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Richard Gunner's Fine Meats

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Life beyond the farm gate – the meat perspective

Richard Gunner – Principal:- Richard Gunner's Fine Meats

ABSTRACT

Challenges faced beyond the farm gate in the meat industry are quite unique and require a different perspective than in other farm gate products. Branding is one way to solve some of these issues and this is one perspective on how branding can be used to break some of the industries "norms"

BACKGROUND

Business Summary

Richard Gunner's Fine Meats (RGFM) is one of very few companies in the Australian meat industry that is successfully implementing a 'paddock to plate' production and marketing programme. RGFM encompasses a diverse range of business units all working together to add value to primary production and deliver exceptional products to both wholesale and retail customers alike.

Beginning as a straightforward beef enterprise, the business now incorporates not just 1800 head female herd, but also a 5000 head feedlot, a boning and distribution facility, four branded retail outlets, a wholesale business supplying a string of the best restaurants and several respected meat brands, its flagships being *Coorong Angus Beef* and recent addition Pure Suffolk Lamb.

Richard Gunner's Fine Meats has been recognised with a number of awards, in 2002 it won two South Australian Meat Industry Awards and Managing Director, Richard Gunner, was recognised with the prestigious Young Leader of the Year in the Premier's Food Awards. More recently has been awards received by the products themselves, including the specialist *Dry-Aged Coorong Angus Beef* being presented with the only Gold medal awarded at the Sydney Fine Foods awards for Branded Beef (2006).

While these awards are gratifying, it is the accolades received from food industry icons such as Stephanie Alexander, Maggie Beer and Leo Schofield that are the most satisfying and inspiring. *Coorong Angus Beef* has been described in various restaurant reviews, magazine articles and television appearances with words including: "sublime", "magnificent", "tenderness and full on flavour", "superb", "full of flavour" and "melt in the mouth."

Richard Gunner's Fine Meats has grown from an efficient primary producer turning off 1000 steers and heifers per annum in 2000 with 3 staff, to a respected, vertically integrated, innovative business processing 55 head per week, with 40 staff and a progressive, dynamic approach to business.

VALUE-ADDING THROUGH CUSTOMER FOCUS

It was the disconnect between the inconsistent beef available through local butcher shops and the exceptional eating experience when eating their own animals that caused the Gunner family to recognise that a lack of customer focus within the meat industry presented them with a business opportunity. Now, Richard Gunner's Fine Meats delivers a consistently high quality range of products to customers and remains responsive to their changing needs.

Through the business' own Feast! Fine Foods stores, Richard Gunner's Fine Meats has been well positioned to develop recipes and trial meal solutions with the aim of adding value to its own meats and distributing the best branded products available, making it the first choice for the discerning customer. While controlling the retail end of the value chain first came about through a desire to guarantee the integrity of the business' product and its brands, it also presents the opportunity to add value to often overlooked 'secondary' cuts and deliver meal solutions that remove the guesswork for consumers by matching the appropriate cut with the optimal cooking method.

Customer feedback is sought at every opportunity, particularly through the Savour Club, a loyalty programme with over 1000 members. The members of this programme are occasionally used to 'test market' possible new products and are encouraged to experiment with unusual cuts. Information on

meat handling, recipes and use of under utilised cuts has helped to involve customers more and increase their openness to product innovation.

Adding veal and organic meats to the offer and switching to 100% free range chicken are just some of the steps that have been taken in response to customer feedback. But it's more than that, a request for a leg of lamb to be tunnel boned or searching for pigs testicles for a family recipe are things the business is prepared to do to exceed customer expectations and set the business apart from competitors.

At a wholesale level, as the business encompasses the grazier, retailer, wholesaler and marketer, restaurant customers can request customised products. For example, the renowned restaurant, The Lion in North Adelaide, prefers its scotch fillet with a portion of the lip left on as it bastes the meat while it is on the restaurant's signature rotisserie. Another restaurant in Adelaide tested several variations of a product before fine-tuning it to suit their needs perfectly. Even modifying the feedlot ration or lengthening the time on pasture are things the business can do for major customers. No known competitor can be this responsive and very few chefs are sharing ideas with the farmer when discussing their next menus options.

VALUE SHARED ALONG THE AGRIBUSINESS CHAIN

Each of the business units in the Richard Gunner's Fine Meats value chain must stand alone as a profitable enterprise. Each has its own business and marketing plans, goals, budgets and therefore accountability.

The feedlot, for example, is where *Coorong Angus Beef* is finished on a customised grain ration and a number of other businesses have their own livestock custom fed there. By providing a custom feeding service, the feedlot is always running at capacity, generating a healthy turnover and remaining a viable entity in its own right.

The processing element of Richard Gunner's Fine Meats is outsourced to an independent business, but a strong working relationship with the contracted business is essential to ensuring the standards and business targets of each party are met. Regular meetings are held and ideas shared for the expansion and development of each enterprise. Currently Richard Gunner's Fine Meats is working closely with the meat processor to assist the latter in attaining export accreditation, for the benefit of both businesses.

Managing Director, Richard Gunner, is also a strong believer in helping to advance the meat industry as a whole. Sharing experiences with peers and representing the business in positions that might exact industry reform are important business activities and time is made to be involved on the boards of the South Australian (president) and National Angus Societies and *Certified Australian Angus Beef*. As this is a family business, Richard's wife Elizabeth also takes an active industry role and is currently on the South Australian Sheep Industry Development Board.

DEVELOPMENT OF STRATEGIC ALLIANCES TO ASSIST VALUE-ADDING

As well as a mutually beneficial relationship with its processor/partner, Richard Gunner's Fine Meats has strategic alliances with like-minded primary producers to help meet demand in Coorong Angus Beef. Other breeders from the Coorong district are now supplying pure bred Angus cattle to meet the demand generated by this product. The Pure Suffolk Lamb brand will also need suppliers and breeders are being sought to help meet domestic and export demand. Given this is not a geographically specific brand, this does mean stock can be sourced from all over Australia with the majority of external supply at this point in time being generated from Western Australia where close links have been forged with the local Suffolk Association.

