segregating first round dry cows on pregnancy status allows management based on nutritional requirements. Drought risk can be minimised by the sale of aged cows, which will calve out of season.

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Notes

Faecal NIRS – opening the door to a better understanding of nutrition

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Introduction

The management of resources for profitability and sustainability in the grazing industries requires an understanding of the resources and the drivers of productivity. Nutrition is one of the main drivers of productivity and there is an increasing demand from cattle producers to learn more about managing nutrition. Unfortunately our knowledge of the nutrition of cattle in northern Australia is surprisingly limited due mainly to past difficulties in estimating the quality of what cattle consume. Because of selective grazing, diet quality is often poorly correlated with the quality of the pasture on offer especially in the grazing systems of northern Australia. Moreover, our 'knowledge' of the nutritional requirements of cattle has largely been derived from studies of temperate systems (pastures and cattle). We know that current nutritional models do not apply at all well to the pastoral systems in northern Australia.

Faecal analysis using NIRS (Near Infrared Reflectance Spectroscopy) can be used to estimate a suite of attributes including dietary crude protein (CP), dry matter digestibility, dietary non-grass proportions and faecal N (Coates 2000). With adequate predictive accuracy, estimates can provide much information on the nutritional status of grazing cattle, information that has previously been impossible or impractical to obtain. Such information can be used to improve our understanding of the nutritional potential and limitations of northern pastoral systems. This paper addresses four specific issues relevant to our understanding and management of the nutrition of cattle in northern Australia.

Protein requirements of growing cattle

Faecal NIRS predictions of dietary CP matched with growth rates can be used to validate published recommended requirements. Required CP concentrations were calculated by combining ARC (1980) recommendations (g protein/day) and estimated forage intakes as calculated by Minson and MacDonald (1987). An example from a grazing trial at Wambiana south of Charters Towers is presented. Results revealed NIRS estimates of dietary CP were less than recommended requirements for a significant portion of the monitoring period, sometimes by more than 2% CP (Figure 1).

In another exercise, dietary CP of cattle grazing *Bothriochloa pertusa* (Indian couch) pasture at Forest Home in north-east Queensland was monitored for two years (Figure 2). Forage samples, plucked to simulate cattle diets, were collected during the second year as an additional guide to dietary CP. There was close agreement between faecal NIRS and forage estimates. Usually it is difficult to pluck pasture to reliably reflect selective grazing but the purity and structure of this pasture severely limited selection opportunities and the match between pasture and diet determinations strengthened confidence in the NIRS predictions. Above maintenance CP levels (> 5.5%) were estimated on only 5 of 22 samplings. Clearly, liveweight gain, calculated on the basis of recommended protein requirements, would have been negative for the two-year period. Actual annual liveweight gain, though not measured, was probably at least 100 kg/hd.

These examples suggest that recommended requirements are too high and that cattle in northern Australia make good growth where dietary protein levels are substantially lower than recommended levels. Although NIRS may have under-predicted true dietary CP, many examples of estimated dietary CP levels well below recommended requirements exist and the weight of evidence strongly suggests that current recommended requirements are misleading and urgently require some modification. Determining realistic protein requirements for cattle is regarded as a necessary prerequisite to cost-effectively manage dietary protein levels to meet production targets.

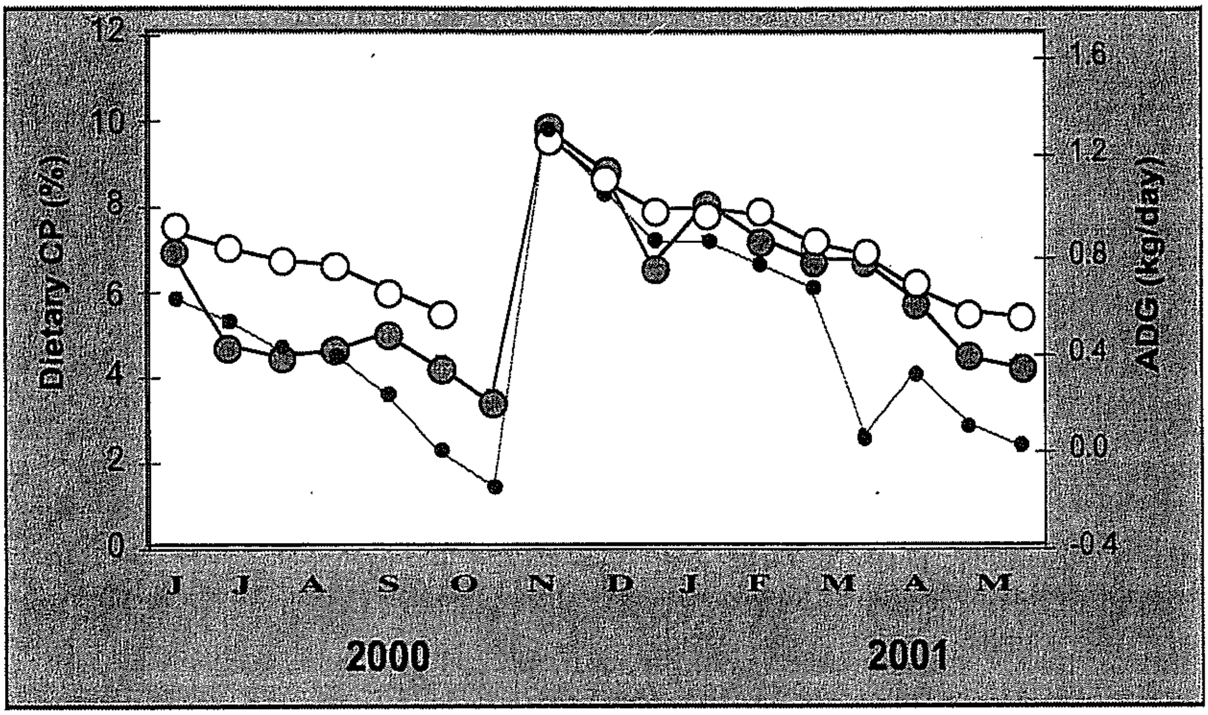

Figure 1. Observed dietary crude protein (CP) estimated by faecal NIRS (●) and recommended requirements (O) in relation to average daily gain (ADG, ●) for steers grazing native pasture at Wambiana, June 2000–May 2001.

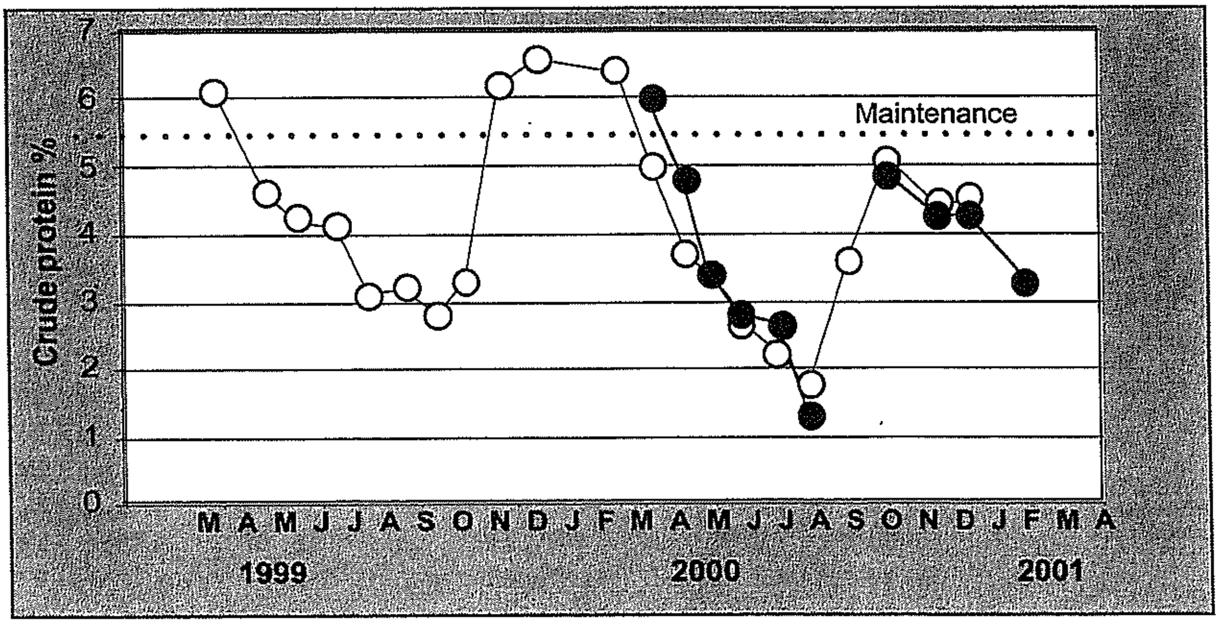

Figure 2. Dietary crude protein (CP) estimated by faecal NIRS (O) and CP of plucked pasture (●) at Forest Home, March 1999–April 2001.

Contribution of non-grass vegetation to the diet of cattle

Forbs and browse species (woody shrubs and trees) contribute to the diets of grazing cattle but, except for sown legumes and some well recognised, economically significant species like mulga (*Acacia aneura*) and saltbush (*Atriplex* spp.), little is known about their quantitative contributions to cattle diets or their effect on productivity. Faecal NIRS provides a simple, cheap and practical means of monitoring dietary non-grass proportions of grazing cattle.

When coupled with diet quality predictions, inferences can be made about non-grass effects on diet quality and cattle productivity. Data are presented here for some different vegetation communities.

Mitchell grass downs. Predicted dietary proportions of non-grass for samples collected at different watering points at Newcastle Waters on the Barkly Tableland on four occasions April–September 2000, ranged from 10–80%. CP was positively correlated with non-grass ($P < 0.01$) (Figure 3). The increase in CP with each increase of 10% in non-grass averaged 1% (10 g/kg DM). On average, therefore, CP of dietary non-grass was 10 units higher than grass CP. The intercepts of the regressions relating CP to non-grass proportions revealed low levels of CP in the grass (3.75% in April, 2.6% in July, 2.4% in August and 2.9% in September). Digestibility was correlated with non-grass in April ($P < 0.01$) and August ($P < 0.05$) but not in July and September. In April and August predicted digestibility increased by 1 unit for each increase of 5% in non-grass. These results, together with similar results from other Mitchell grass communities, indicate the nutritional importance of 'herbage' on diet quality and cattle productivity in these important cattle producing regions. The contrast between the grass and 'herbage' contributions to diet quality, particularly diet protein levels, indicates that cattle productivity would probably be substantially lower in the absence of 'herbage'.

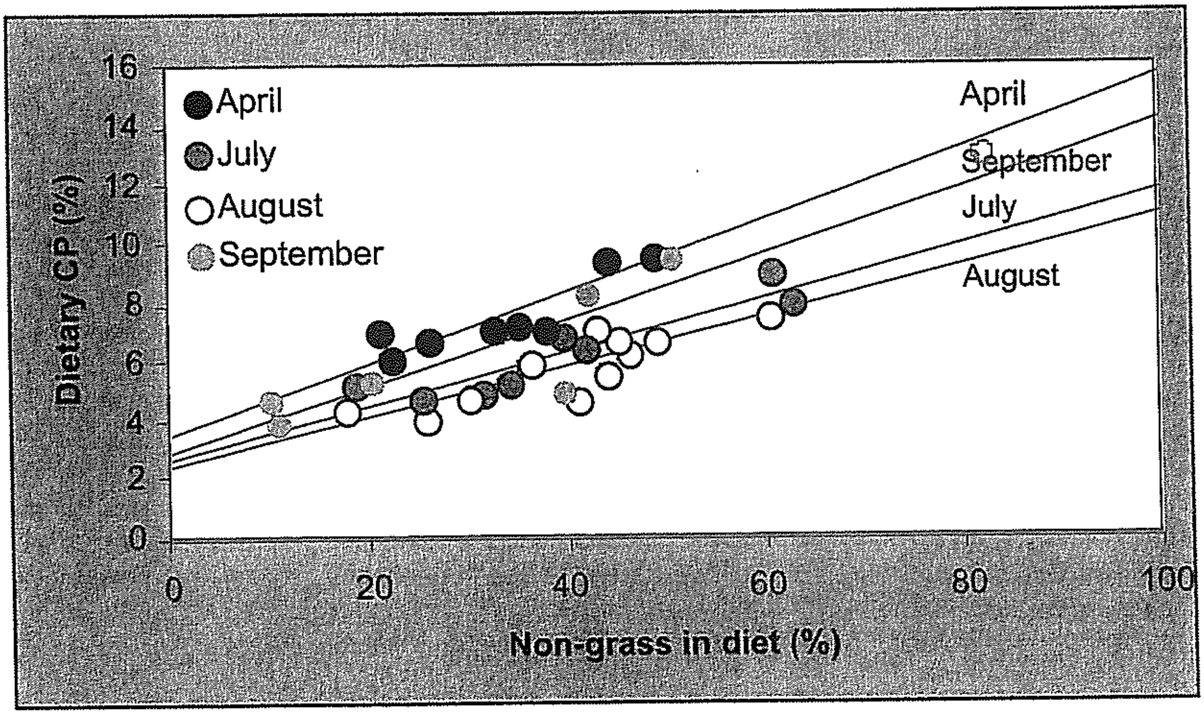

Figure 3. Relationship between dietary crude protein (CP) and the proportion of non-grass in the diet of cattle at Newcastle Waters, NT, sampled on four occasions in 2000.

Buffel grass pasture. Faecal NIRS estimates of dietary non-grass for cattle grazing buffel grass (*Cenchrus ciliaris*) pasture near Biloela in central Queensland averaged only 7% over the 18 months March 2000–August 2001 (n = 18, range 0–14% non-grass). CP estimates were not correlated with non-grass proportions but this was not unexpected considering the limited amount of non-grass in the diets. These results reflect the competitive aggressiveness of buffel grass in limiting the growth of forbs. Low protein levels in tropical grasses means the risk of protein deficiency is likely to be high where grass strongly dominates pasture and diet composition, and supplementary nitrogen may need to be offered earlier than in pastures where diets have more non-grass.

Desert Uplands. Browse or top feed is known to be an important source of fodder for cattle grazing many woodland communities but there is little published information on the quantitative contribution of browse to cattle diets. Some estimates of dietary non-grass from faecal NIRS analysis are presented in Table 1 for the Desert Uplands to the south of Charters Towers in north Queensland. Browse probably accounted for all or most of the non-grass, especially during the drier months. High levels of native browse species certainly raise dietary CP levels well above that of the grass in the diet but assessing faecal NIRS predictions on high browse diets presents difficulties. In particular, many browse species are high in condensed tannins with consequent effects on protein digestibility. Moreover, browse is often low in digestibility.

Table 1. Faecal NIRS estimates of non-grass proportions in the diets of cattle grazing Desert Uplands country. Dietary crude protein (%) estimates are presented in parenthesis

Property and paddock A in 1999		Property and paddock A in 2000		Property B in 2001	
July	60 (6.9)	September	51 (7.3)	February	44 (7.4)
August	72 (7.4)	October	66 (8.1)	March	58 (7.9)
October	78 (6.8)	November	49 (6.4)	May	52 (8.7)
November	70 (12.4)	December	31 (7.4)	June	42 (7.5)
December	50 (8.7)				

Faecal N as a predictor of dietary status

Faecal N is sometimes used as an indicator of dietary protein status and growth rate and most frequently to determine when to commence supplementation with rumen degradable nitrogen. However, there is little evidence to support faecal N as a reliable indicator for these purposes. With faecal NIRS it has become relatively simple and inexpensive to test whether these applications are justified.

Faecal N and dietary protein. Evidence accumulated during the development of faecal NIRS calibration equations leaves little doubt that faecal N is a poor predictor of dietary protein. In a data set of 203 samples with a faecal N range of 0.88–2.62% and a dietary CP range of 3.0–19.9%, the linear regression of dietary CP on faecal N was highly significant ($P < 0.001$; $R^2 = 0.58$) but the standard error of prediction was 2.4%. Therefore, although faecal N is correlated with dietary CP, it is of little use in predicting dietary protein status. In this example, both faecal N and dietary protein values were determined by chemical analysis. Therefore, errors of prediction using faecal NIRS had no influence on the statistical relationship. Faecal NIRS estimates of faecal N and dietary CP from thousands of samples submitted for analysis over the last few years confirm that faecal N is a poor predictor of dietary CP.

