



final report

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Report on MLA-CLI Strategic Science Beef & Sheepmeat RD&E Workshop

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Executive Summary

The National Beef Production RD&E Strategy is complete and provides information on the issues facing the Australian beef industry that require RD&E to develop industry solutions. The Strategy lists ten Priority Industry Outcomes that address the regional and national needs of the industry and seven Strategic Imperatives that align these with Australian Government RD&E priorities.

Some identified industry issues and proposed deliverables lack the base knowledge from which industry solutions can be developed. These will require an investment approach that is either strategic and long term and/or higher risk balanced by potentially higher reward. MLA is currently scoping appropriate investments of this type. As part of the scoping, a workshop was held in Brisbane on 29th and 30th April 2010 to seek the opinions of key researchers. Invitees to the workshop included experienced scientists or research managers from the member organisations of the Red Meat Co-investment Committee, representatives of other research organisations with an interest in strategic livestock RD&E investments and individuals identified as having important contributions to achieve the workshop objectives.

The workshop developed a draft framework for strategic/basic research to meet the issues and deliverables in the National Beef Production RD&E Strategy and National Sheepmeat RD&E Strategy. The framework includes three themes supported by two underpinning approaches:

Themes

- Risk assessment and management
- Measurement technology and its use (monitoring & management)
- Efficiency of production systems (animal & feedbase)

Underpinning approaches

- Capability management, including, sample storage for the long term, building datasets over decades, analysing complex datasets through better use of IT technology, and innovation communication
- Harvesting innovations from other sectors for intractable problems

Within each theme, researchable issues were identified in three main areas: animal health, animal production and feedbase/environment. The themes and researchable issues were then mapped to the seven Strategic Imperatives in the National Beef Production RD&E Strategy, as shown on the next page.

While none of the themes are considered appropriate as the basis for a CRC in their own right, the themes of risk assessment and management, and measurement technology and its use were considered potential researchable areas within a new CRC.

MLA-CLI Strategic Science Beef & Sheepmeat RD&E Workshop

Research framework and researchable issues mapped against the National Research, Development and Extension Framework for Beef

Research framework		Research program/ project	RD&E Strategies						
			Enhancing food safety, product integrity & biosecurity	Increasing natural resource use efficiency & reducing environmental impacts	Increasing cost efficiency & productivity (including adaptability & risk management)	Enhancing integration & value-adding in supply chains (including cost-efficiency)	Improving beef eating quality	Developing new & existing beef markets	Aligning animal welfare practices with consumer & community expectations
Risk assessment & management		Risk management tools at the whole-of-enterprise & agro-economic level	√						√
		Modelling the risk of climate & production system changes on the distribution & impact of endemic disease	√		√				√
	Measurement technology & its use	Integrated systems for data management & decision making	√		√	√			√
		New technologies for advanced phenotyping & monitoring	√		√				√
		Instant & remote data capture	√	√	√	√			√
		Improved monitoring of CH ₄ & water use efficiency including quantitative linkages between animal data & feed base		√					
		Measurement & monitoring tools to improve pasture utilisation		√	√				√
	Efficiency of production systems	Novel production & delivery of nutrients coupled with automated & cheap determination of animal nutritional status			√				√
		Coordinated genetic & management interventions	√		√				
		Biological understanding of the limits to animal performance		√	√				√
		Individual animal variation			√				
		Expanded range of plant species in the diet		√	√				
		Targeted new or adoptive agronomic solutions (including GM) to increase DM production & provide novel feed sources to fill gaps		√	√				
		GM plants for specific purposes		√	√				
		Biofuels/ enzymes for treatment of low quality feed sources or crop residues		√	√				
		Plant attributes to modify selection & processing of unpalatable plants		√	√				
		Soil health		√	√				

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1 Background

The National Beef Production RD&E Strategy is complete and provides information on the issues facing the Australian beef industry that require RD&E to develop industry solutions. The Strategy lists ten Priority Industry Outcomes that address the regional and national needs of the industry and seven Strategic Imperatives that align these with Australian Government RD&E priorities. It also includes proposed RD&E programs and deliverables for further assessment and consideration for investment.

The Strategies have been developed in consultation with beef producers, industry bodies and interested research organisations. Proposed RD&E programs are currently being evaluated to establish potential industry benefit to inform future investment decisions. The potential for achieving industry deliverables from the proposed RD&E programs is being assessed, and for a proportion it will be possible to proceed relatively quickly by further investment in previous RD&E output.

However, some identified industry issues and proposed deliverables lack the base knowledge from which industry solutions can be developed. These will require an investment approach that is either strategic and long term and/or higher risk balanced by potentially higher reward. As part of scoping appropriate investments of this type, MLA, in partnership with CSIRO Livestock Industries (LI) decided to seek the opinions of key researchers from around Australia. This was achieved through a workshop held in Brisbane on 29-30 April 2010.

2 Project Objectives

The primary objective of the workshop was to identify strategic basic science and strategic applied science investment opportunities based on issues and deliverables identified in the National Beef Production RD&E Strategy. A secondary objective was to identify research opportunities for a new Cooperative Research Centre for the beef industry.