Richard Gunner's Fine Meats also nurtures relationships with key chefs to gain valuable information about all products' performances in a commercial kitchen to help fine tune the product offer. Chefs too have been used to help develop recipes for value-adding secondary cuts for the retail outlets and develop fresh products, such as Coorong Angus Beef pies and smallgoods.

DEVELOPMENT OF SUSTAINABLE COMPETITIVE ADVANTAGE THROUGH VALUE-ADDING.

Before *Coorong Angus Beef* was developed and the first butcher shop acquired, significant market research was conducted to ensure there was a gap in the market and there was a genuine opportunity to fill it. That same market-driven philosophy permeates the entire business and helps cement a sustainable competitive advantage.

Richard Gunner's Fine Meats, as a small business that is also vertically integrated, has the advantage of being flexible and responsive to market demands. This alone presents a significant competitive advantage in an industry that has historically been on the whole unresponsive to consumer needs. By identifying a target market and adding value to essentially generic products, Richard Gunner's Fine Meats has found significant business opportunities and a sustainable competitive advantage.

A key success factor in maintaining that competitive advantage is being innovative to keep vigour in the business. For example, the business is currently working with Dr Wayne Pitchford of Adelaide University on a project to develop unique flavour profiles in red meats. The project is basically aimed at determining how the flavours of red meat can be modified by environment and diet. This is ground breaking research within the beef industry and the results are expected to be extremely significant.

Do you need to worry about climate change?

Anthony Clark, Centre for Resource and Environmental Studies, Australian National University and Bureau of Rural Sciences.

ABSTRACT

Popular debate surrounding climate change has become polarised between 'sceptics' who continue to dismiss the phenomena and those that promote 'doom and gloom'. Both points of view take advantage of the uncertainties in climate change science, which is a new and fast moving area of research. Producers are left in a difficult situation where they have insufficient information on which to build their understanding of the risk posed by climate change, and what it means for their business now and into the future.

This paper presents research which takes steps toward remedying this situation, by identifying the risk of climate change across the southern grazing zone of Australia. A well tested simple production model is driven by the latest projections from the Intergovernmental Panel on Climate Change (IPCC) and analysis methods used which make some of the uncertainties explicit. The resulting maps clearly illustrate that exposure to risk is not uniform across the southern grazing zone, and that changed seasonality driven by a warmer thermal environment leads to nutritional stress. Generally production could become riskier into the future, but the degree of exposure ranges from negligible to high depending upon location.

The strategic implication is that producers are wise to ignore both 'doom and gloom' and 'sceptical' accounts of climate change. A robust response to climate change really means keeping focussed on business fundamentals: agronomic innovation and practice as well as business and financial management.

AIMS

The aim of this research was to develop an approach that identifies the broad risks to sheep grazing production posed by climate change. This is the first stage of risk management (AS 4360:1990 Risk Management, cited in Clark 1999) and precedes more detailed farm level assessment of the costs and benefits of taking actions.

METHOD

Experimental design

The experiments compare indicators of grazing system performance derived from base climatology (1990-2004) simulations against those from a projected climatology (2040-2050). The metrics chosen were integrated annual pasture growth rate (Biomass or FOO, t/ha/year), stocking rate (animal/ha/year) and live weight change (kg/animal/ha/week). To account for uncertainties in both the climate change projections and the impact model, the experiments were carried out as a Monte Carlo simulation with 500 or more combinations of model parameters, management actions and climate change patterns.

Base climate data

Observed monthly climate data from 1990-2004 were interpolated to a regularised 5km² grid for rainfall, mean temperature, evaporation and radiation. The interpolation was carried out using a 3-dimensional laplacian thin plate smoothing spline with elevation as a co-variate (ANUSPLIN, Hutchinson 1995b)

Projected climate

Monthly climate change projections were obtained from the World Climate Data Centre (WCDC) as ensemble means from eight coupled Atmosphere Ocean Global Circulation Models (AOGCM) for the twentieth century (20C) as well as the A1B, A2 and B1 greenhouse gas emission scenarios. This is a subset of the latest model projections commissioned by the Intergovernmental Panel on Climate Change (IPCC). The scenarios assume that some degree greenhouse gas abatement occurs in the future, so the projections best represent the impact of greenhouse gas already released on the global

climate system. Monthly change fields were derived for each model and scenario by taking the ratio of simulated base and projection periods. The change fields were then downscaled to the same regularised 5km² grid using a bi-cubic spline, and the mean and standard deviation of all models and scenarios calculated. These were used to create a Gaussian distribution, and a change field was sampled with replacement from this distribution for each iteration in the Monte Carlo simulation.

Impact model

A simplified broad area impact model was developed by extending the GrowEST framework (Nix 1981, Laughlin 2007) to include a physiological response, updating the thermal response, and by coupling the pasture growth subroutine to a simplified animal model. Testing this system demonstrated that the soil water and pasture growth subroutines give robust predictions, and are transportable with confidence to new sites within the medium to high rainfall zone of southern Australia.

The animal subroutine is 'theoretical' as mixed results were obtained between environments, attributable to lack of sensitivity in the model to diet selection in the animal intake subroutine. The lack of transportability and difficulty in predicting animal intake is a property of all grazing simulators (Elsen et al. 1998, Pitroff and Koffman 2001c), however the most encouraging results were obtained in the south west of Western Australia. For this reason only output from the pasture growth subroutine is analysed spatially.

The impact model is suitable for broad scale analysis as it utilises a weekly rather than daily time step. This is an important feature, as in addition to computational savings, it allowed weekly climate data for model runs to be generated from the monthly climatologies using a cubic spline (Hutchinson 2004). Monthly climatologies are preferred because of the greater number of reporting stations and stable methods of spatial interpolation at this timescale (Sharples et al. 2005). The model is best applied to broad spatial scales such as a 5km² grid, rather than fine spatial scales of farm-landscape analysis where data from a single meteorological site is used.