Faecal N and growth rate. A data set of 255 samples (faecal N range of 0.76–2.31%; growth rates of –300 to 1500 g/day) produced a similar outcome to the example above. The regression of growth rate on faecal N was highly significant ($P < 0.001$; $R^2 = 0.67$) but the standard error of prediction at 211 g/day indicated that faecal N is hardly a useful predictor of growth rate. As in the previous example, reference values were not NIRS predictions but evidence from faecal NIRS analyses again confirms that the relationship between growth rate and faecal N is of little use for predictive purposes.

Faecal N and dry season supplements. Faecal N has been used to diagnose rumen degradable nitrogen (RDN) deficiency in cattle. This application is based on results published by Winks *et al.* (1979) where responses to urea-molasses supplement were recorded once faecal N fell below 1.3%. This threshold has been broadly adopted for other pasture types despite the authors' cautioning against such a practice. Although no trials have been specifically undertaken to validate this application, dietary CP and faecal N predictions from numerous faecal NIRS analyses strongly suggest that the universal adoption of such a diagnostic threshold is inappropriate.

Predicting responses to supplements

Past difficulties in determining diet quality of grazing cattle have severely limited progress in both research and application of supplementation technology. Making sound economic decisions on supplementation depends on knowing when, what and how much supplement to feed and predicting the response. In turn, this depends on knowing the quality of the basal diet. Faecal NIRS therefore presents new opportunities for significant advances in the cost-effective use of supplements. Indeed, without further research directed at measuring responses of grazing cattle to various supplements relative to the quality of the basal forage diet, the benefits of faecal NIRS as a management tool will be severely restricted. As part of an MLA funded project, a number of supplementation trials have just been established to start addressing this issue but a major expansion of this sort of work is recommended as a high priority.

Conclusion

The further development and application of faecal NIRS should have a major impact on understanding and managing nutrition in the northern beef industry.

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Adapting the *Best Bet* system to increase profit

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Abstract

This paper describes the results of the NT DPIF's Best Bet breeder management package, and the ongoing program to refine it to yield more profit.

There has been a remarkable change in herd performance in the Katherine Region since the 1980s, best exemplified by the Kidman Springs herd, which averaged 46% weaning and 13% breeder mortality prior to 1990, and 77% weaning and less than 3% mortality since. This transformation was achieved by adopting the Best Bet system – a package of breeder management recommendations, with a benefit:cost ration of at least 2:1. This system has been the backbone of DPIF's extension efforts since 1995, and has contributed to similar levels of improvement in many stations in the region.

However, with the constant cost/price squeeze, the industry is requesting that the recommendations be tightened to provide a more cost-effective package without adversely affecting production. The paper describes a modelled financial assessment of a Reduced Cost package, and identifies the recommendations that really drive profitability. A field trial of this Reduced Cost package will start in 2002.

The current DPIF *Best Bet* system

The DPIF *Best Bet* system is a package of management recommendations developed in 1990, based on experimentation and experience from the Victoria River Research Station, Kidman Springs (Table 1).

Table 1. Current Best Bet package

1	Moderate stocking rates (approximately seven breeders per sq km)
2	Year round mineral supplementation (costing about $17 per breeder)
3	Weaning twice yearly down to 100 kg
4	Cows culled from 10 years old
5	5 bulls per 100 cows
6	Cows culled for temperament, obvious faults and injuries, and low fertility (empty and dry in May)
7	Bulls bought at 2 years old and culled at 8 years old
8	Use adapted cattle
9	Vaccinate all animals against botulism annually (C&D strains)
10	Vaccinate bulls against vibriosis annually
11	Segregating heifers, mating at 2 years of age 280 kg or higher; run separately until they wean their first calf
12	Use fire to maintain pasture condition

Kidman Springs herd performance

Kidman Springs runs about 500 breeders under an extensive management regime similar to most commercial properties in the region. It is virtually in the middle of the Victoria River District, with an annual median rainfall of 617 mm, and red and black soils that could be considered 'average'.

Prior to 1990, the station was devoted to trials of individual components of the production system, notably weaning (Sullivan *et al.* 1992, Sullivan and O'Rourke 1997, Sullivan *et al.* 1997). No mineral supplement was fed. From 1981–90, the breeder mortality rate averaged 13.3% and weaning percentage 46.4%. Although comparative commercial data from that time is not available, particularly since normal sales patterns at that time were greatly disrupted by BTEC, the Kidman Springs data appears representative.

The main changes in the management of the Kidman Springs herd with the adoption of the *Best Bet* system in mid-1990 were the introduction of supplements and an earlier weaning round (April instead of June).

In the 10 years since the adoption of the *Best Bet* system, breeder mortality has averaged 2.6% and weaning percentage 77.2%. As shown in Figure 1, mortality dropped immediately following the introduction of supplementation in mid-1990. There was a lag year before the weaning rate responded.

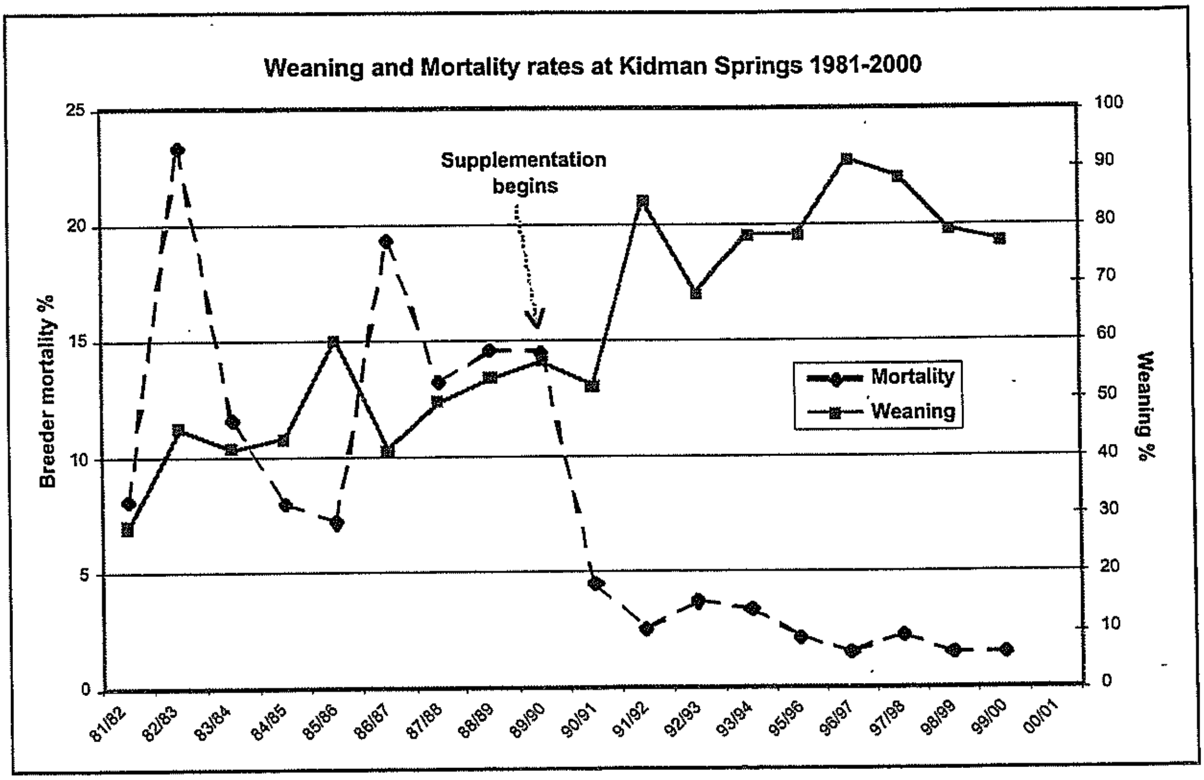

Figure 1.

Costs and benefits of supplementation

The most expensive part of the *Best Bet* system is year round supplementation. A summary of the costs and benefits for the first five years of supplementation (Table 2) showed a benefit of over $2 for every $1 spent.

Table 2. Supplement cost and benefit for 100 cows at Kidman Springs over a five-year period 1990–95

Costs		Benefits	
Supplement cost	$8,469	Value of extra weaners	$19,800
Freight and distribution	$3,250	Value of extra weaners	$10,925
Total supplement cost	$11,719	Total benefit	$30,725

Adoption by industry

Anecdotally it seems that the management system of most commercial stations in the Katherine Region mirror parts of the *Best Bet* system. The slowest aspects to be adopted appear to be minimum weaning size (very variable between stations and the subject of much debate), wet season supplementation (although sales of supplement have increased), and strategic use of fire. Breeder productivity figures from many stations in the region appear to have improved to levels comparable to those of Kidman Springs post-1990.

Cattle management on the Mt Sanford stocking rate demonstration (started 1993), which is managed with industry input, is based on the *Best Bet* system with minor modifications. The minimum weaning weight is set at 120 kg, instead of 100 kg, to compromise with higher industry norms and to reflect the site's good pasture conditions. The other change has been to increase the age at which cows are culled to 12 years. The average weaning percentage on the site has been 81%, with less than 2% mortality.

Reduced Cost package

As the name suggests, the *Best Bet* system is always open to being updated as new circumstances evolve and new research findings become available. With the constant cost-price squeeze, there has been a demand from the industry to look at ways of increasing profit from the system by reducing costs without significantly reducing performance.

It was considered that modifications to the first five of the management practices listed in Table 1 could result in greater profits – called the *Reduced Cost* package. This was compared against the *Best Bet* package using the *Breedcow* herd modelling program applied to the 21 km^2 Conkerberry paddock on Kidman Springs. The *Breedcow* program was specially modified by Bill Holmes to allow increased age of breeders.

1. Modifying stocking rates

The *Best Bet* recommendation is to stock around seven breeders per km^2. In the *Reduced Cost* package, the stocking rate reflects the carrying capacities of the different land types within the particular paddock. These were calculated from the median annual pasture growth estimates from the pasture growth model GRASP, based on the last 100 years of rainfall data (Table 3).

Table 3. Calculation of estimated safe carrying capacity (Conkerberry Paddock, Kidman Springs)

Land type	Median pasture growth	Stocking rate AE/km2	Stocking rate breeders/km2	Percentage of paddock
Grey clay	2560	13.4	10.9	57
Calcareous red	2000	7.8	6.3	43
Whole paddock	2319	11.0	8.9	100

This strategy resulted in an increase in stocking rate in Conkerberry paddock from 148 to 178 breeders.

2. Reducing bull percentage

The *Bull Power* Project has shown that a reduction in bull percentages to 2–3% should not jeopardise herd fertility if tested bulls are used. This model assumes 3% bulls and $20 per bull testing fee. Bulls were purchased at $1500 and were valued at $812 as culls.

3. Reducing supplementation costs

Reduction in annual cost from $17 to $10 per breeder. This could be achieved either by using water medication or limiting supplementation to specific times of year. It was (bravely) assumed that there would be no production penalty from this change.

4. Varying minimum weaning weight

Early weaning allows the breeder to recover condition and helps her to re-conceive. However, early weaned progeny take longer to reach market weight. While the *Best Bet* recommendation is to wean all calves from 100 kg, a possible alternative strategy is to increase the minimum weaning weight when pasture conditions and hence breeder body condition are good enough. As an approximate method of modelling this, it was assumed that the percentage of steers reaching market weight one year after weaning would be raised from 60% to 80%. No production penalty was assumed because calves would be weaned lighter when seasonal conditions were poor.

5. Keeping aged cows longer

Ridley (pers. comm.) has calculated that before heifers reach 3.5 years old, they consume 34% of the resources of the Kidman Springs breeding herd, and yield only 17% of the calf production. Fordyce (1999) has similarly concluded that heifers are the least efficient part of the breeding herd. It may therefore be more profitable to keep aged cows longer in the herd. This was modelled with cows up to 15 years old. Mortality rate was assumed to increase from 4% to 7%, above 10 years old, with weaning rate decreasing from 75% to 70% at 10–12 years, and down to 65% for cows older than 12 years.

Results

The financial measure selected to evaluate the changes was herd gross margin from Conkerberry paddock. Overall the *Reduced Cost* package ($44,395) had an 18% advantage in herd gross margin over the *Best Bet* package ($37,569).

The *Reduced Cost* package was further analysed to determine the contribution of each component to the 18% advantage (Table 4), by discarding the different components one at a time. A negative change therefore indicates a component that will have a positive impact on herd profitability.

Table 4. Herd gross margins discarding different components of the Reduced Cost model

	Herd gross margin.	% change
Reduced Cost model complete	$44,395	
Without changing bull percentages	$43,919	-1.0%
Without reducing supplementation costs	$41,962	-5.5%
Without increasing age of culling cows	$45,919	+3.4%
Without modifying stocking rates	$38,013	-14.4%
Without changing minimum weaning weight	$46,036	+3.5%

Discussion of results

As shown in Table 4, stocking rate has clearly the largest impact on profitability. A similar conclusion has been reached by other recent DPIF modelling exercises. The impact of a $7 reduction in supplementation costs was also not unexpected. Whether this can be achieved without a production penalty requires testing.

The low and negative impact of the other factors was surprising. In each case, the outcome has been affected by the condition of the current market, which offers good prices for cull bulls and cows, and strong demand for larger steers for the Middle East. In the case of aged cows, the model indicates 10–11 years to be the optimum age of culling cows.

In the case of steer turn-off, the model shows that current prices favour maximising the size of steers sold, even if that entails holding them for an extra year. Holding steers over has implications for total grazing pressure, in this case increasing the total animal equivalents of the herd by 3%. This has not been included in the assessment as its commercial importance would vary from station to station.

When the *Reduced Cost* model was run without variable weaning weight and without keeping cows over 10 years, then its herd gross margin was $47,138. This is 25% better than the *Best Bet* model.

Future

A field trial of the *Reduced Cost* package and comparison with the existing *Best Bet* package is planned to commence at Kidman Springs in 2002.

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Better decisions in the business of beef applied to breeder herd efficiency in northern Australia

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Abstract

'Better Decisions' processes, as expressed in Breedcow and Dynama computer software, use proven economic techniques to:

- *screen 'change' options for profitability;*
- *show pathways of change from a herd and financial perspective;*
- *indicate best choices for forced sales or opportunistic purchases; and*
- *analyse change within an investment analysis framework.*

Best options for one business may not be best for another, due to differing goals and physical and financial resources.

The processes of the 'Better Decisions' project are used to analyse a variety of pasture utilisation, weed management and cattle husbandry options for northern Australian beef breeding enterprises.

The 'Better Decisions' project

'Better Decisions in the Business of Beef' is the project name for software development, commercialisation, training and application activities surrounding QDPI Breedcow and Dynama herd budgeting software.

Breedcow and Dynama software applies conventional farm management budgeting and investment analysis techniques to extensive cattle enterprises as operated in northern Australia. A key feature of this software is that it starts with herd dynamics and builds the budgets from there.

Initially, Breedcow and Dynama software was developed for my everyday work as a regional economist. The process was accelerated by the needs of BTEC (Brucellosis and Tuberculosis Eradication Campaign). Soon, other QDPI officers were using the software. It was a short step from there to commercialisation.

What began as a simple software development has evolved into a project of much wider scope, encompassing training and the general empowerment of non-economists to use economic and financial processes which once were the preserve of specialists.

From a personal perspective, this has been a professional odyssey from pencil and paper to the capacity to do in hours or minutes the jobs that once might have taken days or weeks. In my early career I provided analytical services to QDPI and its clients. Now I provide the training and the software for QDPI and other organisations, consultants, banks and the clients themselves to perform these same analyses and to do so far more thoroughly than was possible in the past.

Breedcow and Dynama software is now used across northern Australia by government and non-government organisations, companies and individuals. In QDPI it has been used also as the analytical vehicle or data capture method for the *Local Best Practice, Smart Manager*, and *Grazing Land Management* projects.

Breedcow and Dynama software

The Breedcow and Dynama software package comprises nine programs. The programs are grouped around four questions or themes in business planning and improvement:

- Where are we now and we are we headed?
- Is there a better way to run the herd?
- What do we sell (or buy) when a departure from the plan is required?
- Change as an investment.