The focus for the workshop was to identify potential science and technology investment areas that are one or more of the following:

- Strategic, basic and/or applied science.
- High risk balanced by potentially higher reward.
- Long term.

The workshop did not focus on any one scientific discipline or technology, but rather all possible approaches to issues were canvassed.

Whilst it was anticipated that the workshop might identify potential co-investment and collaboration opportunities, this was not a primary objective.

3 Methodology

The workshop was held in Brisbane on Thursday 29 and 30 April 2010 at the Emmanuel College within the University of Queensland.

Workshop participants included:

- experienced scientists or research managers from the member organisations of the Red Meat Co-investment Committee
- representatives of other research organisations with an interest in strategic livestock RD&E investments
- individuals identified as having important contributions to achieve the workshop objectives

The list of workshop invitees is included in Appendix 1.

Prior to the workshop participants were sent a package of background information that included:

- a briefing document on the workshop prepared by MLA and CSIRO LI
- the National Beef Production RD&E Strategy
- the National Sheepmeat Production RD&E Strategy
- the Beef RD&E framework
- the Sheepmeat RD&E framework
- a workshop agenda

The briefing document prepared by MLA and CSIRO LI and the workshop agenda are included in Appendix 2.

The workshop was opened with a presentation by Dr Stephan Hajkowicz from CSIRO who described a strategic visioning project undertaken by CSIRO centred on the theme 'Our future world – trends, risks and scenarios'. The project has identified five plausible future megatrends:

1. More from less
2. iWorld
3. Personal touch
4. On the move
5. Divergent demographics

Workshop participants then discussed the potential implications of these future megatrends for the Australian livestock industries.

Following on from this, workshop participants self-selected into three breakout groups with themes of animal health, animal production and feedbase/ environment. Each group was given the task of developing a list of researchable issues, keeping in mind the future megatrends identified by the CSIRO project.

A subsequent breakout session was focussed on trying to align the researchable issues to a potential framework for strategic research.

Several issues were ‘parked’ during the workshop, either because National RD&E strategies are still in development (Biosecurity, Animal Welfare) or because they were outside the scope of the workshop (Productivity Commission Review of Rural Research and Development Corporations).

4 Results and Discussion

A summary of the researchable issues identified by the three breakout groups is shown in Table 1. Further detail is included in the transcripts of the butchers’ paper notes from each group in Appendix 3.

Table 1 Researchable issues identified by the three workshop breakout groups

Animal health	Animal Production	Feedbase/ environment
Models that are accessible to all, scalable to the enterprise level	Labour efficiency	CH ₄ mitigation
Economic impacts	Measuring/ monitoring/ identification	Accurate tools to measure productivity
Modelling the risks of climate change on the distribution of endemic diseases	Production efficiency	Risk management & decision support tools
Health impacts on efficiency & productivity	Meat quality – biological understanding in relation productive efficiency	Revisit alternate feedbase options
Better ways to measure i.e. biomarkers, immune competence phenotype, sentinel strategies, etc.	Growth – constraints to upper limits	Fill feed gaps
Better harvesting of innovation from other sectors – IT technology, adult education/ innovation psychology, new actives, new diagnostics, new vaccines, new delivery mechanisms	Reproduction	Breed for water use
Research in specific areas depending on the National Biosecurity RD&E Strategy	Improved understanding of individual animal variation	Return residue
Drench resistance		Storage feed/silage
Transgenics		Selective grazing behaviours/ economics/ persistence

From these researchable issues a draft framework for strategic/basic research to meet the issues and deliverables in the National Beef Production RD&E Strategy was developed. The framework included four themes:

- Risk assessment and management
- Measurement technology and its use (monitoring & management)
- Efficiency of production systems (animal & feedbase)
- Harvesting innovations from other sectors for intractable problems

Underpinning these four themes is capability management, including:

- Sample storage for the long term
- Building datasets over decades
- Analysing complex datasets – better use of IT technology
- Innovation communication

Subsequent to the workshop it was realized that the fourth theme, harvesting innovations from other sectors for intractable problems, was in reality an underpinning approach, rather than a theme per se.

Alignment of the researchable issues identified during the workshop to the draft framework is shown in Table 2.

Table 3 shows the draft framework and researchable issues aligned to the seven Strategic Imperatives in the National Beef Production RD&E Strategy.