A number of processes and management practices are not explicit in the impact model. The scaling assumption is that the model tracks the broad area climate signal and does not need to be sensitive to farm-by-farm differences. However uncertainty in some processes may be approximated by implementing this simplified model in the Monte Carlo framework (Katz 2002). For instance carbon dioxide fertilisation has been shown to influence the water use efficiency of some pastures in greenhouse trials, improving net primary production by 10-15 percent (Lilley et al. 2002), but there is uncertainty as to the level of expression under open field conditions (Lilley et al. 2002, Long et al. 2005). In the simulations conducted, the water use efficiency parameters in the impact model are perturbed to reflect a range of potential responses. Similarly, this approach also captures the range of system responses expected by farm-to-farm variability in fertiliser application.

RESULTS

Example results of the simulation are presented for two Western Australia case studies (Narrogin and Mt Barker) as probability density functions (PDF's, Figures 1-2). Anomaly maps are generated for the high rainfall zone in the south east of Australia and south west Western Australia in Figure 3. This also shows the PDF for the entire southern production zone. Generally these indicate that there is a projected shift toward lower production conditions by 2040 with decreased probability densities for FOO, and for the Western Australian sites live weight gain and stocking rate.

Climatologically the clearest signal is a shift in temperature probabilities towards warmer conditions, which also drive increased evaporation. The results for rainfall suggest that there is minimal or inconsistent change. This is because future projections for rainfall are inconstant across the AOGCM data base, with some suggesting increased and others decreased probabilities of precipitation. Such results are consistent with the global projections recently described in the IPCC's Fourth Assessment Report (AR4, IPCC 2007).

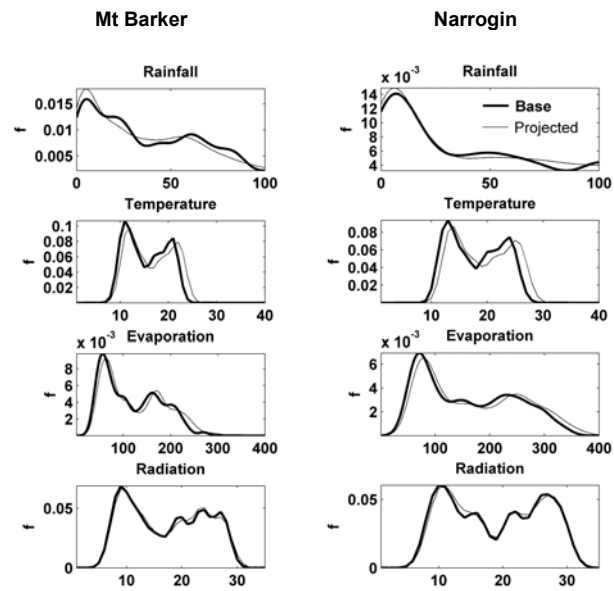


Figure 1. Climate change probabilities for Narrogin and Mt Barker.

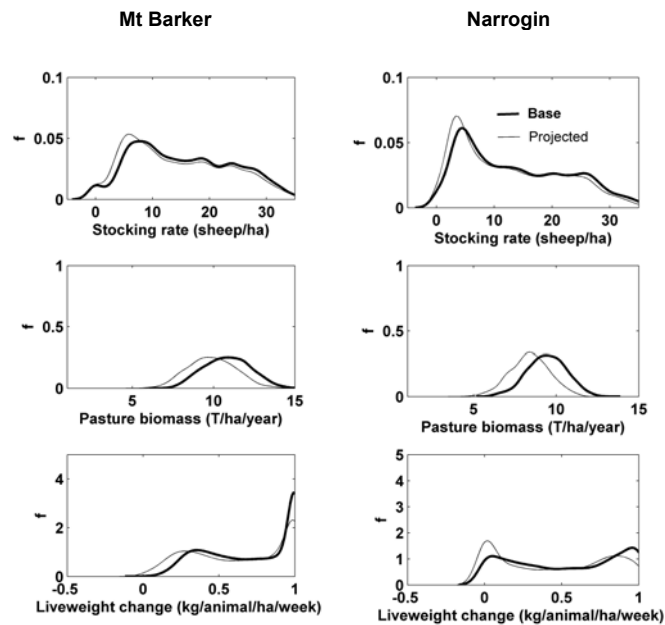


Figure 2. Climate change impact probabilities for Narrogin and Mt Barker

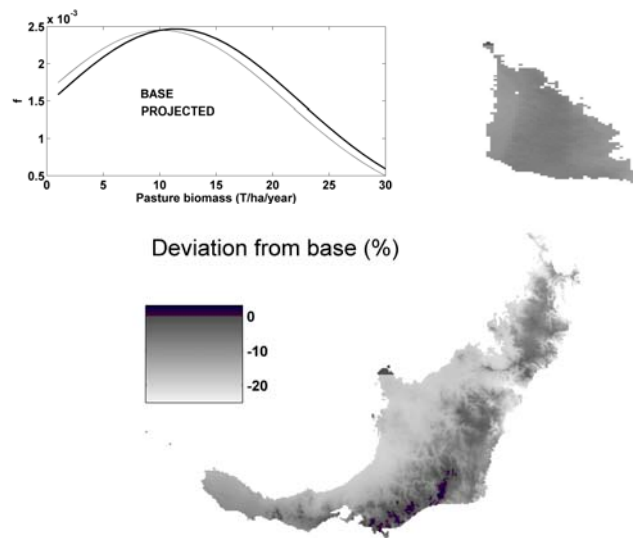


Figure 3. Climate change anomalies for a C3 Microtherm pasture (sub clover) for the high-medium rainfall zone of south east and south west Australia.

CONCLUSION

The Monte Carlo simulation identified a risk to production despite the uncertainties inherent in climate change science. There was a clear shift in probability toward lower production for sub clover. In the two case studies in Western Australia this flowed on to reduced stocking rate and live weight gain, indicative of increased risk of low production for sheep producers. However, the spatial analysis indicates that the level of exposure varied according to location, and in some areas positive production outcomes were evident. There are ongoing uncertainties in climate change science and its extension to examine impacts at the regional to local level. The evaluation of AOGCM precision at the regional level, and spatial downscaling of climate model data, is an area of active research. The methods used in this study are far from perfect, but they do provide a practical approach to the problem.