Taken together, these processes allow decisions of both strategic and tactical natures to be analysed.

Where are we now .....

This is the totally conventional determination of current position, assets and liabilities, plus herd structure and budget for the future. Cattle numbers are projected forward based on expectations of brandings, deaths and sales. Budgets and future debt and asset position follow from the cattle projections and sales policy. Programs are Dynama (10 year projections), MonthCfl (monthly analysis and working account balances for the first year of the budget), and TaxInc (livestock trading accounts for taxation calculated from the 10 year herd projections of Dynama). The psychological outcome of this process may be the realisation that change is required.

Is there a better way .....

Stable state herd modelling is used to compare estimated gross margins for different management systems or sales policies. For example, feeding supplements may reduce male turnoff age, increase branding rates, reduce deaths, or do all three. Stable state modelling can show the effect of these changes on turnoff and gross margin whilst maintaining the same stocking rate for both sides of the comparison. Proposals may be eliminated which do not improve gross margins, or which do not improve them enough to justify additional fixed costs.

What do we sell ... (or buy) .....

Processes described so far apply mostly to planning horizons of several years.

Situations also arise where a more immediate response is required. These include destocking for drought, finding extra sales to meet a cash flow crisis, responding to abnormally high prices, or buying stock to capitalise on surplus feed or low prices.

When dealing with forced sales, the aim should be to achieve the required reduction of stocking pressure (or raise the required cash) with minimum damage to future income.

The InvsetAn program calculates gross margins (GM) for candidate sale groups, allowing groups to be ranked in order of sales priority – those with the lowest prospective GM (if kept) should be the first sold. This may be finessed by specifying that destocking for drought should be decided on GM per adult equivalent (AE), while sales forced by cash shortage should be decided on GM per dollar raised by the sale.

Purchases may be assessed in a similar way, though selecting first those groups indicating *highest* potential GM. This can be GM/AE if the buyer has enough capital to utilise fully the available feed, or GM/$cost if the cash is going to run out before the paddock is fully stocked.

Change as an investment .....

Changes requiring outlays now for rewards in the future can be analysed as investments and compared with alternate investments.

Some changes require capital expenditure over more than one year, and bring forth improvements over time, comprising improved carrying capacity and/or improved animal productivity.

The eventual outcomes of these improvements can be compared using Breedcow or Bcowplus programs. The change may result in better eventual gross margin, but may require capital expenditure, or incur additional variable costs that produce a worthwhile response, but not immediately. Because of these complexities, the decision to adopt or not will be unclear. This is the classic situation for investment analysis processes such as used to assess public buildings, dams, etc.

Scenarios may be compared in Dynama – one representing 'do nothing', or at least the established plan, and the other representing 'change' from that plan. Dynama allows the details of change to be worked through, including changing carrying capacity, animal productivity, herd structure and turnoff.

The program InvestAn (Investment Analysis) compares Dynama files representing 'do nothing' and 'change'. Annual cash flows are compared.

The values of non-cash assets at the end of the budget period are included in the comparison. The most obvious difference may be the size and value of the herd between 'do nothing' and 'change'. There may also be differences in the value of plant and improvements due to the net impact of new investment, depreciation, and capital disposals. It may also be legitimate to factor in changes in underlying land value (asset revaluation) in consequence of changes to grazing or weed management.

Outputs from InvestAn are comparative cash flows and terminal asset values, plus calculations of net present value (NPV), internal rate of return (IRR), and peak deficit.

NPV is value, if received today, of the profit from the change after allowing for interest costs on new investment. IRR is the % return on new capital invested in the change. Peak deficit is determined by compounding forward annual deficits plus interest (less surpluses) to find the peak in the cycle of rising then falling debt. All are important measures for selecting 'best' investments.

Applying 'Better Decisions' to improving breeder efficiency

Breedcow and Dynama software is used at two levels for testing herd improvement options: First, getting more out of the herd without changing the underlying productivity; second, improving profit by increasing inputs or changing husbandry.

Improvement without underlying productivity changes is achieved by adopting most profitable steer and heifer turnoff ages and, to a lesser extent, most profitable balance between culling % of heifers and culling rates of mature cows.

Husbandry changes may improve branding rates and reduce mortalities, but the enterprise does not sell calves, or necessarily the stock which are 'saved'. Herd modelling enables us to convert better brandings and reduced mortalities to changes in sales of steers, heifers and old cows and ultimately to changes in herd profitability.

The profit impact of improved steer growth leading to earlier turnoff at the required weight may likewise be obscure, deriving from being able to carry a few more cows now that the steers are not tying up the country for so long.

The process used to examine husbandry or land management scenarios for improved breeder herd outcomes is as follows:

- Develop a stable herd representation of the current ('base') herd situation in Breedcow or Bcowplus program.
- Develop a stable herd representation of the herd situation after the change has been fully implemented. Changes may include branding and death rates, variable costs, turnoff age or % at each age, and prices (derived from weights). Compare with 'base' and proceed only if GM is higher for the change and sufficient to cover any additional fixed and capital costs. Profitability alone may not ensure adoption if the cash flow hurdles en route are insurmountable. This is the purpose of the next two steps.
- Develop a 'do nothing' Dynama file (10 year projection). This may start from a known producer situation or the start may be modelled and transferred from Breedcow (the 'base' file). 'Do nothing' could include a deteriorating or improving trend, particularly if the issue is land or weed management. The end point of 'do nothing' can be defined by the Breedcow 'base' file or by a new Breedcow file defining the endpoint of an improving or declining trend.
- Starting with the 'do nothing' Dynama model, and the Breedcow 'change' model (used to set the herd goal and eventual sales policy), construct a Dynama file representing the course of the change from the first year of 'do nothing' to the new herd structure and output. Changes to branding and death rates, prices and variable costs are 'graded in' on a timetable reflecting change over time. Will the cash flow pattern for 'change' be easier to finance than the cash flow pattern for 'do nothing'? This is about financing the shortfalls, not eventual profitability.
- To judge the overall profitability of change, especially if there is significant capital investment involved in the change, use the InvestAn program to compare 'do nothing' and 'change' Dynama files.

Outcomes

The 'Better Decisions' process enables the capture, in a herd and financial sense, of the consequences of modelled changes to herd or grazing land management.

Initial application of Breedcow and Dynama modelling by QDPI staff with producers indicated an enthusiasm by producers for the process. Few producers then owned computers but they would certainly come up with ideas for testing and could relate freely to the model output. Husbandry choices such as earlier weaning, breeder supplementation, and even botulism vaccination appeared in a new light when outcomes were expressed as extra sales or debt reduction, and not in the old currency of extra calves branded or breeders saved.

Later, the Breedcow part of the modelling process was used for data capture in the 'Local Best Practice' project. Representative production systems and outcomes for a number of local areas were modelled using informed producer opinion. Data was recorded on a whiteboard and on the computer, and model results projected from the computer on to a screen. The staff involved in this project became quite skilled at 'proofing' the data, recognising selective perception, detecting differences between model output and reality, and guiding group discussion to adjust data until it was giving output consistent with local experience. These adjustments concerned mainly branding rates and breeder death rates. From an extension standpoint, this process could be viewed as the first step by producers in acknowledging a husbandry problem.

Currently, adaptations of Breedcow and Dynama programs are used in the 'Smart Manager' project. Smart Manager entails group modelling of a representative local scenario (if the group has not already done 'Local Best Practice'), followed by modelling own situation, then modelling options for change, and finally modelling the pathway to change. This is done in a workshop setting, each participant being supplied with a notebook computer for the workshop, and with sufficient QDPI staff present to guide participants through the modelling process. In the course of modelling participants' own situations, some benchmarks are produced, the most important being gross margin per adult equivalent. These are used to fuel discussion of likely avenues of breeder herd improvement. There has also been some one-on-one work in conjunction with Smart Manager. I would suggest that staff have gained a much wider perspective on the business of cattle from this and similar activities.

Most recently, Breedcow and Dynama software has been used to analyse improvement scenarios for the Grazing Land Management project, and to do an investment analysis of a large scale woody weed control project for a major pastoral company. The next issue to be investigated will be beef genetic improvement.

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Cograzing cattle and camels

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Introduction

Pastoralism in the semi-arid and arid regions has shifted from being almost exclusively focused on wool and beef production to include other products from grazing animals. Camels are a potential resource already present in Central Australia and adapted to arid environments. Large areas of pastoral land in arid and semi-arid Australia are suitable for grazing camels.

Until recently, many beef cattle producers in Central Australia regarded camels as a pest, principally because bull camels damage fences during the rutting season. The camel industry has recently expanded by opening live export market shipments to Brunei, Malaysia and Jordan. If the camel industry develops further, the attitude of beef producers to camels are likely to change from seeing them as a pest to seeing them as a resource.

Cograzing cattle and camels represents one of the few opportunities for agricultural enterprise diversification available to beef producers in Central Australia. This trial, carried out on 'Waite River' Station in Central Australia, addressed the lack of objective information on livestock production and the effects on vegetation of cograzing camels with cattle.

Methods

Site

The trial used an existing paddock of 8.4 km^2, Muller paddock on 'Waite River' Station, north-east of Alice Springs. An adjoining area of 20.9 km^2 was fenced off and supplied with water, and named the DPI paddock. The DPI paddock was larger for practical reasons that suited station management. Adjoining paddocks on neighbouring 'Woodgreen' Station were used as a control or benchmark for estimating pasture impacts because of a very conservative stocking history since 1972.

Rainfall volume was measured in both paddocks, with rainfall intensity also measured in the DPI paddock using a pluviometer. Seasonal conditions fluctuated dramatically during the project, influencing pasture production and availability (Figure 1).

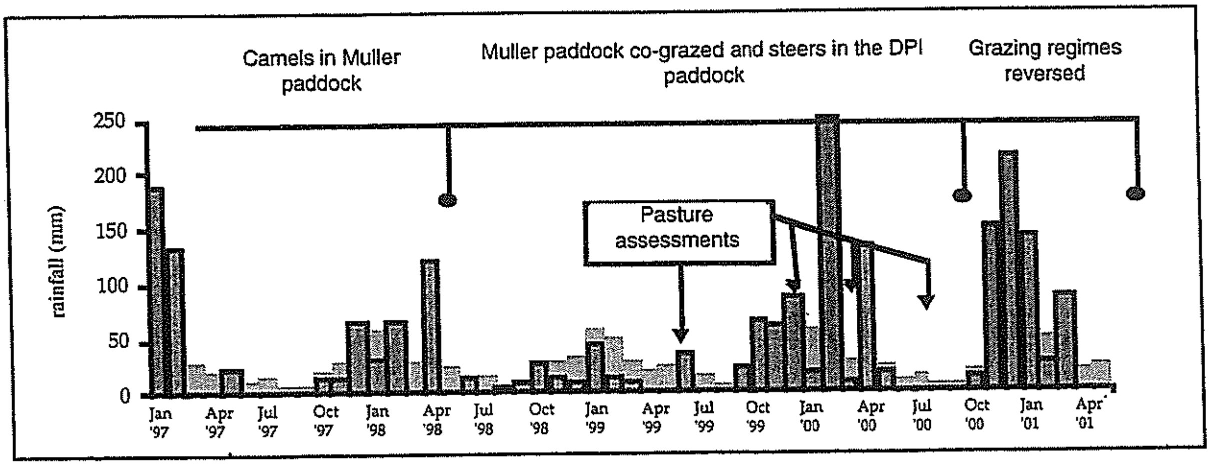

Figure 1. Time-line of the cograzing trial showing monthly rainfall totals against long term averages (light grey) as well as the timing of key treatment changes and pasture assessments.

Both paddocks were spelled preceding the trial so that pasture availability was similar to begin with. Steers were introduced to the paddocks in March 1998. For two years Muller paddock was cograzed and the DPI paddock ran steers only. In the final year of the project, between August 2000 and May 2001, the grazing regimes were reversed in order to account for any paddock effects on animal performance.

Detailed pasture assessments were not undertaken after the grazing regime reversal because of the limited period involved.

Pasture plants, pasture utilisation and ground cover

The three paddocks had six sites selected within each of two land types, 'run-on' or 'run-off', depending on surface water flows after rainfall. At each site, 15 x 1 m^2 relocatable sampling plots were positioned along a 30 m transect extending away from a site marker post.

Within each sampling plot, the 'oven-dried' weight of each species was visually estimated in g/m^2. The visual estimates were adjusted using a linear regression derived by visually estimating, cutting and drying a range of plots adjacent to the sampling sites. This provided data on comparative yield, as well as percentage frequency (presence/absence) of each species.

Further analysis was carried out on key species and functional groupings regarded as important to cattle and camels. For comparative yield the key groupings were total yield, all forbs, perennial grasses (run-on land type), annual grasses, and *Enneapogon* spp. (run-off land type). For percentage frequency, further analysis was carried out for *Salsola kali*, *Sclerolaena* spp., *Sida platycalyx*, all forbs, and *Enneapogon* spp.

During the very dry conditions of October 1999, when other pasture measurements involving species identification were not possible, the percentage of ground covered by standing plants and detached litter was visually estimated. These cover measurements were repeated after good rains returned in February 2000.

Camel feeding and behavioural observations

To allow for easy tracking and observing, one camel was radio collared each year. During the project, the location of the camels was noted and their daily activity patterns recorded. The characteristics of the habitat were also noted with these recordings.

The plant species browsed or grazed was recorded, and any unusual behaviour, such as branch breaking was noted. When possible, quantitative food intake was measured by counting a minimum of 1000 bites from individuals and/or by evaluation of 'time Budgets' (Altman 1974).

Tree and shrub impact monitoring

The impact of camels on different topfeed species in Muller paddock was measured at 20 vegetation transects (200 m x 4 m). Ten comparative transects were established outside Muller paddock, and another 10 were established in the DPI paddock prior to camels being introduced.

Transects were assessed every three months where possible. Individual trees and shrubs on each transect were identified, their height was measured, and any damage or change was recorded. The abundance of shrubs per transect was recorded in seven size classes (< 25 cm, < 50 cm, < 100 cm, < 200 cm, < 400 cm, < 800 cm and > 800 cm). Canopy cover was measured on every transect using a rope connected between two posts as a fixed line. Each tree and shrub that covered or was underneath the rope was measured individually. Browsing intensity on trees and shrubs intersecting transects was classified into six categories ranging from *no browsing* to *totally destroyed by browsing*.

Photographs of 30 fixed representative sites were also taken prior to the introduction of the camels and twice yearly after the camels arrived.

Cattle and camel production measurements

Steer stocking rates for both paddocks were developed using a combination of local producer knowledge, land types and pasture yields, and were set such that pasture quantity would not limit cattle production except under poor seasonal conditions. Stocking rates for Muller paddock and DPI paddock were 4.2 steers per km^2 and 3.6 steers per km^2 respectively.

Individually ear-tagged steers were introduced to the paddocks at six to twelve months of age, with liveweights that were as equal as possible between groups. The first two steer groups were weighed five times – on entry and at approximately three month intervals until their removal from the paddocks. Steers were supplemented with Uramol® blocks under dry seasonal conditions in late 1998 to early 1999 as part of normal station management. Due to exceptionally wet seasonal conditions, the final group of steers were weighed twice, on entry and on exit around nine months later.

After their second weighing in May 1999, half of the steers from the cograzed Muller paddock were swapped with steers of equal liveweight by pairing with individuals from the DPI paddock. This gave four groups of steers with growth information: steers grazing with camels all year; steers grazing with, then without camels; steers grazing without, then with camels; and steers grazing without camels all year.

In 1996 fourteen camel cows and one camel bull were introduced to Muller paddock at a stocking rate of approximately two adult camels per km^2. Several camel calves were born between 1996 and 1998. Some young bull camels of weaning size were weaned and removed from the paddock in September 1998, whereas the sole female calf was kept in the paddock. In March 1999, to address concerns over the prevailing dry conditions, the breeding herd of camels was replaced with nine young bull camels, reducing the stocking rate in Muller paddock to one camel per km^2. The same stocking rate was used when the DPI paddock was cograzed using 20 young bull camels. Camels were weighed at around the same time as the steers.

Total livestock productivity of Muller and DPI paddocks was measured in terms of kilograms liveweight maintained and produced per square kilometre.