Table 2 Researchable issues mapped to the draft framework for strategic/basic research

Breakout Group Theme	Framework		
	Risk assessment & management (including evaluation frameworks)	Measurement technology & its use (monitoring & management)	Efficiency of production systems
<i>Harvesting innovations from other sectors (Identifying & developing technologies to meet strategic objectives)</i>			
Animal health	Risk management tools at the whole-of-enterprise and agro-economic level	New technologies for advanced phenotyping & monitoring (immune status, disease resistance/susceptibility, disease status)	Coordinated genetic & management interventions
	Modelling the risk of climate & production system changes on the distribution & impact of endemic disease		
Animal Production	Integrated systems for data management & decision making		Biological understanding of the limits to animal performance & how to manage these
		Instant & remote data capture & analysis to assess body energetic, reproductive status, precision grazing, survival & welfare	Individual animal variation (how much, why)
		Novel production & delivery of nutrients coupled with automated & cheap determination of animal nutritional status	
			Expanded range of plant species selected in the diet (plus supplement delivery)
Feed base & environment		Improved monitoring CH ₄ & water use efficiency, including quantitative linkages between animal data & feed base	Targeted new or adoptive agronomic solutions (including GM) to increase DM production & provide novel feed sources to fill gaps
		Measurement & monitoring tools to improve pasture utilisation	GM plants for specific purposes
			Biofuels/ enzymes for treatment of low quality feed sources or crop residues
			Plant attributes to modify selection & processing of unpalatable plants
			Soil health
<i>Capability management (sample storage, building & maintaining data bases, innovation communication)</i>			

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Table 3 Research framework and researchable issues mapped against the National Research, Development and Extension Framework for Beef

Research framework		Research program/ project	RD&E Strategies						
			Enhancing food safety, product integrity & biosecurity	Increasing natural resource use efficiency & reducing environmental impacts	Increasing cost efficiency & productivity (including adaptability & risk management)	Enhancing integration & value-adding in supply chains (including cost-efficiency)	Improving beef eating quality	Developing new & existing beef markets	Aligning animal welfare practices with consumer & community expectations
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		Modelling the risk of climate & production system changes on the distribution & impact of endemic disease	√		√				√
	Measurement technology & its use	Integrated systems for data management & decision making	√		√	√			√
		New technologies for advanced phenotyping & monitoring	√		√				√
	Efficiency of production systems	Instant & remote data capture	√	√	√	√			√
		Improved monitoring of CH ₄ & water use efficiency including quantitative linkages between animal data & feed base		√					
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	Plant attributes to modify selection & processing of unpalatable plants		√	√					
	Soil health		√	√					

5 Success in Achieving Objectives

The workshop was successful at achieving the objective of identifying strategic basic science and strategic applied science investment opportunities based on the issues and deliverables identified in the National Beef Production RD&E Strategy.

It was also successful at identifying potential new research themes for a CRC for the beef industry, in particular risk management/ assessment, including measurement technology and its use.

6 Appendices

6.1 Appendix 1 List of workshop invitees

Name	Organisation/affiliation
Paul Greenwood	NSW Department of Industry & Investment
Rodd Dyer	MLA
Heather Burrows	Beef CRC
Wayne Pitchford	University of Adelaide
Greg Harper	CSIRO
Greg Sawyer	Department of Agriculture & Food WA
Beverly Henry	MLA
Peter Johnstone	Queensland Department of Primary Industries & Fisheries
Felice Driver	MLA
Gene Wijffels	CSIRO
Ben Cocks	DPI Victoria
Ian Carmichael	South Australian Research & Development Institute
Neil MacDonald	Department of Resources (Primary Industries) Northern Territory
Bill McKeirnan	NSW Department of Industry & Investment
Dennis Poppi	University of Queensland
Stephan Hajkowicz (morning on Day 1 only)	CSIRO
Lee Fitzpatrick	James Cook University
Terry Longhurst	MLA
John Gibson (Day 2 only)	University of New England
Joan Lloyd	MLA Consultant

6.2 Appendix 2 Strategic Science workshop brief and agenda

'Strategic Science Beef and Sheepmeat RD&E Workshop'
29 - 30 April 2010
Queensland Bioscience Precinct
306 Carmody Road
St Lucia, Qld 4067

Background

The National Beef Production RD&E Strategy and the National Sheepmeat Production RD&E Strategy are complete and provide information on issues facing the livestock industries that require RD&E to develop industry solutions. The Strategies each list ten Priority Industry Outcomes which address the regional and national needs of the industry, seven Strategic Imperatives that align these with Australian Government RD&E priorities, and include proposed RD&E programs and deliverables for further assessment and consideration for investment.

The Strategies have been developed in consultation with beef producers, sheepmeat producers, industry bodies and interested research organisations. Proposed RD&E programs are currently being evaluated to establish potential industry benefit to inform future investment decisions. The potential for achieving industry deliverables from the proposed RD&E programs is being assessed, and for a proportion it will be possible to proceed relatively quickly by further investment in previous RD&E output.

However some identified industry issues and proposed deliverables lack the base knowledge from which industry solutions can be developed. These will require an investment approach that is either strategic and long term and/or higher risk balanced by potentially higher reward. These aspects of the Strategies will be the target for this workshop.

Objective

The objective of the workshop is to identify strategic basic science and strategic applied science investment opportunities based on issues and deliverables identified in the National Beef Production RD&E Strategy and the National Sheepmeat Production RD&E Strategy.

The focus for the workshop will be to identify potential science and technology investment areas that are one or more of:

- strategic basic and/or applied science categories
- are high risk balanced by potentially higher reward
- are long term

The workshop will not focus on any one scientific discipline or technology, but rather all possible approaches to issues will be canvassed.