In accordance with the Australian and New Zealand Standard (Clark 1999), the modelling presented is a 'first stage analysis' in the risk management process. For decision making under climate change, identification of potential management responses and a cost-benefit study are required before actions are implemented—this is equivalent to what is described by the IPCC as 'climate change adaptation'. The tools and techniques in climate change science are still a long way from achieving this level of analysis, and it is likely that a model driven approach will not fully capture the innovation process in grazing agriculture. This stage of analysis is likely to be built by more sophisticated modelling and farm level studies, in concert with the processes of innovation in the grazing industry that emerge from dialogue between researchers, farm advisors and producers.

Climate change is only one of the many risks faced by producers. Price variability, rising costs and shorter term climatic events such as inter annual drought will still be the dominant sources of risk in the short to medium term. Responding to the longer term risk of climate change in a practical way is really about ensuring that the fundamentals of agricultural risk management are operating well over the next decade—this means continued agronomic innovation and improved financial planning.

KEY WORDS

Climate change, risk analysis, grazing production.

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archiving the model output, and the JSC/CLIVAR Working Group on Coupled Modelling (WGCM) for organizing the model data analysis activity. The multi-model data archive is supported by the Office of Science, U.S. Department of Energy.

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Ruminant nutrition panel session – The impact of nutrition on animal health and welfare

Kevin Bell, School of Veterinary and Biomedical Studies, Murdoch University

THE MOST IMPORTANT THINGS IN RUMINANT NUTRITION

Short of severe (and culpable) mismanagement and a few acts of God such as fire, flood and hypothermia, the welfare of animals is essentially about adequate nutrition. I am thinking particularly of grazing ruminants in Australia.

Most would realize that this level of nutrition is also associated with the optimum profit from grazing operations. There is no conflict between profit and welfare, as some misguided or mischievous critics are fond of saying.

What is “adequate”?

Adequate nutrition is providing feed of such quality and quantity that the requirements of animals in the environment to which we restrict them and in the physiological state to which we manage them can be met. Note: we set the environment and the physiological state, and it's our responsibility to manage the enterprise.

What are “requirements”?!

A good approach to the practical implementation of good welfare is to align with the “Five freedoms and provisions.” These give a reasonable guide to an ideal, if seldom achieved, state of welfare.

Freedom from:

- Thirst, hunger and malnutrition
- Discomfort
- Pain, injury and disease
- Fear and distress
- (Freedom to) express normal behaviour

This concept arose from considerations of intensively farmed pigs, poultry and cattle (veal) in the European context, but can be applied in the context of the welfare of grazing ruminants in Australia. We can use the above as a checklist to assess the strengths and weaknesses of any operation. For nutrition (“thirst, hunger and malnutrition”) I think we're on a winner.

To me, even a cursory glance at the above indicates that grazing animals in profitable enterprises in the Australian context enjoy extremely good welfare. A good example is the unambiguous condition score guidelines emanating from the “lifetimewool” project. Condition scores 2.5 and above and the associated weight change parameters can only mean good news for both sustainable sheep welfare and farm profit.

Such levels of nutrition also have substantial benefits for disease control – in particular gastro-intestinal parasitism.

For cattle, the current best practice extension program “More Beef from Pastures” is unequivocal regarding condition score targets and growth paths. Once again, condition score 2.5 and above is clearly demonstrated as being associated with profit – welfare is a given.

Optimum calving and lambing times are now being more confidently and clearly promoted and adopted by innovative producers – not surprisingly the reason being the more efficient use of pasture.

The adoption of best practice guidelines for feeding livestock now have additional urgency and priority, as global resource use and the consequences of ruminant contribution to some “greenhouse” effects are under scrutiny. Putting it simply, it can only be common sense and beneficial on all fronts to feed an animal for less time with less feed consumed.

Ruminant nutrition panel session – Pasture/animal interactions

Hugh Dove, Chief Research Scientist, CSIRO Plant Industry

BACKGROUND IN RUMINANT NUTRITION

Hugh Dove is a Chief Research Scientist at CSIRO Plant Industry, Canberra. After graduating in Agricultural Science from the University of Melbourne, he completed a PhD on the nutrition of growing lambs. He commenced work with CSIRO Plant Industry in 1975 and since then, has been involved in studies on the nutrition of grazing animals, principally sheep and cattle. Much of his work has been directed toward obtaining data with which to relate animal performance to pasture conditions, and data on the interaction between pastures and supplements. His work has been principally with sown pastures, but has also examined the nutritive value of crop residues. His more recent work, supported by GRDC, has examined the role of dual-purpose winter wheats in grazing systems. He is the co-editor of the text book 'Sheep Nutrition', and has recently been involved in the revision of the ruminant feeding standards in both the USA and Australia.

THE THREE MOST IMPORTANT THINGS IN RUMINANT NUTRITION

1. **How do we relate our knowledge of what nutrients grazing animals require to the nature of the pasture on offer...its mass, species composition, nutritive value?**

Knowledge of the nutrient requirements of ruminants is well advanced, as is the agronomy of producing a productive pasture. By comparison, our ability to predict what nutrients animals actually harvest from a given pasture is much less. This issue has a strong economic dimension, because if we recommend that pastures of a certain type or composition be sown, we need to be surer than we currently can be about whether an economic animal response will occur. This issue also underpins economically important events such as substitution between supplement and pasture, or the incidence of 'shy feeders'.

2. **What happens when animals lose weight? What are the efficiencies of nutrient use when animals lose weight, especially during lactation?**

This also has a strong economic dimension. In Australian production systems, we rely on animals 'feeding off their backs' at certain times of the year, and during early lactation this weight loss is unavoidable. However, we have restricted ability to predict what nutrients will be provided by the combination of weight loss and current intake, how efficiently these will be used by the animal and thus what supplementary feeding might be needed.