Results and discussion

Pasture plants, utilisation and ground cover

During the drought conditions of late 1999, the cograzed paddock had only half the pasture (32 kg/ha) of the DPI (cattle-only) paddock and only 20% of what was available in the control paddock. However, after rain periods, both treatment paddocks recorded similar yields of 400–460 kg/ha in February 2000, and 930–940 kg/ha in May 2000.

On all occasions the cograzed paddock had significantly less quantity of total forbs, and that was the only consistent impact attributable to cograzing during the trial. However, there was no consistent impact for any forb species in terms of percentage frequency of occurrence. Camels were suppressing forb production but this did not translate to an impact on the number of plants per unit area during the trial period.

On no occasion did cograzing have any additional impact on perennial or annual pasture grass species, when compared with cattle grazing only, both in terms of quantity available or frequency of occurrence.

Cograzing did lead to a significantly greater number of bare ground plots being recorded during drought conditions, but this ground cover was quickly restored when good rains returned.

Tree and shrub impact, and feeding observations

Tree and shrub cover (Table 1) was largely driven by seasonal conditions (Figure 1). In 1998, good autumn rain and subsequent herbage availability enabled the camels to graze more ground storey species. In 1999, the decrease in canopy cover was a result of cattle browsing on preferred topfeed species during the dry conditions. In 2000, extraordinary herbage availability enabled the camels to predominantly graze forbs. Only minor browsing impact on the trees and shrubs in the cograzed paddock was recorded. From August 2000 to May 2001, canopy cover increased everywhere in response to excellent seasonal conditions.

Table 1. Percentage changes in canopy cover inside the cograzed paddock and comparative transects in the control paddock and paddock with cattle only

Year	Cograzed	Control	Cattle only
1997	-15.5%	+22.4%	
1998	±0%	+4.7%	
1999	-8.8%	-9.5%	
2000	+30%	+33%	
2001	+11.8%	+9.1%	+19.4%

This project did not demonstrate impacts on vegetation which would be attributable to cograzing, however it did not run long enough to ascertain long term differences. Despite camels being generally perceived as browsing animals, they can preferentially graze forbs when they are available. They also graze fresh grass growth after the first rains following a dry period, until forbs become available. There are therefore some dietary overlaps between cattle and camels for preferred tree, shrub and herbage species and for grass at certain times.

Cattle and camel production

Steer growth patterns reflected seasonal conditions and were therefore completely different during the first two periods, yet annual weight gain and overall growth rates were very similar (Table 2).

Table 2. Average weight gains (kg) and average daily gains (kg/day) of steers and camels

Period	Species	Average daily gain (kg/day)	Annual weight gains (kg)
Mar 1998 – May 2000	Steers	0.41–0.45	150–165
	Young bull camels*	0.16	64
Aug 2000 – May 2001**	Steers	0.58–0.63	145–160
	Young bull camels	0.26	109

* Measurements begin from March 1999, when the breeding herd of camels were replaced with nine young bull camels.

** Growth rates in this eight month period were higher as a result of exceptionally high rainfall.

Average steer weight gains were consistently slightly higher in Muller paddock. Average daily gains of steers were 38 g/day higher between March 1998 and March 1999, 30 g/day higher between March 1999 and April 2000 and 54 g/day higher between August 2000 and May 2001. Although these differences were similar, they were not statistically significant during the first two periods, but were significantly higher during the final period. This finding is believed to have been due to the combination of excellent seasonal conditions and different land types, rather than any impact from reversing the grazing regimes.

Cograzing with camels was not shown to limit steer performance during the two years in Muller paddock, presumably because they were not in competition for feed resources and did not have any other detrimental interactions. Although steer growth information cannot be directly compared between years because of different seasonal conditions, if steer growth rates were reduced by cograzing, the maximum possible difference was minor (10 g per day).

In 1998 when the camel breeding herd was in Muller paddock, all camel weights (except calves) fell in autumn when the bull was in rut. Cow and weaner weights recovered three months later. In April 2000 several of the nine young bulls removed from Muller paddock showed signs of rut, and their weights had fallen by an average of 58 kg since January. Rut is thought to have been stimulated by the presence of one camel cow that was injured and not removed from the paddock with the rest of the breeder herd. In May 2001 none of the young bull camels were showing signs of rut. Their average weight gain, and average daily gain over this eight month period, is illustrated in Table 2. It seems necessary to avoid rutting behaviour to optimise camel production. Importantly however, camel rutting behaviour did not affect cattle weight gains.

Cograzing camels with cattle substantially increased the weight of livestock grazed per km^2. In the three periods that camels were cograzed with steers, they accounted for 52%, 28% and 26% of the total livestock weight maintained per km^2 in the cograzed paddocks. Equivalent increases in the cattle stocking rate per km^2 would be expected to cause their production to suffer under most seasonal conditions. Running young bull camels at stocking rates of approximately one camel per km^2 with steers resulted in camel weight gains accounting for 10% (after being affected by rutting behaviour) of the total livestock weight produced per km^2 in 1999/2000 and 16% in 2000/01.

Conclusion

If markets for camels continue to expand and it becomes economically viable to domesticate significant numbers of camels, this trial showed they can be successfully cograzed with cattle. Under careful management, a successful outcome of unchanged cattle production, plus additional camel production could be achieved without negative impact on pasture resources. Cograzing however, may increase variable and capital costs somewhat when compared to grazing cattle only.

Cograzing may be even more applicable to the large areas of marginal land in Central Australia (such as spinifex and mulga country) than in the more productive land types used in this trial. The proportional contribution that camels could make to total livestock production would be expected to be higher on land types more marginal for cattle grazing and where there are long distances between water points.

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Notes

First-calf heifer reconception – Central Australia

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Abstract

First-calf heifer reconception influences the lifetime reproductive performance of an individual breeder cow, as well as the overall breeder herd efficiency. Studies have shown that the post-partum anoestrus period is longer in first-calf heifers than in older cows, resulting in a first-calf heifer reconception rate that is lower than the whole breeder herd conception rate. Information on first-calf heifer reconception has not been available for beef cattle herds in the Alice Springs district.

Retrospective analysis of a long-term cattle herd health and performance study in the north-east Alice Springs district shows an average 12-month first-calf heifer reconception rate (52% +/- 2%) well below the average annual pregnancy rate (83% +/- 6%) for the whole breeder herd. A graph plotting recorded monthly rainfall against cumulative reconception highlights the potential impact of effective monthly rainfall and seasonal nutrition upon first-calf heifer reconception.

This paper indicates a need to define the influence of first-calf heifer reconception on breeder performance in extensive beef cattle herds of Central Australia. The cost-effectiveness of management strategies that maximise first-calf heifer reconception also needs to be determined for these beef cattle herds.

Introduction

First-calf heifer reconception influences the lifetime reproductive performance of an individual breeder cow, as well as the overall breeder herd efficiency. A delay in first-calf heifer reconception is usually the result of delayed post-partum oestrus. This has a negative impact on heifer reproductive efficiency. The delay in post-partum oestrus is longest in female cattle with the lowest body condition or liveweight (Holroyd 1986).

Heifers at their first calving need extra nutrition if they are to cope with growing-out, the stress of lactation and cutting teeth (Freer 1999). Lowered fertility in lactating first-calf heifers is the result of channelling nutrients into more immediate needs of lactation and continued maternal growth, rather than into reproduction (Holroyd 1986). This prolongs the post-partum anoestrus period. Under intensive beef cattle grazing conditions, first-calf heifers may have a pregnancy rate 10% lower than adult cows, and take from 10 to 21 days longer than cows aged five-years-plus, to return to heat after calving (Taylor 1982). Beef cattle information from the United States quotes an average calving to first oestrus interval of 67 days in young cows suckling calves and 49 days in older cows (Boyles n.d.).

Underfeeding will compound the negative influence of increased maternal nutritional needs on first-calf heifer fertility. Underfeeding prior to calving delays oestrus, while underfeeding after calving tends to lower conception rate. These effects are additive (Brown 1995). For optimal rebreeding efficiency, a cow should calve at condition score 3 (on a scale of 1 to 5), in order to reconceive within three months of calving at a minimum condition score of 2.5 (Field and Anderson 1997). Optimal nutrition can increase the rate of first-calf heifer reconception. In the dry tropics, targeting first-calf heifers for supplementation improves pregnancy rates (Dixon *et al.* 1996), even if only provided as pre-partum 'spike feeding' (Fordyce *et al.* 1989).

Assessment of the first-calf heifer reconception rate provides a base for management decisions about heifer nutrition during and after gestation of their first calf (Massey, Whittier and Bierschwal 1993). A lack of current, reliable, basic biological data from Alice Springs district beef cattle herds, as identified by Holroyd and O'Rourke (1988), has limited discussion about first-calf heifer management in the district.

Through discussion about first-calf heifer reconception in a long-term cattle herd health and performance study, this paper helps to address the identified lack of data.

Methods

Location of study

The study area is located 200 km north-east of Alice Springs (Westside Mount Riddock, 23°S, 134.5°E). Major land systems in the study area as described by Perry (1962) are the Harts (15%), Kanandra (10%), and Bond Springs (65%) systems. Carrying capacity of the pasture types ranges from 0.5 to 8 head per square kilometre (Bertram, Oliver and Phillips 1996). The study area had an average stocking rate of two breeder cows per square kilometre and was fenced into two paddock areas with five major watering points:

- Paddock area #1 (500 km^2) is principally stony open woodland and small hills with crests and ridges, plus some sandy open woodland and mixed acacia woodland. This is vegetated by mulga, witchetty bush, broombush, whitewood and corkwood over woollyoat, oat, mulga and kerosene grasses with scattered perennial grasses.
- Paddock area #2 (40 km^2) is principally sandy open woodland and mixed acacia woodland. This is vegetated by whitewood, supplejack, ironwood, corkwood, witchetty bush, mulga and broombush over kerosene, oat, sandyhill oat, woollybutt, curly windmill, mulga, silky browntop and kangaroo grasses, plus forbs such as buckbush, Birdsville indigo, verbine, rattlepods, ruby saltbush and spiny saltbush (Bastin, Shaw and Dance 1996).

The Alice Springs district is in an arid region with an average annual rainfall between 150 and 350 mm. Rainfall is increasingly summer-dominant towards the north of the district and very variable with an average of one dry year in four. Pastures respond rapidly to summer and winter rain with forbs growing predominantly after winter rain (Bertram, Oliver and Dance 1996).

Table 1 summarises the annual rainfall recorded during the study. The rainfall recordings were collated from the nearest consistent recording site (Mount Riddock Station Homestead), approximately 20 km from the centre of the study area.

Table 1. Annual rainfall totals recorded at Mount Riddock Station Homestead, 1991 to 1995

Year	1991	1992	1993	1994	1995
Rainfall total	404 mm	308 mm	338 mm	110 mm	446 mm

Maximum temperatures in the Alice Springs district often exceed 38°C for long periods in summer, and frosts occur in winter (Bertram, Oliver and Dance 1996). Temperatures recorded for the study ranged from 14° to 49°C in summer and from -2° to 36°C in winter.

Cattle herd management in study

The study was undertaken over five years between 1991 and 1996, using a Poll Hereford breeder cattle herd with an average of 971 head of breeder cows per muster. The cows were 18 months to 10 years of age.

Management practices included:

- year-round phosphorus and urea supplementation, using a variety of commercial lick blocks on different waters over the years (*MINAREA®* (Olsson's), *ULTRAPHOS®* (Olsson's), *QUEENSLAND DRY SEASON BLOCK®* (Olsson's), *STOCKMASTER '30' Dry Feed Block®* (Ridley), *NT URAPHOS®* (Olsson's));
- continuous mating with a bull percentage of 5%;
- herd improvement with annual purchase and introduction of herd bulls, plus culling of breeder cows on temperament, visible physical faults and reproductive performance;
- twice yearly musters, including branding and weaning to an average weaner weight of 260 kg;
- enhancement of calf survival by baiting to reduce dog predation, and by providing extra care during muster and yard work for heavily pregnant cows, recently calved cows, newborn calves and freshly branded calves.

The five year average annual performance indicators recorded during the study for the whole breeder herd included a pregnancy rate of 83% +/- 6%, a branding rate of 81% +/- 7%, and a weaning rate of 80% +/- 6%. These averages were based on calendar year calculations with at least four years of data.

Retrospective analysis

Measurement of first-calf heifer reconception rate was undertaken by pregnancy testing a group of continuously mated first-calf heifers, twice within the 12-month post-calving period. Cow age, lactation and pregnancy status records collected in the study were maintained on a computer database (*Microsoft Excel 97).* Retrospective analysis of these records enabled evaluation of the cumulative 12-month reconception rate in three groups of first-calf heifers.

Young breeder cows that met the criteria for inclusion in a first-calf heifer group were estimated to be 18 to 30 months old, lactating and calved, on average, three months previously. The pregnancy records of first-calf heifers in each group were analysed in order to determine the number of reconceptions per group in a 12-month post-calving period. The cumulative number of reconceptions per month, over 12 months, was expressed as a percentage of the number of heifers per group.

The cumulative reconception rate of each first-calf heifer group was compared to the monthly rainfall, that was collated from the nearest consistent recording site.

Results

The 12-month first-calf heifer reconception rate averaged 52% +/- 2% between the three first-calf heifer groups. There was no statistically significant difference ($p > 0.92$) in the reconception rate between the groups ('StatCalc' 1993). The average 12-month reconception rate over the three first-calf heifer groups is lower than the five year average annual pregnancy rate for the whole breeder herd (83% +/- 6%). Average pregnancy rate is used as an indicator of the whole breeder herd conception rate. Table 2 shows the 12-month reconception rate for each of the three first-calf heifer groups.

Table 2. First-calf heifer group 12-month reconception rate, Westside Mount Riddock, 1991 to 1994

First-calf heifer group	1989/90 born	1990/91 born	1991/92 born
(Number in group)	(42)	(18)	(14)
Reconception period	1991	1992	1993
12-month reconception rate	55%	50%	50%

Figure 1 is a graph showing the temporal relationship between recorded monthly rainfall and cumulative reconception rate for each of the three first-calf heifer groups in a 12-month post-calving period.

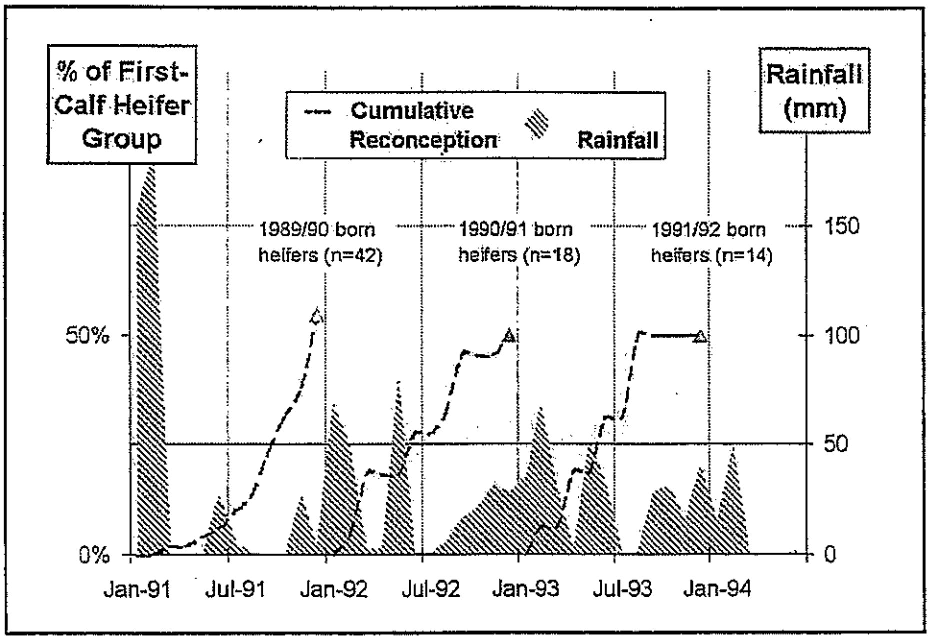

Figure 1. Cumulative first-calf heifer reconception rate vs. recorded monthly rainfall, Westside Mount Riddock, 1991 to 1994.