Whilst it is anticipated that the workshop may identify potential co-investment and collaboration opportunities, this is not the primary objective and detailed discussion on this area will be deferred to post-workshop meetings.

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The output will be a list of possible science and technology research priorities for further evaluation in terms of their potential to provide industry deliverables and economic benefit as identified in the Strategy. Included in this post-workshop evaluation will be identification and development of co-investment and collaborative opportunities.

Attendance

Invited to the workshop will be:

- Member organisations within the Red Meat Co-investment Committee to send an experienced scientist or research manager
- Representatives of other research organisations with an interest in strategic livestock RD&E investments
- Individuals identified as having important contributions to achieve the workshop objectives

Funding

MLA and CSIRO Livestock Industries will support the workshop organisation costs

- Each of the Red-Meat Co-investment Committee members and other research organisations fund attendance of their own representatives

Workshop details

The workshop will be hosted by CSIRO Livestock Industries at Queensland Bioscience Precinct, 306 Carmody Road, St Lucia, Qld 4067 on 29 and 30 April 2010.

Output

The workshop proceedings will be report on possible Strategic Science investments arising from the Strategies for consideration by participating organizations. The report will include:

- list of potential new 'Beef Cattle CRC' topics for further evaluation prior to an as yet undefined application process
- list of potential project and program topics for further evaluation for investment by individual members of the Red Meat Co-investment Committee
- identification (without implied commitment) of groups which might have the capability to deliver potential projects and programs in the near future
- list of issues and industry deliverables for which potential science and technology RD&E to develop solutions have not been identified

Terry Longhurst
Manager Strategic Science, MLA
March 2010

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MLA-CLI Strategic Science Beef & Sheepmeat RD&E Workshop

MLA - CLI Strategic Science
Beef R, D&E Workshop
Thursday 29th and Friday 30th April, 2010
Emmanuel College (within The University of Queensland) Sir William MacGregor Drive, St
Lucia, Brisbane

Agenda

29th April

1. 10:00 Arrival (coffee/tea available)
2. 10:30 am Co-convenors introductory comments and workshop objectives (**Longhurst, Harper**)
3. 10:50 Goals and process for the workshop (**Longhurst, Harper**)
4. 11:00 Strategic Visioning - The Global Future (**Hajkowicz**)
5. 12:00 Workshop: Global influences on livestock production (split into 4 groups)
6. 12:30 Report Back (Group spokespeople) (**Chair - Hajkowicz**)
7. 1:00 Lunch
8. 1:45 Workshop discussions around future opportunities and challenges (**ALL**)
Start with Australian livestock production level, and split into interest groups animal health, environment, animal productivity, feed-base
9. 3:00 Report back (**Group spokespeople: Chair - Longhurst**)
10. 3:30 Afternoon tea
11. 3:50 Livestock Genomics Initiative update (**Woolaston**)
12. 4:10 The Beef and Sheepmeat National R, D & E frameworks (**Ball**)
 - a. Processes leading up to the plan
 - b. Strategic imperatives
 - c. Implementation processes
 - d. Biosecurity and Animal Welfare RD&E Strategies
13. 4:30 First cut at linking ideas into programs, fit with industry imperatives, and discussion of gaps (**Harper**)
14. 5:20 Wrap up for Day 1 and dinner plans
15. 5:30 Finish

30th April

16. 9:00 Opening remarks to Day 2 (**Longhurst, Harper**)
17. 9:15 Presentations on particularly promising new areas and refinement of groupings to related areas identified in item 13 (**Chair - Longhurst**)
 - a. 15 minute presentation from key researchers
18. 10:15 Workshop discussions around promising new areas(**Chair - Harper**)
 - a. scoping broad area of research and output for industry use
 - b. comment on relation to the Strategic imperatives
 - c. statement of the research output and potential industry benefit
19. 1:00 Lunch
20. 1:30 Report back (**Group spokespeople: Chair - Harper**)
21. 2:30 What's missing?
22. 2:45 Summary and subsequent actions (**Longhurst, Harper, Lloyd**)
23. 3:00 Workshop close

6.3 Appendix 3 Transcript of butchers' paper from break-out sessions

Day 1 - 29 April 2010

Breakout session 1: Discuss reactions to presentation & global influence on livestock production

Group 1

Food shortage – is it real or distribution problem

Water

Incidental rainfall

Conflict between food shortage & personalised service

Stabilizing supply chain – water resource etc.

How can Australia become a food bowl for Asia?

Demand for protein – different types – matching demand & supply – what is Australia's niche – what are the environmental constraints?