3. **Animal nutrition at the farm level is becoming increasingly quantitative, with producers seeking data on the amount and nutritive value of the pasture on offer. A system of more accurate and rapid feed testing services is needed to support this with reliable feedback on the nutritive value of feeds.**

State Departments of Agriculture have been active in training producers to assess the amount and the digestibility of pasture, and in encouraging producers to seek feed test data to support their decisions (analogous to soil tests in agronomy). However, are feed testing facilities able as yet to provide a reliable service to support such decisions, or do test results differ between facilities?

Precision Cattle Breeding for the 21st Century

H.M. Burrow, Cooperative Research Centre for Beef Genetic Technologies

ABSTRACT

The Cooperative Research Centre (CRC) for Beef Genetic Technologies was developed in partnership by the Australian beef industry (Cattle Council of Australia, Meat and Livestock Australia, Australian Lot Feeders' Association, corporate and individual beef producers) and prestigious national and international scientific institutions over 2003 and 2004. It is a collaborative venture between 19 partner organizations from Australia, New Zealand, Korea and the USA, with associate partners from Northern Ireland, the Irish Republic, France and South Africa. It focuses on four beef industry priority issues (high quality beef, feed efficiency, disease resistance and improved reproductive performance) to capture unique opportunities for Australia through world-class gene discovery and gene expression research and accelerated adoption of beef industry technologies to improve profitability, productivity, animal welfare and responsible resource use of Australian beef businesses. The Centre commenced operations as a third-term CRC in July 2005. Research outcomes are aimed at providing Australia with the ability to consistently produce beef products of exacting specifications to meet the needs of domestic consumers and those of the 110 countries to which we export, thereby ensuring Australia's position as World's Number 1 Beef Trader.

THE OPPORTUNITIES

Beef is Australia's most valuable agricultural export commodity. But with only 2.5% of the world's cattle numbers and 23% of the world's beef trade, Australia will only retain leadership through greatly increased and smarter use of new technologies. The Beef CRC is now developing and commercialising novel genetic technologies to capture the benefits of:

- i) the explosion in knowledge of genetics from the Human Genome Project, completed in April 2003 (Collins *et al.*, 2003) and the Bovine Genome Project, largely completed in 2006 (<http://www.hgsc.bcm.tmc.edu/projects/bovine>). Combining the genomic sequences with the existing CRC's unique data and cattle resources and patented DNA tests will provide Australia with world leadership in precision cattle breeding and production. This will be achieved by selecting cattle for specific markets based on the genes they carry, not through artificial modification of their genomes. New technologies derived from our understanding of gene networks will then be used to enhance cattle performance.
- ii) the "Livestock Revolution" derives from "Livestock to 2020 – the Next Food Revolution" (Delgado *et al.*, 1999; 2002) and is based on the International Food Policy Research Institute's global food model that uses data from 37 countries and country groups and 18 commodities. The model predicts consumption of meat in developing countries will grow by 2.8% per year between 1997 and 2020. By 2020, developing countries will consume 100 million metric tons more meat, dwarfing developed-country increases of 18 million metric tons. The "Livestock Revolution" provides Australia, as the world's number one beef exporter, with significantly increased beef trade opportunities through to 2020 ; and
- iii) past investments in the Beef CRC (1993-2006) that delivered the unique phenotypic and genotypic databases (accurate measurements for hard-to-measure traits on thousands of specifically designed, fully pedigreed cattle whose DNA is also available) that are necessary to capitalise on the availability of the bovine genome sequence. Through the efforts of the previous Beef CRCs, Australia is now the only country in the world where such extensive databases, based on industry cattle herds, are currently available.

SCIENTIFIC EXCELLENCE FOCUSED ON PRIORITY BEEF INDUSTRY ISSUES

New Beef CRC research is focusing on ground-breaking "Gene Discovery and Gene Expression" research to equip Australia for precision cattle breeding and management for quality, efficiency and profitability. It will provide Australia with the ability to consistently produce beef products of exacting specifications to meet the needs of domestic consumers and those of the 110 countries to which we export.

The new Beef CRC is targeting an additional 1.5% p.a. increase in gross revenue of the Australian beef industry, estimated at \$179 million per annum from 2012, with total expected benefits of the new CRC research being more than \$2 billion over 25 years. It is using emerging genetic technologies to:

- improve the capacity to deliver high quality beef to Australia's 110 global markets using cattle of known genetic merit for exacting specifications, without compromising animal welfare or the environment.
- enhance beef yield and herd reproductive efficiency, improve efficiency of resource use, reduce production costs, minimise methane emissions and avoid chemical and antibiotic residues through precise application of knowledge about the genes controlling these attributes in cattle, their rumen microorganisms and in parasites that affect cattle productivity.
- ensure Australia is the number one supplier of beef to meet the growing demand by neighbouring Asian countries to 2020.

APPROACHES TO ACHIEVE BEEF CRC OUTCOMES

The new Beef CRC has a three-pronged approach to achieving beef industry outcomes, with each program comprising a combination of gene discovery and gene expression research and accelerated adoption of beef industry technologies.

Gene Discovery

The Beef CRC's gene discovery research aims to develop "genomic tools" to increase the profitability and competitiveness of the Australian beef industry by i) performing genome-wide associations with Single Nucleotide Polymorphisms (SNP) panels to discover DNA markers that impact on economically important phenotypes; ii) developing statistical models that predict phenotype (measured performance of individual animals) from SNP genotypes and expression profiles; and iii) validating those prediction models in a commercial setting and promoting their adoption by the industry.

Using gene discovery approaches the Beef CRC plans to find multiple Quantitative Trait Loci (QTL) that impact on economically important attributes in beef cattle and develop diagnostic tests for them. The aim is to deliver to industry, DNA tests that account for 50% of the genetic variation for each economically important trait. For breeding purposes, DNA test results should ideally be used with information such as Estimated Breeding Values (EBVs) derived from measurements of the trait. The Beef CRC is therefore also planning to deliver future DNA marker results directly through BREEDPLAN as marker-assisted EBVs and marker-assisted Estimated Phenotypic Values (the latter values being applied to commercial or non-breeding cattle).