Discussion

The graph in Figure 1 shows a conception response one to two months after the monthly rainfall exceeds 25 to 50 mm, and by this shows a conception response to fresh growth of pasture and browse. The conception response is consistent with the observation that calving tends to be concentrated in spring (Shaw, Bastin and White 1996) in response to summer-dominant rainfall (Bertram, Oliver and Dance 1996).

The graph highlights the potential impact of effective monthly rainfall and seasonal nutrition upon first-calf heifer reconception. 'Effective rainfall' is a non-technical term based on subjective judgement to describe rain that produces plant growth. The effectiveness of rainfall depends upon rainfall intensity, time of year, ambient temperature and subsequent weather events (more rain, sunshine, wind, frost). During summer months in Central Australia an 'effective rainfall' event requires 25 mm of rain with a follow-up of another 25 mm of rain (Dance 2001, pers. comm.). This is supported by other observations about the balance between rainfall and evaporation with respect to substantial pasture growth in the Alice Springs district (Perry 1962).

Conclusion

Objective information on first-calf heifer reconception rates has not been available for beef cattle herds in the Alice Springs district. With the use of a longitudinal study design and retrospective analysis, this paper has provided current and objective information on this indicator of beef cattle reproductive performance in the Alice Springs district.

Analysis showed that the average 12-month first-calf heifer reconception rate was well below the average annual whole herd pregnancy rate. However, the study's structure limited the statistical power and external validity of this analysis. The first-calf heifer sample size was small and only a few strategies for first-calf heifer management in Central Australia were taken into account. Other management strategies to consider include the following:

- no mineral supplementation of first-calf heifers;
- mineral supplementation of first-calf heifers using methods such as water medication;
- supplementation of first-calf heifers using methods such as 'spike feeding';
- management of first-calf heifers separate from the main breeder herd, in order to efficiently target heifers for supplementation, saved pasture and managed stocking rates.

This paper indicates a need to define the influence of first-calf heifer reconception on breeder performance in extensive beef cattle herds of Central Australia. The cost-effectiveness of management strategies that maximise first-calf heifer reconception also needs to be determined for these beef cattle herds.

Acknowledgments

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Northern
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Increasing producer demand for knowledge

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Developing an education program in grazing land management for livestock producers in northern Australia

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Introduction

Over the past decade or so, there has been increasing recognition of the potential for enhanced management of grazing lands to meet the goal of sustainable beef production. This has been largely driven by concern over declining land condition (e.g. Tothill and Gillies 1992) in many areas of northern Australia (Queensland, Northern Territory and Kimberley region of WA), understandably motivated by the desire to minimise negative impacts on the environment such as soil erosion. This concern has matured somewhat to include the critical link between land condition and production, and the threat to sustainable carrying capacity that comes from declining land condition. At the same time, there is also interest in optimising the use of pasture, e.g. through development of infrastructure (waters, fencing), through more pro-active management of stocking rate and use of grazing systems, and through pasture development. In fact, achieving production goals while looking after the health of the land has arguably become the major on-property issue for beef enterprises.

The gradually increasing demand for better information and decision tools in grazing land management has been accompanied by investment into relevant R&D. Issues like land resource surveys, grazing management, use of fire, weed management and tree-grass balance have received some attention. However, a general view is that there has been limited uptake of information and ideas from this investment in R&D, and this perception is limiting further investment into strategic, long-term R&D. The reasons for low uptake include issues like:

- the lack of any comprehensive, ecologically-based framework to guide practical decision-making in grazing land management;
- bias in past research and extension efforts to issues of herd management and pasture development, with insufficient emphasis on rangeland management;
- low level of awareness of R&D outputs and outcomes amongst beef producers.

To help address this lack of impact from R&D, we are developing an education product that specifically addresses the needs in grazing land management identified by beef producers in northern Australia.

The Grazing Land Management (GLM) education product

Several organisations, including Meat and Livestock Australia, QDPI, and the DPIF (NT), identified the need for a concerted effort to build a 'product' that would enhance management of grazing lands in northern Australia. This 'product' should include:

- the principles, concepts, and relationships underlying sustainable grazing land management;
- the technical process or framework that supports planning, decision-making; and implementation;
- design and delivery that would both attract and satisfy producers.

The scope of the project was defined as:

- covering the North Australian livestock industry;
- including all dry-land, pasture-based enterprises;
- covering all aspects of grazing land management (GLM), especially:
  - grazing management (numbers and types of animals, and their temporal and spatial distribution);
  - land development and maintenance practices (management of trees/shrubs; fire; pasture improvement; weed management);
  - landscape health and biodiversity.

Our strategy had two parts. Firstly, to use existing project work being undertaken in the Burdekin region and the Victoria River District as a guide to providing the substance in the product (that is, the principles and concepts of sustainable management and the related decision tools). Secondly, to use a market research approach (see Blakeley *et al.* 2000) for assessing requirements of the 'market', for identifying priority outcomes and issues for producers, and for consulting with operational staff and stakeholders.

To bring this together, a project team was formed, with representatives from:

- Meat and Livestock Australia
- Qld Department of Primary Industries
- NT Department of Primary Industries and Fisheries
- CSIRO Sustainable Ecosystems
- Qld Department of Natural Resources and Mines
- Tropical Savanna CRC

MLA provided substantial support for both the market research and the product development.

Market research

The market research was in two stages, the first was qualitative research to identify the 25–30 general outcomes for grazing land management that were important to cattle producers. The second stage was quantitative, and provided a ranking of the 25 outcome statements generated by producers. The research allowed the ranking to be analysed in several ways, including by region, by type of enterprise, by size of enterprise, and by gender.

The highest priority outcomes for beef producers across northern Australia were:

- Know how to increase the better pasture plants and discourage less desirable ones on the property.
- Know how to assess pasture quality and quantity to manage feed supply.
- Know how to assess land condition to manage for long term productivity.
- Have practical ways of varying stocking rates to match animal requirements with feed supply.
- Know how to determine the financial implications of grazing land management options.
- Know how to avoid and control exotic weeds.

As expected, there were also some major regional differences. For example, use of fire was a critical issue for producers in the Northern Territory and Western Australia, while it was of only moderate importance for most other regions. Use of sown pastures was of moderate importance to producers in central and south-eastern Queensland but of relatively low importance for most other regions.

Importantly, about 75% of producers are interested in accessing a GLM education product designed around meeting these outcomes. Most producers:

- preferred hands-on activities;
- wanted all the information to be accessible in one package;
- wanted to understand the underlying principles;
- believed that conserving bio-diversity should be a more important part of managing the property;
- wanted the information to be locally relevant;
- wanted follow-up support after any workshop or training activity.

Research of stakeholders (industry organisations, R&D organisations, environmental lobby groups) and operational staff (those in both the public and private sectors who may help deliver the product) showed that the vast majority saw better education in GLM as a high priority. They were generally unhappy with current efforts in GLM education. Interestingly, about 80% of these respondents believed that the program should assist land managers to show they are meeting duty of care obligations.

Product development and testing

The product will have two major themes: the health of the land and productivity. It will provide:

- principles and concepts of GLM, with local examples/case studies;
- steps, processes, and information for development of a GLM plan for each participating property;
- support for implementation on-property.

The general structure of the program is shown in Figure 1. The core program will be accessible in either face-to-face delivery (e.g. three-day workshop) or in distance education format.

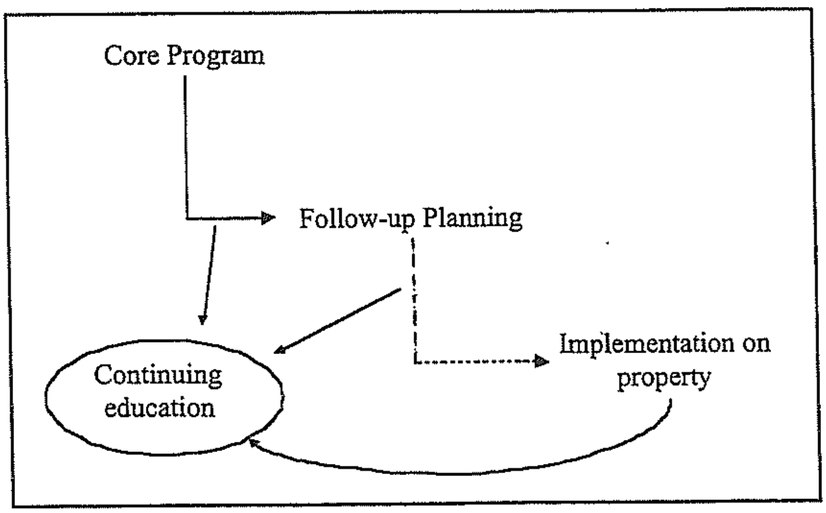

Figure 1. The structure of the GLM education program.

The project team is developing the product for four regions, in the first instance:

- Katherine region
- Burdekin region
- Burnett region
- Rolling Mitchell grass country of western Queensland

These regions were chosen because they already had ongoing R&D work that could support development of the concepts, relationships and decision tools that would underpin the product. It is important to note that the development of this product is reliant on the outputs of past and current R&D. Given we set ourselves only 12 months to develop and test the product, the approach has been to make best use of the information and tools that were already available or at least under development. There was limited time and resources too undertake any significant new work. We were dependent on the cooperation and goodwill of agency staff and producers within each region to share information, ideas and decision tools.

The 'workshop' version of the product has been developed, and preliminary testing undertaken, for three regions: Burnett, Burdekin and Katherine. Information and decision tools are built around six major topics:

- Understanding the grazing land ecosystem.
- Managing grazing.
- Using fire.
- Managing tree-grass balance.
- Pasture development.
- Controlling weeds.
- Bringing it all together.

The emphasis is on providing the best-available information in an interactive process, with continuous reference to analysis of a case study property. Participants are encouraged to relate each session to their own property, and to commence the inventory and analysis process that leads to identification of management options. Assessment of the financial implications of each management option is emphasised throughout.

We are currently completing development of the product for each of the four regions, based on feedback from the preliminary testing. We anticipate the product will be available through MLA's Edge network in the first half of 2002.

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Swimming lessons for the BigPond™

Carey Paterson

Pilbara Livestock Depot, Port Hedland, Western Australia

Introduction

My name is Carey Paterson and although not an expert in any particular field, I have a bit of knowledge about many areas. This paper will discuss some of the tools used to keep building that knowledge base. Chris, my husband, and I have developed a live export depot 30 km south of Port Hedland. This has been our first year of trading and a very interesting learning curve in the many areas of small business. Even now we're still unsure if financially it was a good move from a safe income – but who would want to get to 90 and say: "I wish I'd had a go at that"?

I'll start by giving a brief history of how we came to be where we are at this point in time.

The Paterson clan have been pastoralists in the Kimberley and Pilbara district for over 100 years and if that doesn't make you a local well I'm not sure what would. I have been in the north for about 18 years, so a newcomer, and chosen for the ability to bear children genetically far removed from a NorthWester and therefore capable of producing three sons with excellent hybrid vigour. Prior to going into private enterprise Chris was managing a property in the east Pilbara, 'Marillana Station'.

This paper sets out to explain how technology has helped within our business and our lives.

Beyond the bush telegraph

We are all aware of the speed at which technology has expanded even over the last 40 years. For example, Chris can remember, as many of you may, receiving stores by ship. Mail planes often delivered more than just mail, and provided the means of returning to Perth to school – much to the disgust of many students.

When we first went to 'Marillana' the RFDS radio system was in place. As a new bride, I originally found it quite quaint – but the novelty soon wore off. This was February 1986. After about six months the phone was connected via a copper wire system, the radio was still used for the School of the Air lessons. Later the DRCS and Internet and e-mail was opened up.

Unfortunately the DRCS was, and is unreliable and does not keep up with the speeds needed for Internet connections. As explained to me the computers we have are designed for compatibility for Japanese phone lines. Not a lot of those around the bush, so to get around this you can purchase an external modem designed for Australian conditions.

There were and still are times that there is no phone service at all. We have all experienced this frustration along with always being connected to someone in Sydney or Melbourne to report faults, until the '1-800' Brisbane connection. In all fairness Telstra has moved a long way to rectifying many of these earlier problems and through a lot of lobbying from many rural and remote groups particularly ICPA (Isolated Children and Parents Association) we now have local call connections for e-mail and Internet services.

There is a lot of work happening on satellite systems etcetera, to improve communications in rural and remote areas. Although our depot is only spitting distance to town, we would have to have a tower DRCS system installed. We have chosen to wait until the satellite systems are feasible. We have mobile connections on site, and as we are yet to build our abode will wait until an improved, faster speed system is available.

"Number please?"

Having had no formal training in computers, Internet or e-mail, it can be quite nerve-racking when beginning. However usually your kids or house-girl are quite skilled at getting you out of the proverbial when up to your neck in it. They also love to roll their eyes and look at you in that "you poor dumb old bastard" stare, while taking on an air of superiority and high intelligence. If you cannot bare that humiliation – Telstra are also great at talking you through many problems.

This brings us to the fact that it is best to have two phone lines. This may take some time to install but it is well worth the energy needed to pursue that end. One of the advantages of having two lines is that it allows you to phone someone whilst the computer is going – to actually talk you through the system. I am currently working on having two computers – one for the Internet and e-mailing use, and one for business. This saves the ongoing problems with viruses. It is so important to have a good virus scanner and regularly update it through the Internet. These are purchased with code numbers for logging on for upgrades. Speaking from the perspective of having lost everything, I now ensure I back everything on to disc and regularly update the virus scanner.

We have also applied for the federal funding for an alternative power supply. This will allow a 24-hour office and the guidelines for the project also allow us to re-apply for more funding when we build the new house. We have a fax, printer and scanner all connected in one system and faxes can be sent and received via the computer, providing a huge saving on paper.

"Connecting you now"

Whilst doing all the initial research for the new depot enterprise we were residing at 'Marillana Station'. Because of the Internet connection I was able to enrol in an external course at the University of New England, Armidale, NSW. The Internet connection enabled me to pursue the research necessary for the ongoing study of Cattle Feedlot Management. Assignments could be e-mailed and information returned and forwarded at all hours of the day and night. As you can imagine, our local town, Newman – being an iron-ore town, did not have information at the local library for any of the subjects undertaken in the course.

Internet also allows purchasing, which for many often raises the issue of security. In my experience it is as safe as using either phone credit card purchasing systems or over the counter credit card transactions. I have used the system and found it very satisfactory, particularly when the item is a book published overseas and near impossible to purchase here.

We use Internet banking services. Unfortunately at this point there is a limit of $5000.00 for daily transactions – although any amount can be deposited into accounts. There is also an option to do business online however for small businesses this is not cost effective due to charges. At least 800 transactions per month are needed to make this worth the outlay. Our bank has said they are looking at a system for businesses with less transactions and smaller throughput, but alas client pressure may be needed to put them into action. Internet transactions are the cheapest as far as bank charging systems go.

Being able to access your account details at any time of the day or night is especially efficient. We use a business access card. With these cards, provided you pay before the due date no interest is charged. Payments are made by simply logging on to the Internet statements and transferring funds from your working account. These are credit only cards and allow you to use the bank's money for monthly cash flow and saves writing out all those cheques for small amounts. There are annual charges but weighed up we feel they are worth it. We are now setting up a GST account. Although this has a cheque book attached, there are two free withdrawals a month, and eight free deposit transactions.

"Three minutes, are you extending?"

Trying to set up the Pilbara Livestock Depot was bureaucracy at its best. Our mail service was unreliable and sometimes non-existent. Remembering of course we were 1.5 hours from town on a dirt road. At one stage we were dealing with 14 government departments. It makes you shudder to think about trying to track these people down by phone, or even fax. With the e-mail we could converse at any time of the day or night. Early morning before mustering (4.30 a.m.) was a good time as the lines are relatively clear. The amusing side is that the poor bloke receiving the e-mail must wonder about your sanity as the sending time is logged on the mail.

E-mail allows less paper to physically be used. Another great bonus is fast efficient communication without the need for idle chitchat before getting to the point – ideal for my personality type, who often cannot be bothered with all that nonsense. A bonus for bush people is that you do not need the computer, or even the generator, on to receive mail as it goes to a central bank and you log on when it suits. Saves that dreaded "I'll start the motor for the fax" scenario. There is always confirmation of sending and receiving. If the mail does not get through a message comes back to say so. Screening can be used to stop junk mail.