Fish – vegetative source of feed

Phosphorous – decline

Use poor quality feed better/ improved feed base

Microchipping animals – possibilities

Manipulating growth/ reproduction remotely

↑ Reproduction through twinning (cattle) – benefits/risks – more from less

Group 2

More from less

- Resilience (innovation)
 - Animal
 - Enterprise (Productivity)
 - Industry
 - Nation
 - Community
- Constant change & challenge
- Independence of action
 - Justification
 - Legislation/ control/ regulation
- Beyond competition for resources
- Internal responses with Australia Land
- Alternative production systems (Green buildings)
 - Sustainability of animal production

- Labour
 - Intellect
 - Skills
 - Motivations
 - Alignment
- Land (inputs)/ animals/ labour
 - Alternative lifestyles under-resourced
- Valuation of food

Personal touch

- Diversity
- Differentiation products
- Malthusian challenge
- From China → client state
- Corporate ownership

On the move

- Devalues agriculture
- Ag to mining
- Why source labour within Australia?
- Global – labour mobility
- Change in skill sets
- Global markets for increased number of services/products
- Decentralisation policies
- Obviously linked to food security/food safety
- Threats
 - Energetic efficiency
 - Animal welfare

iWorld

- Information, knowledge, measurements
- Unknown unknowns
- More data → more wisdom?
- Work flexibility
- Remote access
- Access to the iworld
- Discomfort with technologies
- Robustness → applicable

- Monitoring
- Scanning the IT community
- Leapfrogging options
- Layer option
- Labour again
- Platform

Group 3

More from less

- Livestock pushed into less productive land
- Higher value products that compete on quality
- Production efficiency – large and small holdings
- Measurement technology

Personal touch

- Information processing – improved measurement technology, applications for new technologies

Movements of people

- Linking business risk/investment tools with production risk/management tools

Breakout session 2: What are the researchable issues?

Animal Health

Risk assessment

- Models scalable to enterprise (farm level)
- Economic impacts
- Social & public health impacts
- Market models; weather modelling; downscaling to enterprise
- Models need to be accessible to all (from instantaneous to strategic). Policy impacts
- Long term to adaptation response
 - Genetic improvement response
 - Land use
- Models building up from biomarkers
- Epidemiological models
- Looking for second tier diseases within which MLA can make a difference

Efficiency of production systems

- Health impacts on efficiency & productivity
- Adoption science to underpin efficiency gains

Measurement technology

- Biomarkers as early indicators of parasite challenge
- Environmental monitoring →→ parasite populations
- Immune competence phenotype
 - Resistance
 - Sensitivity
 - Tactical aspects
- Enough phenotypes, enough new phenotypes
- Sentinel strategies including wireless
- Aerial monitoring

Harvesting innovation from other sectors for intractable problems

- SMS alerts and Apps. ←←Pod casts
- Climate modelling and down scaling, adapting
- Aspects of adult education, innovation psychology
- New actives
 - Intractables
 - Anthelmintic experience
- New diagnostics
 - Drench resistance
- New approaches to vaccine development
 - Molecular parasitology
- Outputs from CRCs → captured in non-target areas
- New delivery modalities
 - Nanopatches

Specific areas (Subject to the details for the National Biosecurity RD&E strategy)

- BEF (vector borne diseases in general)
- Bluetongue
- Drench resistance
- Biomarkers
 - Parasite load (like Dipstick but for cattle)
 - Tick borne disease susceptibility
 - Tick resistance
- Barbers Pole
 - Genetic progress? Too long for economics

Modelling the risks of climate change on the distribution of endemic diseases

- Endemic disease awareness covers the major zoonotics
 - Q fever, E colis, BSE, Hydatids
 - Cost sharing responses including States
- Non-tariff trade barriers like bluetongue titres
- Ticks
- Tick-borne disease
- } Remain important
- Transgenics (knockouts)
 - Community engagement
 - Link to transgenesis in other species
 - Needs to be a compelling case
 - Screen the options on an on-going basis

Animal Production

Strategic R&D Opportunities & challenges

- North/South
- Cattle/sheep
- Extensive/intensive
- Production efficiency

- More from less → Factor productivity/efficiency
kg/ha
kg/hd
kg/FTE labour
kg/energy/ water/CO₂/soil loss (environmental metrics)
- Info management/ utilisation/ technology
 - Production quality
 - Nutritional ability – market diversity (opportunities)
 - Food safety
 - Environmental & welfare integrity
 - ethical
 - Profitability, adaptable, adoptable, risk/resilient

Labour efficiency

hd/FTE → risk, social sustainability, drought impacts

- Husbandry → virtual PD, polled bulls, immunocastration (permanent), weaners, heifers, breeders
- Mustering → Max. ?, virtual fencing, behaviour/ ?/ increase efficiency of muster, geotag
- L&M
- Health

- Feeding/supplementary → alternatives to urea for water medication, nutritional delivery to animals – automated N & P
- Grazing
- Water management
- Measuring/ monitoring/ identification → lifetime ID, smart tags, chips; visual image recognition – body condition score, LW, structure; remote drafting/ weighing – OK for controlled water, need attractants for cattle other than water where water uncontrolled (behaviour); auto application/ vaccination; pedigree recording ↑ accuracy of genetic selection
- Shearing – fleece shedding on ‘command’

“SMART FARM LABOUR SYSTEMS”