As a result, seedstock breeders will be able to readily select breeding cattle with favourable forms of the genes or cull those cattle with unfavourable forms of the genes. Commercial producers, feedlotters and beef processors will be able to cost-effectively use the tests to identify cattle that best meet market specifications under their particular production systems.

Gene Expression

Gene expression is aimed at understanding the function of the genes associated with economically important traits and identifying non-genetic approaches (for example, changed management practices, modified diets, water medications, vaccines etc) that can be used to 'switch on' favourable genes or 'switch off' unfavourable genes in cattle so the cattle can be individually managed to better comply with market specifications.

Beef CRC scientists use a 'microarray', which is a glass microscopic slide comprising up to 20,000 gene probes, for their gene expression research. The colour of the 'spots' on the microarray indicates whether a gene is being 'switched on' or off or remains unchanged due to a particular treatment and therefore gives an indication of the genes that are involved in expression of that gene for the trait of interest.

Hence, gene expression provides a short-cut approach to gene discovery and potentially also to individual-animal- specific non-genetic treatments to allow beef producers to customise their management practices to ensure cattle cost-effectively comply with market specifications. *Note: This will be achieved by selecting cattle for specific markets based on the genes they carry, not through artificial modification of their genomes.*

The vision is that within the next 1-2 decades, beef businesses will be able to cost-effectively collect a DNA sample from all their animals early in life for the purposes of developing a gene marker profile for each individual animal. The gene marker profile can then be used to customise the management of the individual animals to maximise achievement of market specifications or to identify the animals best suited to deliver genetic improvement for traits of economic importance.

Accelerated Adoption of Beef Industry Technologies

“Accelerated Adoption” aims to increase the level of industry “ready adopters” (i.e. industry end-users who, once they are aware of new technologies, can readily adapt those technologies and implement them in their own businesses) from 25% to 35% (based on cattle numbers) by 2012. Economic analyses undertaken to support the CRC renewal application indicate that \$54 million of the \$179 million per annum estimated value of the new Beef CRC accrues from increased use of CRC technologies by industry (Griffith *et al.*, 2006).

“Accelerated Adoption” is being achieved in the Beef CRC using innovative participative and partnership processes based on credible industry profitability and productivity benchmarks (Clark and Timms, 2000). The approach primarily targets the ~25% of “fence-sitters” (2003 MLA survey; i.e. industry end-users who are aware of new technologies but require assistance to adapt the technologies for use in their own businesses and integrate them to have a favourable impact on economic, environmental and social “bottom lines”). The approach uses an action-learning design based on well-proven business principles to derive profitability and productivity benchmarks for each individual business participating in the “Accelerated Adoption” activities. Thereafter, the end-users identify those technologies with greatest potential impact on their goals and then trial, evaluate and measure their benefits in their own herds.

The same approach is being undertaken with five “Supply Chains” throughout Australia. Collectively, these supply chains process in excess of 500,000 head of cattle per year. A comprehensive database containing all information on three million carcasses graded by Meat Standards Australia was compiled by the Beef CRC to provide a benchmarking and feedback system for members of the project and to provide the basis for value-based payments across the supply chains. Gross margin tools, customised to specific production systems, are used to evaluate alternative pathways for beef producer partners to improve compliance to market specifications and generate improved returns across the entire value-chain.

BEEF CRC RESEARCH PROGRAMS

The Australian beef industry identified four high priority beef industry issues with best potential to capture the above opportunities. These priorities are now the targets for each of the Beef CRC’s scientific programs, which are planning to achieve the outcomes identified below.

Program 1 – High Quality Beef for Global Consumers

- From 2012, 10% of Australian beef sires will be evaluated for multiple DNA tests that account for 50% of the genetic differences in carcass yield, marbling and beef tenderness, increasing annual gross revenues in the Australian beef industry by \$43 million for improved beef quality and a further \$15.5 million for increased retail beef yield.
- By 2012, the compliance rate for cattle achieving market specifications will be increased by 20% with concomitant improvements in profitability due to improved operational, environmental and production efficiencies and increased throughput across the supply chain.
- By 2012, palatability prediction models, customised for international markets, will be developed and used by at least two of our key trading partners.

Program 2 – Feed Efficiency, Maternal Productivity and Responsible Resource Use

- From 2012, feed costs for the national beef herd will be reduced by \$15.5 million per annum without impacting on cattle weight gain, through genetic improvement of feed efficiency in seedstock cattle.
- From 2012, breeding herd efficiency (kg calf / MJ energy per cow and calf unit) will be improved on average by 0.5% per annum in at least 50% of specialist beef enterprises in temperate Australia.
- By 2012, commercial products and management strategies developed by the CRC will be used by 50% of feedlots and 20% of grazing enterprises to decrease methane emissions from beef cattle by 20% and increase dietary energy captured for production by 5–10%.

Program 3 – Adaptation and Cattle Welfare

- From 2012, the combined effects of reduced parasite control costs and improved productivity from use of optimally adapted cattle and improvements in animal welfare will increase the gross annual revenue of the Australian beef industry by \$43 million.

Program 4 – Female Reproductive Performance

- Every year from 2012 an improvement of \$46.5 million will be achieved in the gross annual revenue of the Australian beef industry due to improved reproductive performance of the beef breeding herd with no impact on breeder herd mortalities due to younger age of joining and with cows rearing their calves to normal weaning age of 6-9 months.

NATIONAL AND INTERNATIONAL PARTNERS

The new Beef CRC is delivering an unrivalled, integrated program of research focused on economically important traits for the Australian beef industry, involving multi-disciplinary teams and partnerships across a greatly expanded CRC network, including leading scientists from Australia's key trading partner countries. It is using novel technologies and new bovine genome sequence information to considerably expand the scope of the earlier phases of Beef CRC's research beyond carcase and beef quality to include a much wider range of economically important traits than addressed in the past.