E-mail is also a great medium for sending minutes and all sorts of information to groups and organisations. Another way of saving paper as you can just print out what is relevant to you or save to disc for later perusal. Of course if the phone lines are down, there is no e-mail or Internet, but of course there is also no other connection with the outside world. This reiterates the importance of reiterating to decision makers to keep us up to speed with the larger population centres and staying on a par with their telecommunication access. Our industry is important as the country's number one protein source and a major export earner, and its worth should not be underestimated.

The party line – revisited

E-mail is being used extensively in the Schools of Distance Education. Video computer link-up is being trialed in NSW. There is no reason we cannot tap into this resource to enhance our education from a home base. It allows tertiary education subjects to be studied at home – a bonus for kids who have spent a lot of time away at boarding school and want to come home for a while. I am certainly against the complete abolition of any face-to-face contact, as we must learn to get along with others and have exposure to competition in the workforce and life, and this generally happens in secondary education when away at boarding school. E-mail is used at the boarding schools. We have one son who e-mails home regularly – while the other is far keener to clog the lines of the girls schools.

It is important to access any residential schools in the curriculum of external tertiary subjects. Networking with others out of your district broadens outlooks and ideas, increases lateral thinking and forges friendships and future business connections. E-mail can enhance these beginnings with the ease of informal communication.

My favourite aspect of e-mail convenience is personal. Earlier this year I had a niece born in *that* country that took Ansett down. Within a couple of hours of her birth a digital photo was sent via e-mail, so although it may be sometime before I see her in the flesh it really was wonderful to "have a look at the new addition to the world", and her new mum, so quickly. I now get lots of progress photos, and for those living in remote areas this is a great way of staying in touch with those who are so important in our lives.

I would urge all of you if not already connected to do so now. Training can be accessed through local libraries and TAFEs, or you could organise a group training session.

Notes

BeefPlan – Producer driven property management for Northern Australia

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Summary

Following a three-year investigative period finishing in June 2001, the Northern Beef Program of Meat and Livestock Australia (MLA) is planning to maintain the existing five BeefPlan groups and foster new groups across northern Australia.

BeefPlan has proved to be a process of empowerment for producers that has producers directly responsible for their own change. Working outside any defined curriculum, producers work as a management team to identify and resolve their learning needs. The groups receive support from MLA in the process of working together as a team, however the groups develop their own focus issues and work out how they are addressed.

Groups seek out and participate in planning and training activities and develop decision-making tools that meet their individual and collective needs. This covers a wide spectrum of activities to do with social, production, economic and environmental issues.

The desired outcome is for groups and individuals to measure an improvement in the personal, financial and environmental aspects of their business. MLA understands there is no single management system, which can be applied across the north Australia beef industry. MLA has recognised that it is allowing producers to drive change while providing access to information that is critical. It is ownership of the process that sees information more effectively converted into knowledge.

Existing BeefPlan participants are enthusiastic about promoting BeefPlan to other producers as the process acknowledges the valuable skills and knowledge they have and recognises that true learning originates with the learner.

The BeefPlan project will be expanded as it has the potential to improve the triple bottom line of producers, bring about cultural change in the beef industry, assist the industry to cope with future shocks and guide future research and development.

Introduction

BeefPlan is a non-traditional approach to learning where groups of like-minded beef producers, acting together as a management team, focus on property management outside of a defined education curriculum.

Since 1998, MLA has progressively supported five beef producer groups in Queensland and the Northern Territory to improve their business profitability and sustainability. The pilot BeefPlan groups have clearly demonstrated that producers know their business needs better than anyone and it is attitude and ownership of change that is important for continual improvement.

Each group of producers forms a management network to learn from each other, from consultants, advisers and other specialists that they themselves choose. Regular on-property and off-property management meetings are crucial to facilitate this form of learning. The approach is unique to northern Australia, as the groups are producer driven and aim to look at the whole beef business and not single issues of management.

Results from the pilot groups have encouraged MLA to further support existing BeefPlan groups and create and foster new groups.

By improving your business via change to your personal, environmental and financial situation, BeefPlan will result in a better understanding of where your business is heading. An involvement in BeefPlan will see existing relationships with information and skills providers improve and new alliances develop with many sectors of the industry.

Project results so far

The project delivered outcomes, which have empowered producers to learn more effectively and bring about change. BeefPlan is assisting producers to take ownership of solutions and plan for the future.

BeefPlan has been a brave experiment aimed at improving beef production systems across the economic, environmental and social dimensions, by giving responsibility for this improvement to producers themselves.

Easily the biggest effects are in personal development and increased confidence. BeefPlan is empowering producers to be in control of their futures, to improve their property management, and to lead change in the industry. Groups have developed much of the capability and many of the components to wholeheartedly develop and implement integrated property management systems.

What producers say about BeefPlan

BeefPlan can improve lifestyle, environment and profitability, short term and long term, of our beef enterprises through the sustainable use of all resources – human, physical and financial, and through working and sharing together via a team approach to find our own answers. These learnings and knowledge are passed onto the wider community.

Producers do this by:

- recognising and accommodating differences;
- identifying issues we want to know about;
- seeking out knowledge;
- applying it;
- documenting and sharing what we have learned, in order to:
  - run an increasingly profitable cattle business;
  - maintain our life style; and
  - improve our mutually supportive community.

What the evaluation team say about BeefPlan

Throughout the three-year experimental phase of BeefPlan, the project was externally evaluated by a team from the firm URS Asia Pacific. The following is an extract from their final draft report on BeefPlan:

> *BeefPlan, as a means of giving responsibility for industry change to producers, is an unqualified success. BeefPlan groups, after some hesitation at being in this unusual situation, have enthusiastically embraced the responsibility.*
>
> *BeefPlan participants are empowered for change and are making radical changes to their lives. Onlookers are struck at the changes in behaviour and attitude among participants. BeefPlan participants are primed to make dramatic moves towards improved whole*

property management. They are ready to cope with future shock. They are empowered change agents for the Beef Industry. MLA needs to harness this potential for change.

MLA should continue and expand the BeefPlan concept, because it has enormous potential to:

- *promote personal development and cultural change within the beef industry community;*
- *assist the beef industry to cope with uncertain futures; and*
- *guide and participate in future research and development.*

BeefPlan is a bold investment. The dividends can be immense. The BeefPlan experiment needs to be continued so these dividends are realised.

Vision for BeefPlan

To provide the opportunity for beef producers to gain a greater control of their future through personal development and improved business management.

Selecting new BeefPlan groups

It is essential to have a group of producers involving at least six business and no more than 15 businesses which is prepared to work not individually but collectively to improve their knowledge base, skills and business performance. This does not need to be an existing group. (You may choose to form one from a variety of people in your region.) It is also desirable that the group include as much diversity as possible, e.g. young producers with more experienced people; farmer/graziers along with graziers; smaller holdings and larger ones, etc.

Groups must be willing to be responsible for their own strategic vision, set goals and achieve these goals with limited outside direction and facilitation. Group participants should be motivated producers with a desire to choose how and what you learn and to share information with all group members. There are no education or experience prerequisites to be part of BeefPlan.

There should be a willingness to communicate with and share knowledge and learning activities, with other producers in their region.

It is highly desirable all partners and/or all the members of the family unit involved in the business are encouraged to become actively involved in the project as BeefPlan participants.

Support from MLA

MLA will provide start-up funding for each group to fund group administration, a professional facilitator, strategic planning and training in personal development and group dynamics. The size of the start-up funding will be determined by the needs of the group. The groups will be assisted to actively seek funds from other recognised funding bodies to meet training and planning needs.

Members of the group will be trained in facilitation skills as called for by the group. Professional facilitation will be funded as the group sees fit. This facilitation will guide the process and not the content. This is an important element of the success of BeefPlan.

A limited amount of further funding will be available from MLA on a group case-by-case basis for additional training and planning. This may be for the likes of monitoring, benchmarking, which complements the training and planning components of the group's BeefPlan activities. Funds for core research, product marketing, on-property trials or development will not be available from within the BeefPlan project.

A MLA project coordinator will support groups where necessary without directing the group's progress. This same project coordinator will report to the MLA on the group's progress. The group's strategic plan will include a short-term goal to be achieved within the first six months. This will demonstrate that the group can work together in preparation for the longer-term group goals.

Support will be available from existing BeefPlan group members who can provide mentoring and advice. This mentoring will be funded by MLA funding separate to the group's funding. MLA will provide access to information, learning opportunities and contacts to support the groups during the life of their group.

Expectations of MLA

It is expected that each group will act towards achieving goals identified by the group that lead to improved business performance, which will encompass a better bottom line measured by financial, people and environmental benchmarks.

Each group will be responsible for measuring their own success against personal, business, group and industry goals, which will assist MLA in determining the progress of the group. The groups' goals must be SMART, i.e. specific, measurable, assessable, realistic and time bound.

It will be essential for each group to appoint an experienced group facilitator during the six-month start-up phase of the project. The facilitator will be funded by MLA and appointed by both the group and MLA.

Each group member will contribute their own time and normal travel expenses to attend group meetings and property visits. In addition, each business will contribute an annual dollar amount per year to the group's operating expenses. The size of this contribution will be determined by the group and should be large enough to signal individual commitment to the project. The producer's contribution will add to MLA funds and funding grants from other fund sources.

Progress reports to MLA will be expected every 12 months, which include group progress and financial statements. Each group will be asked to become incorporated as a non-profit organisation and provide their own insurance and workers compensation where necessary.

BeefPlan contract

Following an initial six-month provisional period, groups will sign a contract with MLA for a period of three years, which can be renewed following mutual agreement. The provisional period will allow the group to develop a strategic plan and receive training in working as a group.

The agreement with MLA will reflect the group's strategic plan and how the group will measure its own success. It is expected the agreement will be revisited each year to evaluate goals, actions and progress.

At the end of the three-year contract period, the group will produce a written report to MLA, which summarises the changes to the group's businesses and the approach taken by the group in attaining their goals.

Project time line

Group selection period

1. Advertise for Expressions of Interest from producers.
2. Assess Expressions of Interest.
3. Project coordinator and project champion meet interested groups.

Groups' first six months

4. Successful groups begin six-month introduction to BeefPlan process.
5. Selection of group facilitator by MLA and group.
6. Group facilitator provides strategic planning, group process and facilitation training.
7. Project champion is available to act as a group mentor.
8. Group achieves strategic short term goals.
9. MLA and group sign agreement for the next three years of BeefPlan which details group vision, goals, actions and how progress measured.

Three year contract period

10. Group becomes incorporated.
11. Group progresses their strategic long term goals.
12. Project coordinator provides general support to each group.
13. Group reviews their strategic plan and reports to MLA on an annual basis.
14. Group achieves their strategic long term goals and reports to MLA.

Acknowledgments

The authors wish to acknowledge the contribution of the existing five BeefPlan groups and the project external evaluation team led by URS Asia Pacific.

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Leadership styles in the pastoral industry

Rod Strachan[1]

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The premise of this paper is that each of us are born with a set of gifts – a set of tools that we have become comfortable using and thus prefer to use in the everyday business of living. Although we all have access to the same basic tools in our psychological toolbox, each of us is more comfortable with a particular tool (or set of tools) for a particular task.

It is our unique set of these preferences that gives us our distinct personality and makes us appear similar or dissimilar to others.

Introduction

Jabiru Human Resource Services is a Registered Training Organisation with a strong focus on rural enterprises. For over eight years, the organisation has conducted training courses in Leadership, Communication and Staff Management for both managers and employees engaged in the pastoral industry across northern Australia.

A core module of these training courses has been the identification of personality type now accepted as a strong indicator of leadership style. This is achieved through the application of the *Myers Briggs Type Indicator (M.B.T.I.). Based on the work of Swiss psychologist Carl Jung, and further developed by a mother and daughter team, Kathrine Briggs and Isabel Briggs Myers, over more than 40 years, the assessment is now one of the most widely used psychological tools throughout the world.

The M.B.T.I. reflects individual preferences for energy (extraversion or introversion), information gathering (sensing or intuition), decision making (thinking or feeling) and lifestyle (judging or perceiving), resulting in 16 unique and different personality types. Applications for M.B.T.I. results include career development, individual coaching, team management training and organisational development.

Knowledge of an individual's preferences and the strength of those preferences, can be a reliable indicator of leadership in terms of communication style, attitude to change, emotional intelligence, attitude to closure and other behaviours.

The personality types of managers and headstockmen employed by six of the major pastoral companies operating in northern Australia are presented. They represent Australian Agricultural Company, Consolidated Pastoral Company, Heytesbury Beef, North Australian Pastoral Company, S. Kidman and Company and Stanbroke Pastoral Company.

The data provides an insight into the 'culture' of management within the pastoral industry of northern Australia. Implications for change and the management of the human resource are briefly discussed.

Personality types

The personality types of ninety-five (95) managers are presented in Figure 1. This shows that 60% of managers in this group are **I.S.T.J.** or **E.S.T.J.** This is similar to findings in other rural industries in other parts of Australia. A further insight into the 'culture' is presented in Figure 2. This shows that 65% of the managers were found to be introverts (I), suggesting a possible lack of communication skills; 80% preferred sensing (S) which is a preference for detail, a desire to maintain the status quo, a more traditional attitude; 20% had a preference of intuition (N) suggesting a more open mind and a greater willingness to change.

* MBTI and Myers Briggs Type Indicator are registered trade marks of Consulting Psychologists Press Inc.