Pasture base/ Feed conversion efficiency

(kgxhd)- labour→\$

↑ pasture utilisation of low quality forages

Production efficiency

- Reproductive efficiency → understanding genetic variation in female energy balance requirements, body condition; understanding/ overcoming lactation anaestrous; yearly mating; perinatal deaths → quantify, measure, monitor; ↑ calf output
- Growth (LWG)
- Mortality

Measure of individual animals

- Feed intake
- Energy balance
- Metabolic/ endocrine phenotyping
- *Bos indicus* & *Bos taurus* – genetic/ characteristic

} Understanding G & E drivers
G→PxE

Environment and feedbase

Researchable issues:

- CH₄ mitigation
 - systems approach, holistic takes into account interaction between plant & animal & C balance; understand system before manipulate it
 - role for remote sensing technologies
 - ruminant manipulation, feed type, supplements, feed efficiency conversion, feedlot role, microbes, optimise animal growth & feed conversion efficiency
 - other speculative strategies
 - better measurement techniques

- Accurate tools to measure productivity – MEASURE, MONITOR, MANAGEMENT DECISIONS
 - water harvesting & incidental rainfall (biomass→kg beef/heet/mm water)
 - seasonal variation & tools to manage risk mitigation for producers & landscape→resilience
 - strategic methods to better harvest production (plant biomass) & manage risk (& animal health/ welfare/ environmental issues)
 - optimise feedbase & harvesting (remote sensing) MORE FROM LESS
- Risk management & decision support tools
 - better seasonal forecasting
 - interpretative tools→decision support for risk management
- Revisit alternate feedbase options
 - increase DM production – also quality (↑ impact productivity)
 - ↓ requirement for supplements ↑quality
 - variable climate production zones; WUE, temperature, C₄/C₃ plants, lignan, P abiotic stress
 - germplasm availability, target niches, pasture breeding companies, elite traits into right backgrounds, GMO cultivars
- Fill feed gaps (think outside the square, biofuels/enzymes)
 - mix of solutions, use of alternate feed sources to fill gaps (grain, silage, other crops)
 - silage from weed species to improve palatability
 - treatment low quality feed to improve digestibility→tap into new enzyme technology
 - manage conversion of cellulose/ lignan→sugars (~50%), pre-ingestion by animal
 - manage process on-farm/ site
- Breed for water use
 - water harvesting plants/ roots
- Return residues
 - Microbial environment
- Storage feed/ silage
 - \$/ unit energy stored/ time
 - transport
- Selective grazing behaviours/ economics/ persistence
- Persistence of new high value cultivars (~20 year scale?)
 - Moving transporting protein/ energy
 - Return on investment (perennials!)
 - Overemphasis

Day 2

Breakout session: Linking research ideas with programs

Animal Health

New technologies for advanced phenotyping & monitoring
Risk management tools at the whole-of-enterprise and agro-economic levels
Coordinated genetic and management interventions
Modelling the risks of climate and production system changes on the distribution and impact of endemic disease

Animal Production

Left over issues from Day 1

1. Meat quality
 - Biological understanding in relation to productive efficiency especially with respect to tenderness & flavour
 - Underpins markets
2. Growth
 - Constraints to upper limits to growth
 - Management
 - Feed base
 - Animal biology } & interactions
3. Reproduction
 - As per Day 1
 - Knowledge of individual variation (across all aspects of productive efficiency)

Strategic Objectives

- “Instant” & “remote” data capture & analysis to assess:
 - Body energetic
 - Reproductive status
 - Precision grazing
 - Survival
 - Welfare (indices??)
- Integrated systems for data management & decision making
- Biological understanding of limits to animal performance & how to manage
 - Growth
 - Reproduction, including artificial breeding
 - Behaviour } Feed efficiency / intake

- Survival
- Welfare
- Individual animal variation
 - How much
 - Why
 - G→PxE
- Expanded range of plant species selected in diet (+ supplement delivery) N & P (Mixed species – cattle, sheep, goat)
- Identification/ development of technologies to support strategic objectives
- Novel production & delivery of nutrients e.g. algae in water coupled with automated & cheap determination of animal nutritional status

Environment and feedbase

1. Environment – CH₄
 2. Environment – water use efficiency & deep rootedness
- Large program current
 - Monitor technology – remote & large scale, what want to measure
 - Manipulate (some in current program)
 - What measure (remote & crush side)
 - Intake & grazing behaviours (selection site, distribution, landscape)
 - CH₄
 - Health
 - Body composition, body condition score, weighing
 - Pasture (see point 3)
 - Link above back to feed base to manage system
 - (use of models in pasture & animals to use above info: further model development)
 - Current limitations
 - Linking paddock data to animal data
 - Measuring intake in paddock
 - Quantitative knowledge of known principles in Northern Australia
 - Projects
 - Monitor technology
 - Quantitative linkages/ knowledge animal data with feed base
 - Intervention and testing using above