The nine Participants (or "shareholders") of the CRC for Beef Genetic Technologies are Meat and Livestock Australia, Meat and Wool New Zealand, the state Departments of Agriculture in NSW, Queensland, South Australia and Victoria and the Universities of Adelaide, New England and Queensland.

Supporting Participants include the Australian Lot Feeders' Association, CSIRO Livestock Industries, Department of Agriculture Western Australia, Murdoch University, National Livestock Research Institute of Korea, the Northern Pastoral Group of Companies (a consortium of the major pastoral companies and individual seedstock breeders in northern Australia) and The Ohio State University in the USA.

Associate Partners include the Northern Territory Department of Primary Industries, Fisheries and Mining in Australia and research provider organisations working through a European Union Framework 6 "ProSafe Beef" project (Northern Ireland, the Irish Republic and France) and a similar ACIAR-funded project in South Africa (ARC Animal Production Institute, the National Department of Agriculture and several provincial departments of agriculture in South Africa).

The CRC is bringing together a network of cattle industry, genomic and physiological expertise and resources unmatched in the world. The complementary resources, skills and expertise of the CRC's national and international partners, combined with the CRC's unique cattle populations are now providing very exciting opportunities for the new Beef CRC to capitalise on the publicly available human and bovine genome sequences to a greater degree than any other livestock industry globally.

KEY WORDS

Gene discovery, gene expression, accelerated adoption, bovine genomics, DNA, beef quality, feed efficiency, adaptation, cattle welfare, female reproductive performance

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Profitable Perennials™ for Australian Livestock Industries

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ABSTRACT

The Future Farm Industries CRC has been approved for Australian Government funding of \$34.125m in the CRC Programme's 2006 Selection Round. This paper describes the innovative and distinctive science planned for FFI CRC, commencing 1 July 2007, relevant to dryland livestock industries.

The proposed research will be conducted at two levels:

1. Development of farming systems and environmental management strategies requiring a multi-disciplinary approach.
2. Specific perennial plant and technology development as components of farming systems.

This paper identifies major areas of scientific activity and headline technologies ready for market now. Examples that follow (see boxes) list the distinctive components that differentiate the FFI CRC from other research relevant to livestock production. Implicit in these descriptions is a path to adoption where the CRC has partnerships with agribusiness, new companies and catchment bodies.

INTRODUCTION

FFI CRC is a consortium of partners involving Universities, State Agencies, CSIRO, Industry Research Funders and private businesses which have joined forces in a coordinated program of initiatives to deliver profitable perennials (Figure 1)

Figure 1. FFI CRC science will create opportunities > on Farm > for Industries > for Catchments

Creating new commercial perennial plants	Designing new farming systems	Creating new industries	Managing resources in catchments
PastureSearch	EverGraze; Enrich; Sustainable Saline; Grazing	Salt tolerant wheat; New woody crops	Natural resource management investment framework

SCIENCE LEADING TO NEW OPPORTUNITIES

The scientific effort is organized as 6 research programs to deliver regional relevant national outcomes. The on-farm benefits, according to rainfall zones, are:

1. High rainfall – livestock dominated systems with opportunities for intensification

The need for a substantial increase in production and profit is the primary driver for change. Grazing systems targets will be permanent pasture systems (see EverGraze Plus on next page), and pasture/crop rotations that can cope with the challenges of intermittent excess water.

EverGraze Plus – science behind new high performance prime lamb production

- Perennial plants to stimulate the reproductive system and increase the number of offspring.
- Enhanced reproductive survival through an understanding of environmental stress and its management at birth, including foetal programming to improve lifetime fitness.
- Nutrition as a driver of early sexual maturity delivering earlier entry into the production cycle and higher lifetime reproduction rates.
- Technology to facilitate the adoption and use of superior plant/animal combinations - of particular relevance to the 'conservative' livestock industries.
- Bio-economical modelling approaches to optimising feed base planning in variable landscapes subject to strong climatic variability.
- Methodology for the quantification of biodiversity benefits of perennial pasture systems compared to current annual based systems.
- Pasture selection and management to match the productive needs of high performance livestock with more sustainable plant systems.

2. Medium rainfall – mixed crop livestock systems with new woody perennials.

Currently, profitable options for perennials are not available for many parts of the landscape. Grazing systems targets will be:

- pasture/crop rotations for the full edaphic range with particular attention to herbaceous perennial species (from PastureSearch) that can accommodate acidity and waterlogging
- Integrated tree cropping using short cycle coppicing species

PastureSearch – science leading to more productive, better adapted cultivars

- Internationally renowned consortium of breeders using the right mix of breeding methods to deliver cultivars in the minimum time (domestication to wild native species [*Cullen*, *Lotus*, *Swainsona* etc], interspecific cross-breeding [*Lotononis* spp.], technology supported conventional crossing using molecular markers, mutation technology etc [*Dactylis glomerata*, *Lotus* spp. etc]).
- Agro-ecological matching (integration of spatial and ecological models) to identify the best perennial options and sources of generic variability – particular focus on ecology of promising Australian native genera.
- Activate international and national networks and collaborations to establish access to best germplasm of target genera and species (with explicit freedom to operate).
- Design of field testing regimes and protocols to identify the potential for positive benefits (within the target farming system) and minimise the risks (persistence, drought susceptibility, weediness etc)
- Integrated bio-physical and bio-economic analysis used to prioritise plants for breeding for the target farming systems.