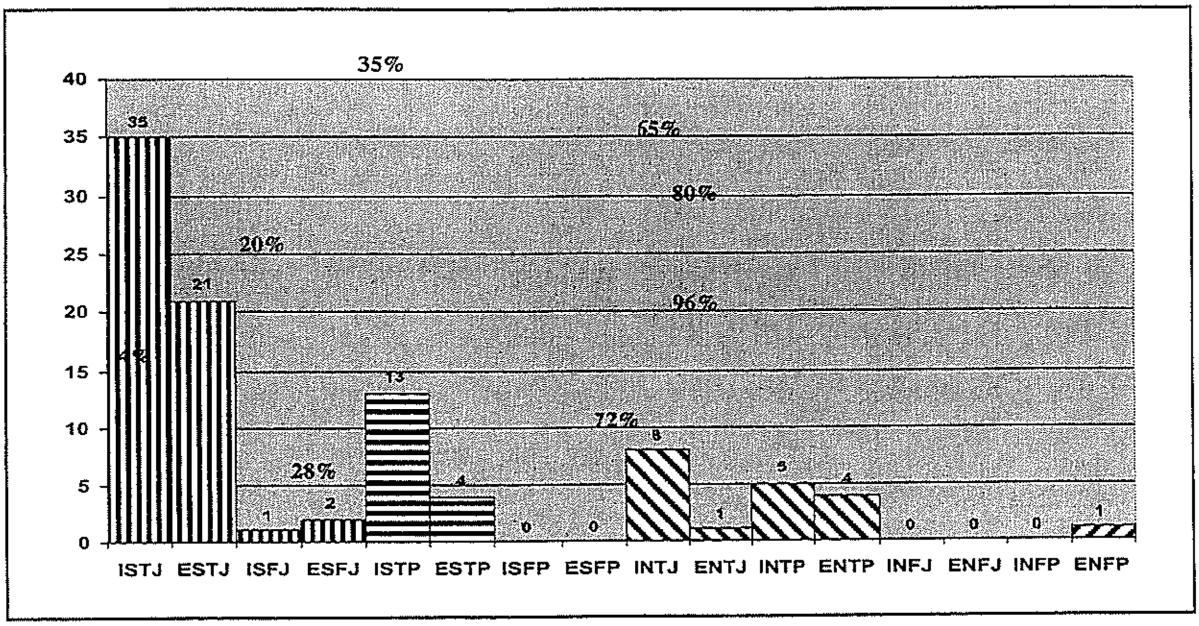

Figure 1. Property Managers in Pastoral Industry in Northern Australia.
N = 95

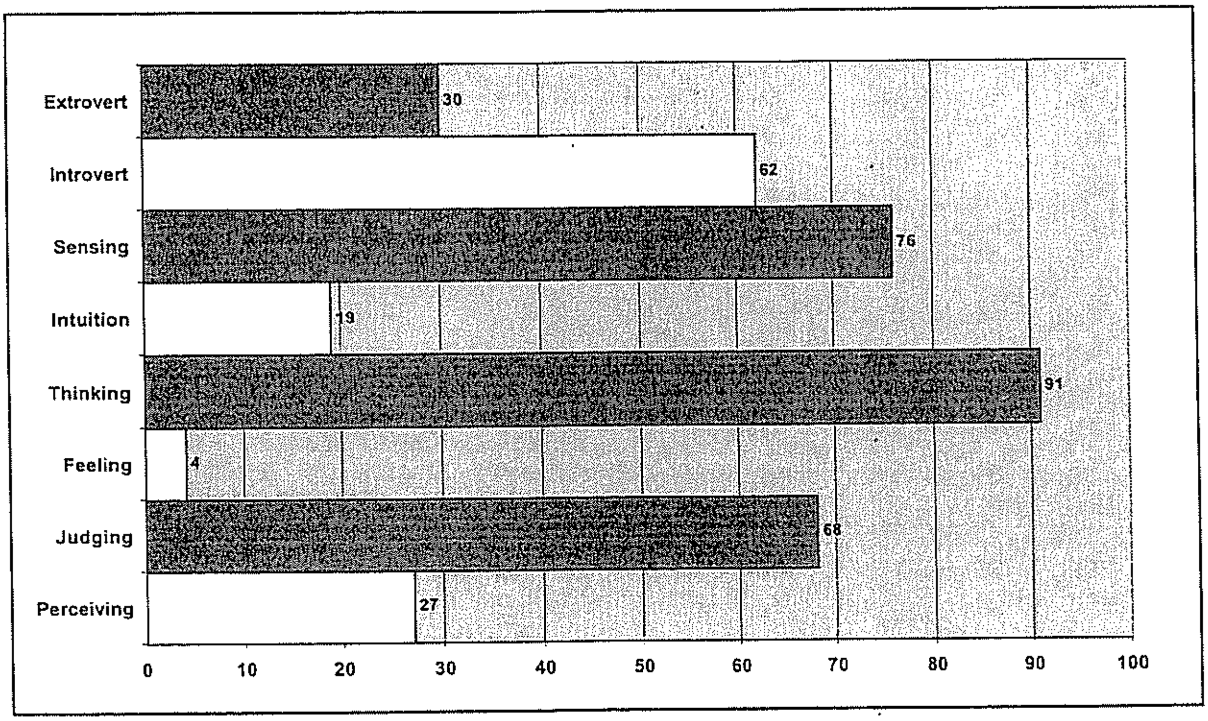

Figure 2. Preferences of Property Managers in the Pastoral Industry of Northern Australia
N = 95

Significantly 96% had a preference for thinking (T) compared with only 4% for feeling (F). This is an indication that managers generally are logical decision makers, they are rational and are ready to judge others, particularly if correction is in order. The low preference for feeling (F) among managers clearly points to an inability to freely express gratitude, although as a group, they may value good work, care for subordinates and are usually fair in their dealings with others. The significance of the thinking (T) vs. feeling (F) preference with the management group is highlighted by the fact that in the general population it is generally accepted that around 60% of males have a preference for thinking (T) and 40% a preference for feeling (F).

Seventy-two per cent (72%) of managers showed a preference for judging (J) compared with only 28% for perceiving (P). This suggests that the majority prefer to be organised and work within a structured environment. They prefer to work towards closure, to get a job completed and may resist changing plans once they have been put in place. A minority of managers, those that prefer perceiving (P), may appear to be less organised, are more flexible, and may tend to handle a number of tasks at once with a less than strong drive for closure.

The personality types of headstockmen are presented as Figure 3. and their preferences as Figure 4. They show similar profiles to the management group.

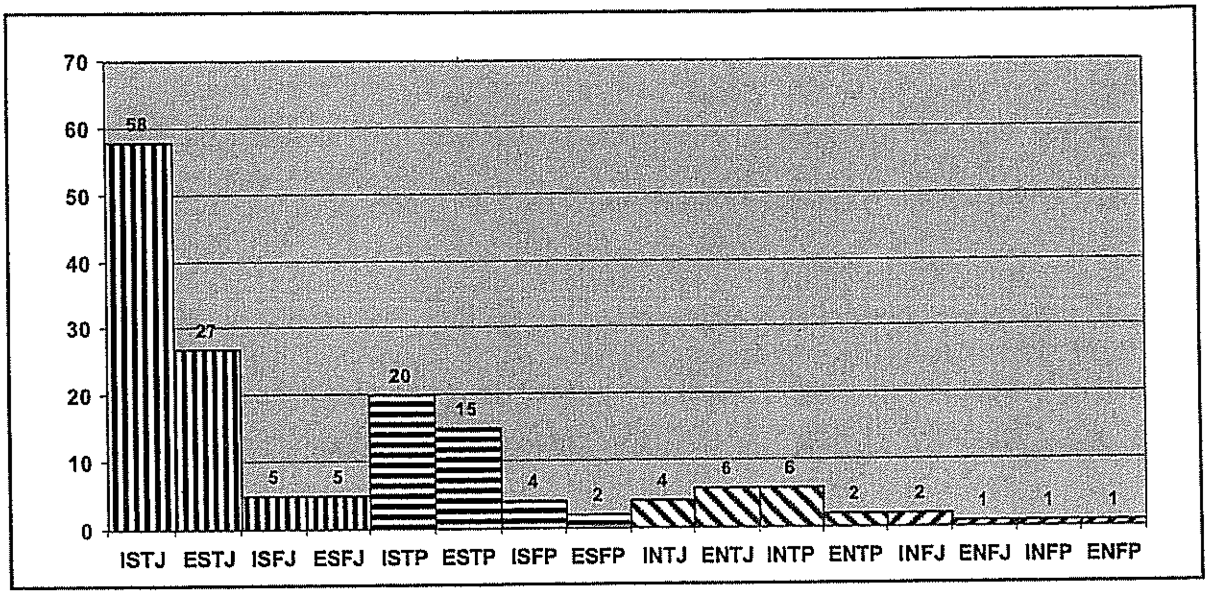

Figure 3. Headstockmen in Pastoral Industry in Northern Australia
N = 159

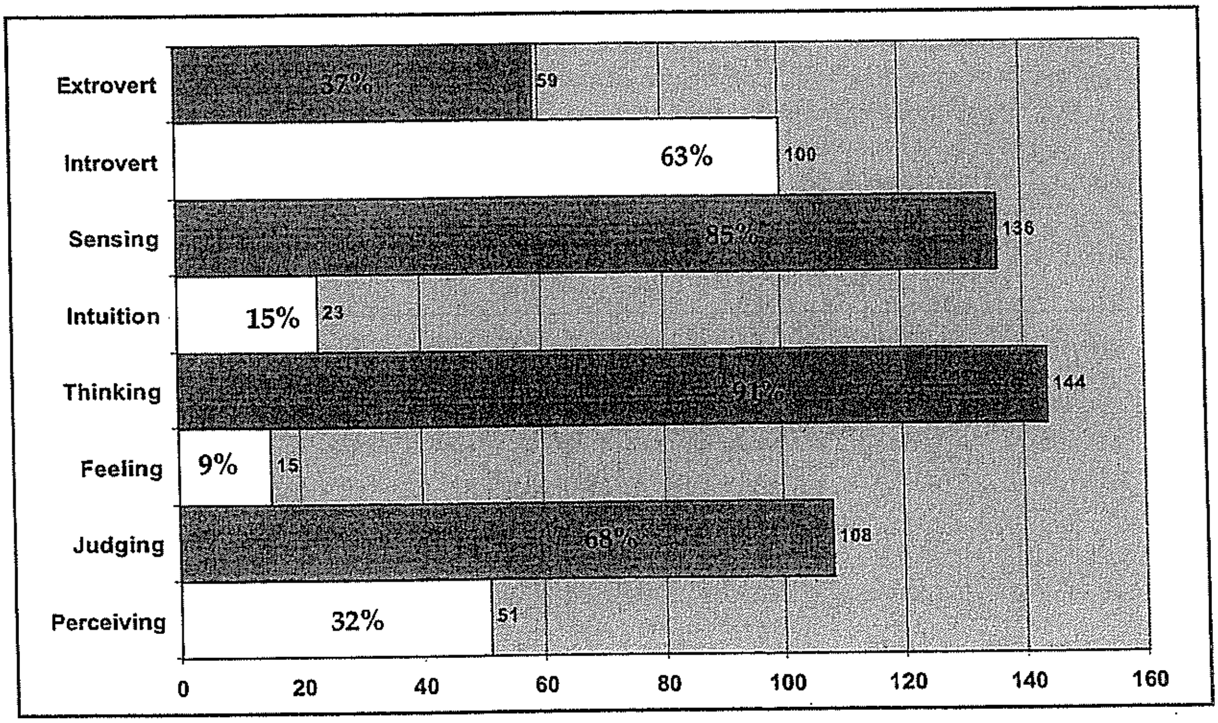

Figure 4. Preferences of Headstockmen in the Pastoral Industry of Northern Australia
N = 159

Temperament

While the Myers Briggs Personality Type model provides a comprehensive means of understanding individual personality, a sub-set of the model referred to as Temperament is surprisingly powerful in its descriptive and predictive ability. There are four classifications of temperament. The following is a brief portrait of each.

*Self-portrait of the '**SJ**' – the 'Traditionalist'*

'I value social stability, security, right order, loyalty, industry and belonging. I am cautious, careful, steady paced and certainly reliable. If rules have been made one should keep them – due process is important to me. My skills include: attention to detail, stabilisation, common sense, being dependable, accuracy and keeping deadlines.'

*Self-portrait of the '**SP**' – the 'Troubleshooter'*

'I value freedom, fun, change, flexibility, action and spontaneity. I must feel free. I will not be tied down or obligated. I enjoy impulse, I have acute observation skills. I am open minded, fairly tolerant and certainly realistic. Give me a crisis and you will see me at my best.'

*Self-portrait of the '**NT**' – the 'Visionary Builder'*

'I value competence, logic, knowledge, truth and perfection. My search is to be able to do anything I put my hand to, well. I regard principles highly, I am good with conceptual things and I can usually see patterns in complexity. Intellectual ingenuity, pioneering and predicting and sophisticated understanding of problem solving are all skills of mine.'

*Self-portrait of the '**NF**' – the 'Catalyst'*

'I value authenticity, integrity and harmony and my life is partly summed up as a search for meaning. I thrive on autonomy and self-determination. I hunger for self-actualisation. I am a high energy person for things I believe in – it is often said I can sell anything I believe in, especially my own value system. I am what is called a 'people person.'

The range of temperaments found in the general population are shown in Figure 5. This shows 38% **SJ**; 38% **SP**; 12% **NT** and 12% **NF**. This contrasts sharply with the range of temperaments of the managers of pastoral enterprises as shown in Figure 6. In the management groups 62% have an **SJ** temperament; 18% an **SP** temperament; 19% an **NT** temperament and only 1% an **NF** temperament. The 159 headstockmen, Figure 7. show a similar range: 61% with an **SJ** temperament, 24% with **SP** temperament, 10% with **NT** temperament and 5% with **NF** temperament.

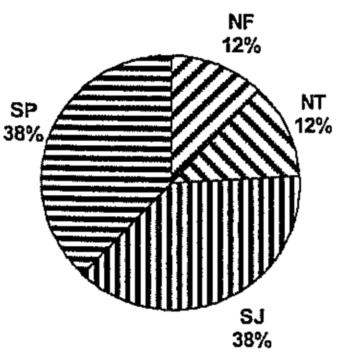

Figure 5. Australian population (temperament).

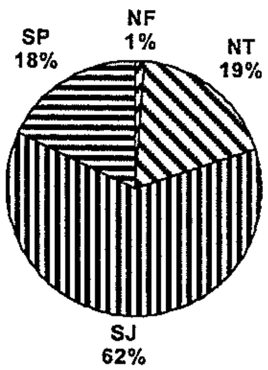

Figure 6. Station managers (temperament).

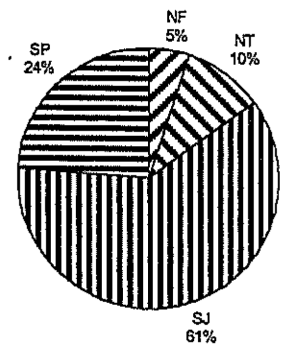

Figure 7. Headstockmen (temperament).

Implications

1. The pastoral industry attracts persons with preferences for hard work and a structured environment where they find security, stability and a sense of belonging.

2. The pastoral industry also satisfies the needs of those, particularly the young, with a preference for freedom, fun, action and spontaneity, although more of these types are found in the general population.

3. The pastoral industry does serve the needs of those seeking a new challenge. The management group analysed in this paper has a higher than average (19%) of persons with a **NT** temperament.

4. The pastoral industry does not attract those persons with what are often referred to as 'soft skills' usually found in those with an **NF** temperament. They are rarely found in management.

The 'culture' defined in this analysis of 254 persons working in the pastoral industry in northern Australia has implications for senior company management and educators. Two factors identified that are significant in the changing environment of the 21st century are:

1. On-property management is largely influenced by a traditional or conservative (**SJ**) style. While managers do accept change and they have in the past, new ideas are likely to be resisted and change may take place at a less than desirable time frame. Managers with an **SJ** temperament need to be convinced of the need for change. Methods currently used to bring about change may need to be re-assessed.

2. There is evidence that a majority of property managers (and headstockmen) do not have an inherent ability to manage people. Strong **STJ** types are more focused on tasks. This may well be in conflict with the needs of younger employees entering the industry who are expecting a more fulfilling experience and acknowledgment of their worth.

A new yardstick in the selection of managers and leaders is 'emotional intelligence'. Managers of the future need people skills in addition to the very necessary practical hands-on skills in stock and property management.

The data presented in this paper highlights the need for training in human resource management throughout the pastoral industry. Such training, in the longer term, will attract better quality staff and lead to a reduction in turnover.

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Notes

A journey to change on a grazing property

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Abstract

Change is a journey, not a destination: This family's journey began in 1990. Significant learning contacts between the family and the Queensland Department of Primary Industries since 1994 have facilitated the journey. Contacts include:

- *Financial Counselling.*
- *Beef Cattle Husbandry Extension.*
- *Participation in a* Futureprofit *series and Smart Manager workshops.*
- *One-on-one discussions following* Futureprofit *and Smart Manager.*
- *Breedcow and Dynama herd modelling.*

The catalyst for change was helping neighbours put out a fire in their heifer paddock late in a drought. This convinced them of the potential benefits of investing large sums of money to increase herd productivity and profitability.

Following the fire, contact with the authors led to herd modelling. This indicated that initial costs of year round supplementation could be paid for within the business (without further borrowing), and that long term enterprise viability would result.

The case study property owners exemplify the conservative attitudes of many established property owners and managers in Northern Australia's Beef Industry. An autocratic family lifestyle may have caused self imposed isolation from information.

Background

The property owners, two brothers and their wives in their mid to late fifties, own and manage a grazing property West of Mareeba in Far North Queensland. They left school young, working for their grandmother and then their father. In 1974 they inherited the property.

The property is in the monsoonal dry tropics, the vegetation type is open savannah and the phosphorus status of most of the country is deficient to grossly deficient.

Herd numbers (3000 head) have not increased since 1974. Branding rates probably averaged about 45% and breeder death rates 13% to 15%. Turn-off was mostly three years of age bullocks and a few old cows sold through Mareeba saleyards.

In the past, droughts have caused high breeder death rates. Lick feeding was not practised, except for salt feeding during mustering.

Botulism vaccination was started in the early 1980s.

Prior to their father's death, the property was debt free. When he passed away they borrowed to cover the death duties. This problem was compounded by the 1974 cattle price crash.

The financial situation since 1974 has been one of having a high level of equity but always being cash strapped. Factors contributing of this situation include:

- Death duties, droughts in 1983 and 1994, and capital development such as dams.

- High interest rates throughout the 1980s.
- Premiums imposed on interest rates by the banks due to limited land equity – part of the property is held under Occupation Licence (OL).
- No cashflow monitoring or budgeting.

Cattle management and financial management have been separate concerns; the men look after the cattle and one of the women controls finances. In the past, as the overdraft reached its limit, the men would say, "You can't sell cattle in the dry".

Information sharing and sourcing has not been a high priority. They do not use magazines, newspapers, television or radio as information sources.