} Satellite
Tags
iGIZMO

3. Utilization pasture & tools to measure & monitor
 - Huge impact on profit. & stocking rate & sustainability
 - See links to 1. Environment & Monitor Technology
 - Pasture DM & growth – measure
 - Risk assessment tools – using above monitor parameters what can we learn from copping systems & use of monitor tools & IT
 - Application of evolutionary computation (see Bill): need improved robust monitoring systems
 - Moving monitor devices forward
 - New electronic wireless/satellite technology
 - Range of physiological parameters (e.g. pH, temperature, CH₄, etc.)
 - Cost of larger scale monitor on farm not just research
 - New imaging analysis
 - Mapping soils, plants, animal distribution
 - Data management: simple outputs
4. DM production & novel feed sources to fill feed gaps
 - Supply a local protein bank: look for novel food sources e.g. algae
 - Link to point 2 water
 - Pasture species:
 - DM production, persistence
 - Go back to stored germplasm
 - New roles: changing climate, drought, etc.
 - Role of crops e.g. new cereal cultivars
 - Agronomic direction
 - Use of pasture genomics to identify attributes in introduced & native plants
 - Current GM too focussed on a few temperate species
 - Quality & quantity are both strategies
 - Animal adaptation (rumen & tissue maintenance) too low CP diets: link to genomics and alternative to filling a feed gap
 - What is the limitation at present? – in the past broad based, large scale
 - Storage of national germplasm for future work
 - Target requirements for system
 - Cropping system: targeted crops for distinct period of annual cycle (as example)
 - In south climate changed, more frequent drought, changed conditions, current system starting to fail

- Also change in demand for agronomic practices (N fertilizer, soil condition, environmental issues)
 - Skill base, capacity being lost
 - Screen current collections for new conditions in South & North
 - Targeted, new or adoptive agronomic solutions (includes GM approach)
 - Screen & review
- } Approach/
Project
5. GM plants for specific purposes
 6. Biofuel enzymes for treatment of LQ feed sources/ crop residues
 - Review & watch USA
 7. Plant attributes to modify selection & processing of unpalatable plants
 - Covered in 3
 8. Soil health
 - P & pasture growth – increasing the availability of P
 - Soil biota & disease
 - What options/ management practice might be used to reduce P fertilizer requirement
 - Soil C – measure/ monitor; manipulation options

6.4 Appendix 4 Notes collected during the workshop

Workshop notes

Day 1 29 April 2010

Session 2 – Introductory comments and workshop objectives

Terry Longhurst & Greg Harper

Welcomes

Background from Greg – from R, D & E framework, good collaboration for applied research, but lacking forum for new research ideas, aim is long term planning, strategic science, what we don't know. Greg is representing CSIRO not MLA.

Terry – history – 18 months in planning as R D & E framework discussions progressed. Aim is to identify strategic research issues, not about forcing strategic research into frameworks. Mentioned request from CCA and MLA Board re new CRC applications for beef cattle, including a list of potential areas. Personal view about what should be in strategic science – 1) what is the industry issue, 2) what can be done about it 3) what is the value of the investment? Number 3 is off the agenda for the next 2 days. The workshop is about possibilities.

Outputs he would like – good discussion, identification of possibilities, report from workshop – participants, CCA, MLA. Grouping of ideas into programs, what research would fit, what would be the benefits?

MLA-CLI Strategic Science Beef & Sheepmeat RD&E Workshop

Workshop participants

Name	Organisation/affiliation
Paul Greenwood	NSW Department of Industry & Investment
Rodd Dyer	MLA
Heather Burrows	Beef CRC
Wayne Pitchford	University of Adelaide
Greg Harper	CSIRO
Greg Sawyer	Department of Agriculture & Food WA
Beverly Henry	MLA
Peter Johnstone	Queensland Department of Primary Industries & Fisheries
Felice Driver	MLA
Gene Wijffels	CSIRO
Ben Cocks	DPI Victoria
Ian Carmichael	South Australian Research & Development Institute
Neil MacDonald	Department of Resources (Primary Industries) Northern Territory
Bill McKeirnan	NSW Department of Industry & Investment
Dennis Poppi	University of Queensland
Stephan Hajkowicz (morning on Day 1 only)	CSIRO
Lee Fitzpatrick	James Cook University
Terry Longhurst	MLA
John Gibson (Day 2 only)	University of New England

Terry commented that although there is wide representation, but not all players are present. Not exclusive. Additional scoping will follow.

Session 4 – Strategic Visioning – Presentation by Stephan Hajkowicz - Our future world, trends, risks and scenarios

Internal CSIRO site set up last July, scientists entered trends, others could enter and edit, 100 trends identified.

August – downloaded info, analysis workshop, resulted in 19 mega trends

Further work reduced to 5 megatrends

Scenarios written

To CSIRO Board – wanted risks/mega shocks considered as well (natural, economic etc.)

Aim is to identify where CSIRO should invest in the future.

Futures considered – plausible (not possible)

Five megatrends – More from less, iWorld, Personal touch, On the move, Divergent demographics
 More from less – reduced ore body quality, drive for efficiency (water, resources, etc.), regulation to ensure availability, caps then new markets emerge, loss of agricultural land, loss of coral reefs affecting tourism, increase in energy consumption & change in sources of energy, energy consumption of economic output reducing (producing more from less), increased risk of armed conflict – nations which share a river basin increased risk of military conflict.