3. Low rainfall – challenges to the wheatbelt mixed farming systems.

Drought, climate change and declining terms of trade for crops are the drivers for farming systems change in this zone and perennials currently play no substantial role. Grazing systems targets will be:

- permanent perennial pasture for low-input pasture production from poorer soils – see Enrich example on following page
- perennial legume based crop rotation system for use on soils where crops are profitable – components of PastureSearch (see example)

ENRICH – innovative science creating new livestock production opportunities

- Fodder shrubs (preferably domestication of Australian native species e.g. *Atriplex*, *Rhagodia* etc) identified and adapted to the needs of animal production and land capability.
- Seed biology of the target species used for the design of direct sowing to replace expensive seedling establishment.
- The role of plant secondary compounds (common in shrubs) in sheep grazing behavior managed using a mosaic of feeding sources.
- Plant compounds used in the metagenomic analysis of rumen function to improve gut health, microbial diversity and digestive efficiency.
- Grazing animals to 'self-medicate' when selecting shrubs containing beneficial secondary compounds.
- Resilient systems designed that improve livestock health and welfare while increasing water use and plant diversity and decreasing erosion.
- World first research into actively developing new farming system based on shrub species for multiple roles (profit, productivity, animal health, multiple environmental benefits).
- Perennial forage shrub systems conceived, analysed, justified, researched and developed as a sub-system of a whole mixed farming enterprise using multi-disciplinary and participatory research and development.

4. Saline land farming systems

Research will be undertaken to deliver a second generation of innovations on the base of technologies pioneered in CRC Salinity. See “Sustainable Saline Grazing box below.

Sustainable Saline Grazing – science overcoming production constraints

- Direct seeding technologies for hostile soils as a driver of low cost re-vegetation.
- Salinity stress as a guide to plant site selection and production potential derived as a quantitative index of site physical measurements and mapped spatially.
- Differential toxic ion sensitivity and uptake by plants from drained saline land as a factor constraining the rehabilitation strategy.
- Role of *in utero* exposure to salt on gene expression and feed preference of the offspring will be used to improve production and health on saline pastures (with potential implications for human health)
- Species differences in kidney function, management of fluid loads and digestive function determining choice for saline pastures
- Phenotypic differences, within flocks, in the ability to grow and thrive on saline pastures understood and used as a basis for animal selection
- The nutritive value of salt tolerant plants as drivers of plant selection, system design and management

Industry opportunities

New industry opportunities centre on the development of novel crops. While not central to livestock productivity on farm, they contribute to sustainability of the farm enterprise. FFI CRC is involved in two key areas:

1. Novel cereal crops

The drivers for this research is to identify cereal crops that can be grown profitably in situations where current cereals are too low yielding to remain profitable. Target opportunities are:

- Salinity tolerant wheat for use in areas where salinity and waterlogging are major constraints to production (moving from pre-breeding [CRC Salinity] to cultivar development – see Salt tolerant wheat cultivar example).
- Perennial wheat for areas where constraints such as infertility limit yield and profit with high input annually sown crops and a lower input alternative is required. The scientific challenge of this project comes from the need to simultaneously assess novel inter-specific breeding methodologies, novel farming systems development with the economics of market prospects

2. New woody crops

The drivers for development of new woody crops for regions not traditionally associated with forestry production arises from the need for economic diversification driven by expanded industrial demand (bio-fuel feed stocks, secondary wood products etc), contributions to sustainable landscapes (hydrological footprint) and biodiversity enhancement (within existing farm boundaries). Key research activity will encompass new industry production feasibility in partnership with co-investing potential end users.

Catchment – natural resource management solutions

The FFI CRC will centre its natural resource management activities on biodiversity, potable water and the decision systems required to integrate community objectives at catchment scales. Key areas of scientific activity will be:

- Biodiversity - provide new or improved habitat for native plants and animals from perennials on farmland, protect existing biodiversity from key threatening processes, including salinity and avoid the major risk of weed introductions.
- Water - managing the trade-offs involved in applying perennial systems in water supply catchments. These trade-offs will be described for catchment decision-makers by further developing the Catchment Assessment Tool (CAT) developed in the CRC Salinity.

- Decision support and policy - knowledge will be combined into decision systems for natural resource management that support the work by Commonwealth, State, and regional groups working in Natural Resource Management – see Natural Resource Management Investment Framework example.

Natural Resource Management Investment Framework – science informing policy

- Rigorous, practical and transparent framework, that rationalises investment decisions by regional natural resource managers, accounting for:
 - value and type of environmental or built asset at risk
 - level of threat of economic loss
 - responsiveness of catchment process to land use change
 - likely behaviour of land managers under policy options
 - cost effectiveness of alternative policy options
- Integration of biological, physical, economic, and social research, in a strongly participatory approach, to develop practical decision rules for policy makers and environmental managers.
- Extend the existing Salinity Investment Framework, which is currently influencing national policy directions, to incorporate biodiversity and water resources.
- Rigorous risk management applied to natural resource management policy and the best use of government funds and landholder investment.
- World first policy framework tool that enables investors in integrated catchment management to make sound decisions based on science

OPPORTUNITIES FOR INDUSTRY ENGAGEMENT

The Future Farm Industries CRC will focus on the key industries of meat, grain, wool, wood products and bio-energy and the 60M ha of dryland farming in temperate Australia (WA, SA, Victoria and NSW) where the greatest gains are to be made.

Three interconnected strategies guide the activities of FFI CRC:

- Commercialisation and utilisation
- Research and development
- Education and training

The CRC's stakeholders range across agribusiness and manufacturing companies, farm production groups, catchment management authorities, agriculture and natural resource management advisers in the delivery of new knowledge to farmers. It will take full advantage of the highly developed extension training and knowledge dissemination services of industry R&D corporations, government agencies and the rural media.

Key activities will be:

- *Commercialisation for private sector delivery*: products, services and processes that are suitable for private sector delivery under licence or other commercial arrangements
- *Improved delivery through partner organisations*: working with partner industry organisations and extension agencies, the CRC will develop improved methods for commercialisation and enhanced adoption of its technologies
- *New knowledge partners*: knowledge exchange and participatory research products that meet shared goals and enhance the adoption of the CRC's technologies.

The key research and development program relevant to livestock industries is Future Livestock Production. The program leader is Dr Joe Jacobs, DPI, Victoria, Warrnambool. It is a feature of FFI CRC's commercialisation function that programs engage with industry organisations, including MLA, AWI and Landmark who are participants in the CRC.

KEY WORDS

Cooperative Research Centre, perennial, farming system, natural resource management