The learning process

The learning process which led to management change began with a property visit by Beef Cattle Husbandry officer John Boorman in 1990. The property owners viewed and discussed the video 'Bonechewing Country: cattle management for northern Australia'.

In 1994, drought resulted in consultation with a financial counsellor who suggested management changes. These were not adopted.

In 1998, they participated in a Future*profit* series. This improved their understanding of the financial situation.

They also participated in two Smart Manager workshops at the end of 1998. These established production benchmarks and looked at the benefits of changed management. However, despite the second meeting being on a property using improved management it was not seen as relevant because of the financial resources behind that property.

Making the decision

In October 1999, they helped neighbours put out a fire in their heifer paddock. At the time, cattle were dying on their own place, but the neighbour's heifers were fat.

They decided to feed a urea supplement to stop their cattle dying, but, being short of cash, they made an appointment to see Farm Financial Counsellor Greg Mason. Greg's assessment of the financial and management situation indicated they needed production assistance and he suggested that he and John Boorman visit the property.

It was decided that we should build on the relationship begun during the Future*profit* and Smart Manager workshops. During the property visit, the Action Learning Cycle was used to understand the thought processes of the family in arriving at the conclusion that annual dry season supplementation would prevent breeder deaths in a drought and give a similar result to that seen next door.

Using the static herd model Breedcow, a best bet profile of their 'current' herd was established. This was validated from branding and turn-off records. When annual dry season supplementation was compared with the current situation there was little improvement.

We then discussed financing year round supplementation. The Dynama model indicated selling older cows would cover costs in the first few years until higher growth rates, increased branding rates and reduced breeder death rates increased cash returns. Cash flow analysis confirmed the strategy looked sound.

Progress to date

In late 1999, lick stations were built. Approximately 2000 head were fed over the 1999/2000 wet season and 2500 last wet. The remaining cattle will also be fed over the coming wet.

Lick feeding 2500 head this year will cost an average of $21 per head.

Cattle were counted for the first time over the 1999/2000 mustering year. This was done as a result of the modelling experience. While disappointing to the owners, total numbers were in line with those used in the modelling.

Breeders are now sold at nine years plus. Dry cows and weanable cows are sold during the first round muster. Unweaned cows are spayed, weaned at the second round, and sold during or after the following wet.

Branding records appear to show numbers responding to management change:

1996/1997 – 586

1997/1998 – 618

1998/1999 – 652

1999/2000 – 615

2000/2001 – 720

Current indications are that 2001/2002 brandings will be higher again.

The difference between the cattle being fed lick in the wet and those that aren't, really stands out.

Barriers to change

Atkinsson (1999) suggests change occurs as a result of a diffusion process through a community or culture and identifies five critical characteristics which innovation researchers suggest 'greatly affect the rate at which new ideas get adopted'.

We asked how the family felt about making management changes, what was helpful at the time of making the decisions, and what has been helpful in reinforcing their decisions since. For this paper, we evaluated their responses against the critical characteristics Atkinsson recommends, with the following results:

Relative advantage: Appears to be highly advantageous.

They could see the physical advantages in terms of cattle condition and survival from using supplementation, however, they had problems with the financial constraints.

Complexity: Relatively simple to understand.

Feeding supplementation year round is a simple process. However, cash was not available and they were reluctant to borrow further. This led to the dilemma over how to finance the program. One solution was to sell old breeders, but this goes against the strongly held paradigm on traditionally managed properties, 'If you sell breeders you are going out of business'.

Trialability: Allows people to try it before they irreversibly commit to it.

They felt they had to 'make the jump', but because of the drought and the dying cattle they weren't in a position to run a physical trial on the ground. The computer modelling gave them the opportunity to do a virtual trial. They could see from the Dynama modelling that if they got over the first two to three years they 'would be right'.

Observability: Action taken results in visible improvements.

In a crisis situation you don't have time to run trials comparing supplemented and unsupplemented cattle, or to think strategically. However, they had the recent experience with their neighbour, and our discussions made what they had seen on other properties using improved management relevant.

Compatibility: Idea is from trusted source and is relatively easy to incorporate into existing lifestyle.

They had been comfortable with the Future*profit* and Smart Manager processes. This, and our participation may have made it easier for them to feed phosphorus in the wet season. They felt fairly confident when they started as they knew of people doing similar things.

The female partner who does the books did not like spending money on supplementation. She felt it was risky because things were moving too quickly. She would have felt better if this had happened over a longer period. She said, "It looked fine on paper, but my question was, 'Will it happen in real life?'".

She now thinks it may be working. She can see that income has gone from $80,000 to $150,000 but can also see most is going out again for lick, etc. However, she acknowledges this may change in the future. She needs another 12 months to be convinced.

Outcomes

- The timing was great. Cattle prices have been rising since they started.
- Financial control has improved. Their Future*profit* experience allowed the men to take greater interest in cashflow monitoring. Sales are planned about six months ahead to offset the cost of lick feeding and year round supplementation allows a longer selling season.
- By counting cattle they know what to expect to sell before mustering and can plan ahead.
- Wet season feeding was easier than expected. The cattle are now quieter and easier to muster as they congregate around licks.
- As predicted, cattle are in better condition and there are more calves.
- Family members are taking a more active role in herd management.

Discussion

Many producers have trouble believing that practices used on even nearby properties will work for them. Reasons given for why the practice(s) will not work or why they cannot afford to make necessary change(s) include:

- We can't afford the money they put in.
- We haven't got enough cattle.
- We have too many cattle.
- We don't need to feed lick in the wet season, our cattle put on weight.
- It looks good on paper but how do I know it will work on my place.
- If you sell breeders you are going out of business.

This last argument is correct on traditionally managed properties where branding rates often average 45% and breeder death rates average 15%.

Unfortunately for extension, experience indicates that many pastoralists, including this family, are only prepared to change when they are in crisis. In crisis, change is more difficult, or impossible to manage.

Many pastoralists do not count their cattle. They have a rough idea of how many they have, but their estimate can be out by as much as 20%, thousands in large herds. Cattle numbers can help diagnose problems such as low branding rates and high death rates and can assist in planning annual turn-off and budgeting. The simple act of counting cattle and recording numbers by sex and age groups is an essential aid to both business and risk management.

We asked the family, "How can we (as supposed change agents) speed up the adoption of management practices we 'know' will improve the economic viability of pastoral properties?".

Their answer:

- You can't force people to change.
- Just keep giving them information. When they are ready they will take it up. "We wouldn't have done anything if it wasn't such a dismal year."

The lesson for extension, in our opinion, is that if you understand the five 'Critical Characteristics of Innovations' discussed by Atkinsson, it may be easier to deal with barriers and paradigms used by pastoralists to resist and reject 'innovative' management.

Reference

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Managing the human resource (for profit and lifestyle)

Rod Strachan[1] and Sarah Strutt[2]

[1] Jabiru Human Resource Services, Brisbane, Queensland
[2] Consultant – Kununurra, Western Australia

A business operation can be reduced to three words – *people – product* and *profit.* People come first. Unless you have a good work team you can't reach the desired levels of achievement with the other two.

Introduction

It is said that we are in the midst of the greatest change since the industrial revolution 200 years ago. There is much talk about managing change (or how to avoid being managed by change). There is little doubt that the rapid rate of change is affecting all aspects of our lives. The agricultural sector is becoming more aware of the need to change in order to survive. However, it is easy for employers to overlook the fact that one of the greatest changes over the past 20–30 years has occurred in the attitudes and expectations of the human resource seeking a future working on the land. As a consequence there is an obvious need for employers to change their attitude to the management of staff (including sons and daughters).

Is it not true that an employer who invests in new machinery usually spends time and money making sure it is properly installed (induction), a manual is followed (job description), performance records are kept and maintenance systems are implemented to avoid breakdowns (performance management)? This is in stark contrast to the haphazard way most employees are being managed. This needs to change.

The ultimate reward is that the contribution which competent, highly motivated employees can make increases from year to year – unlike machinery which begins to deteriorate from the first day it operates.

This paper highlights some of the deficiencies and provides some answers.

The evidence

From a survey of 8000 employees (3000 in Australia) conducted by **Les Picket**, leading Melbourne based International Consultant in Managerial Effectiveness and Human Resource Development and published in 1999, the following were major findings:

- 22% did not know or were unsure of the objectives they were expected to achieve.
- 37% reported that their manager provided little or no assistance in improving their performance and they had never had a formal discussion regarding their performance.
- Nearly 50% said their manager was not clear, frank or complete in telling them what they thought of their performance.
- Over 94% said they would welcome the opportunity to have a real dialogue about their performance and discuss their training needs and career aspirations.

It is probable that not many rural employees were represented in Picket's survey. However, experience gained through Jabiru management training courses suggests that on property employees would paint a similar picture. A recent survey of a group of dairy farm employees in S.E. Queensland and 80 persons employed in the pig industry gave similar results (Humphreys pers. comm.).

If an employee does not know what is expected of him/her how can performance really be evaluated? If managers do not have the ability to provide their people with clear objectives and targets how effective are they? The evidence clearly indicates that the employees' lament may be 'stop the 'pillow-talk' and tell me how I am going'. Equally, it suggests that employers are in need of training in human resource management.

It is obvious that 'interpersonal ineptitude' in management lowers performance, wastes time, creates acrimony, corrodes motivation and commitment and builds apathy and hostility. How much human endeavour is being misdirected and wasted? How many people are frustrated and lack motivation because they lack clear guidance?

The employment of labour a major investment and the cost of recruiting and inducting new staff is too often overlooked. Research is showing that the loss of a staff member and the time taken to recruit and train a replacement can cost between 40%–60% of the annual salary.

The answer

Having listened to the problems faced by nearly 3000 managers, supervisors and employees engaged in a variety of rural industries across Australia, including many pastoral enterprises, Jabiru Human Resource Services has developed a basic but effective six (6) point **Management System** that is designed to meet the needs of both employer and employee. The system is being implemented successfully in a number of corporate and private businesses.

The Management System recommended stresses the need to place more emphasis on recruitment and selection – the need to employ the right person in the first place. Induction is equally important. This is usually a three-hour induction to the workplace. This needs to become a three-month program of contact and encouragement. Having appointed and inducted the best available, the keys to effective management is the Job Description and a formal Performance Review process. Finally the ongoing management of the employee should model the participative decision making concept.

The management system (A summary)

1. • Recruitment • Selection	Each component managed as separate entity and professionally.
2. Contract of employment	Salary/wages, conditions, company rules, expected behaviour etc.
3. Job description	Title, purpose of job, major responsibilities, time allocation, skills check list, performance goals, authority etc.
4. Induction (including manual)	A three-month process. (An employee will usually decide to go or stay during the first 2–3 weeks.)
5. Performance review	A 6 monthly review of performance to praise good work, correct poor performance, revisit goals, training needs, review job description etc.
6. Participative management	Involve employees in decisions – delegate outcomes not process.

The **Management System** recognises that employees that feel that their employer values their contribution and encourages their development work well. In contrast, employees who feel they are a number on the pay roll, whose opinions are of no value are demotivated, lack initiative, and seek satisfaction outside the workplace.

The days are gone when an employer could decide and tell an employee what to do and expect them to do a **satisfactory** job **on time.**

Working together

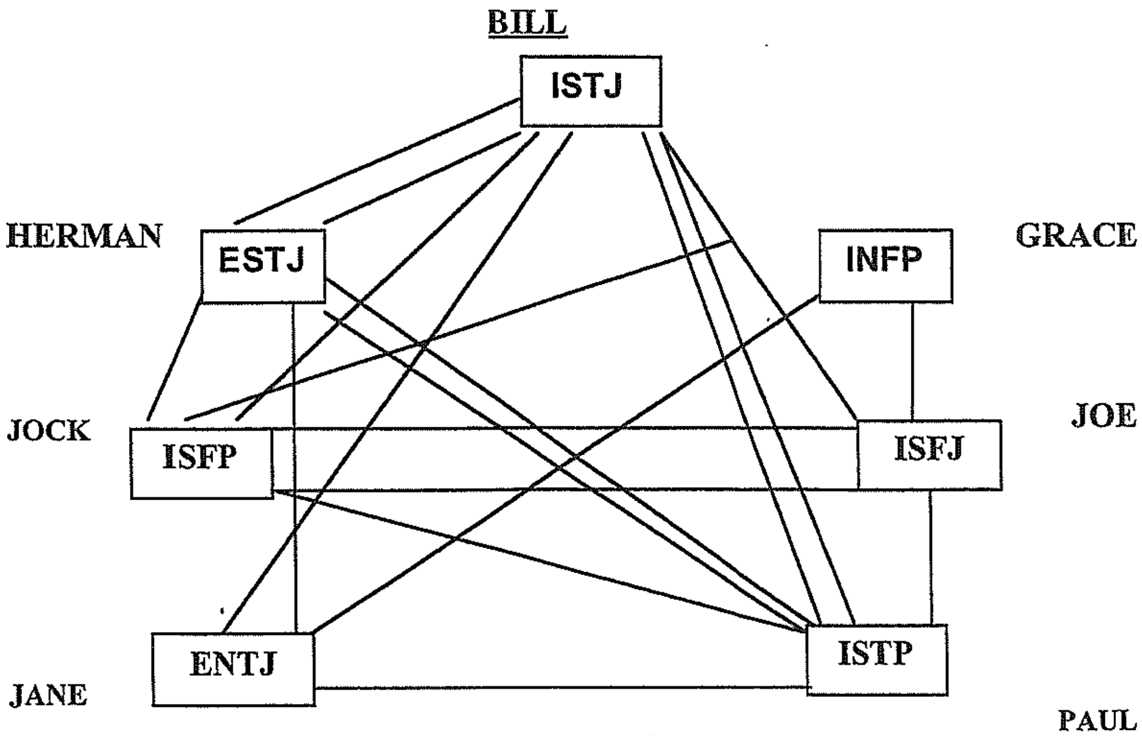
Modern people management is **personality centered.** This is an emerging and significant development. Research has shown that each of us are born with different preferences – differing in communication styles, perception and decision-making processes and flexibility. We need to be more aware of why people we work and deal with on a daily basis seem to react, function and behave in the way they do.

The management of an effective work team involves understanding **individual preferences.** It is the smart manager who can use this knowledge to lead a team with impact while at the same time meeting the motivational needs of the individual team members.

Today's world is so complex and fast moving that it is virtually impossible for important decisions to be made by one person. Those situations in agriculture where the 'head of the firm' still feels the need to reign supreme are at a disadvantage.

Using the ®Myers Briggs Type Indicator (M.B.T.I.), Jabiru human resource trainers have effectively introduced an instrument that has resulted in improved communication, understanding and the ability to utilise individual strengths to empower work teams. Probably an even more significant outcome is the development of greater self-awareness in managers. Self-awareness leads to improved self-management and more effective leadership.

What follows is an example of a team analysis using the M.B.T.I. It is a personality-centered approach. Referred to as a 'cobweb' it highlights the strengths of individual members and how this knowledge can be utilised to improve communication and interpersonal understanding, reduce conflict and provide the means to make better group decisions. The analysis can also help in the allocation of roles within the work team.



TEAM FUNCTIONS
(Using Myers Briggs Type Indicator)
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Summary

There is evidence that a significant number of employees across all industries are not experiencing job satisfaction. They are not motivated and lack initiative. Absenteeism is common and less energy is being directed towards the workplace.

Young employees are more knowledgeable, more restless, more mobile and more independent. They have a higher regard for their potential and feel strongly that a job is more than a livelihood. They seek satisfaction and a meaningful experience. They need to feel that their employer has a respect for them as individuals as potential resourceful human beings rather than a number on the pay roll.

In contrast, it would seem that employers see the employment of labour on farm as a source of stress. The management of staff is something they would rather do without. The cost is increased pressure on themselves and reduction in lifestyle when it can, in the majority of circumstances, be shown that investment in additional labour or a reduction in staff turnover can significantly increase profit.

There is an urgent need to re-address the obvious problems and introduce staff management systems that will yield the desired results.

A champion management team will attract a team of champions. In this way we will attract 'quality' employees back to the bush for the benefit of all concerned.

Reference

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Workshops

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Acknowledgments

The Northern Australia Beef Industry Conference was initiated by the North Australia Beef Research Council as a continuance of the tripartite series of North West Australia Pastoral Conferences.

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