Personal touch – personalisation of products & services, services sector of Australian economy growing fastest, information overload 30% typical workday is lost to processing information, increase in national level of debt in Australia.

Divergent demographics – change in way people live, ageing population, hungry (malnutrition) vs. obesity, more demanding (goods & services), chronic illness vs. infectious disease, Jet travel to Australia from Asia one of largest growth routes.

On the move – increased movement globally, moving house more frequently, mobility in labour movement, urbanisation, increase in Indian middle class, skilled migration needs, geopolitical issues (USA vs. China), increase in food production needed, decline in food prices since 1973 (technology improvements and supply meeting need) but price spikes important for malnourished people, volatility improving, more food may not stop people starving – governance issues, will Australia become the food bowl of Asia – resurgence in Australian agriculture?

iWorld – computing, gadgets, sensory gadgets, everything in natural world getting digital replacement, counter gadgets as well.

Mega shocks – asset price collapse, hard landing for Chinese economy, pandemic, oil/gas price spikes, extreme weather events, nanotechnology risks, terrorism, biodiversity loss, conflicts (nuclear explosion).

Scenarios – fields vs. fences

Sessions 5 & 6 – Global influences on livestock production

Workshop participants were divided into three groups to consider Stephan's presentation and what it might mean for livestock production. Stephan picked what he thought were several key themes from this:

- Phosphorous decline
- Fish – vegetative source of feed
- Food bowl of Asia – do we understand the opportunity – need to be nimble and quick.
- Session 8 & 9 Future opportunities and challenges
- Three groups – animal health, environment and feedbase, productivity

The next break out session involved workshop participants breaking into three theme groups: 1) animal health, 2) animal production, 3) feedbase and environment. During this session the aim was to develop a list of researchable issues for each theme, towards the final aim of developing programs.

Following are summarised overviews reported by each group. The full transcripts of the butcher's paper notes prepared by each group are included separately.

Animal health

Welfare not discussed, instead is a parked issue for the purposes of the workshop.

Monitoring & biosecurity – Lot to be done. Not clear how far Biosecurity CRC got. AHA doing a lot. Parked issue for the purposes of the workshop.

Perinatal death, lamb mortality, parasites, epidemiological studies/tools, genetic/genomics

- Biomarkers – identify resistant and susceptible individuals, target treatments – disease assessment tools.
- Long term view – need to maintain datasets, samples
- Immune competence phenotype
- Animal health vs. fitness vs. productivity

Vaccine and new drug development – new antigens, accelerating development

Reproductive health – anoestrus of the lactating Brahman cow

Transgenics

Genetics and genomics – tools to improve health rather than an end in themselves.

Environment and Feedbase

Methane mitigation

More accurate tools to measure productivity

Risk management tools

Production

Production efficiency – more from less (area, head, labour, energy, water, water quality, soil loss
Information management

Production quality

Profitable, adaptable, adoptable, risk/resilience

Two main areas for research – 1) Production efficiency – reproduction – body condition – individual animal measurement – genetics, physiology & environment. Will this become worse as extensive industries pushed into less favourable environments? 2) Labour efficiency

Session 13 – Linking ideas into programs, fit with industry and discussion of gaps

While workshop participants listened to updates on the Livestock Genomics Initiative (delivered by Rob Wollastone) and the Beef and Sheepmeat National R, D & E frameworks, Terry Longhurst, Greg Harper and Joan Lloyd developed a draft framework for the identified research issues:

- Risk assessment and management
 - Evaluation frameworks
- Measurement technology and its use (monitoring & management)
 - Verification/certification
 - Measuring flavour
- Efficiency of production systems (animal & feedbase)
 - TF Productivity
- Harvesting innovations from other sectors for intractable problems
 - Step changes
 - Better use of IT technology

Underpinning these four themes is capability management, including:

- Sample storage for the long term
- Building datasets over decades
- Analysing complex datasets – better use of IT technology
- Innovation communication

Session 14 – Wrap up of Day 1

Day 2 30 April 2010

The second morning of the workshop largely involved the three theme groups from the first day discussing working towards linking identified research issues to the draft framework.

A summary of the reports from groups follows

Animal health

- 3 catch phrase 1) New technologies for advanced phenotyping & monitoring – immune status, disease resistance/susceptibility, disease status, source on IT industry, interface with Biosecurity planning by other groups. 2) risk management tools at the whole enterprise & agro-economic level, single usable delivery platform, new risk assessment tools packaged behind. 3) Coordinated genetic and management interventions – MLA can make contribution recognising all other activity in this area, look at what is available and make rational decisions about where to invest, also include transgenics.
- External scanning activity is important for all 3 areas.

- Modelling the risk of climate and production system changes on the distribution and importance of endemic disease.
- Plant toxins
- Need for the right economic frameworks to rank disease.
- Large predator pests – where do these fit
- Scanning promising new technologies – who does this
- Adoption science – social science research

Terry then asked would risk management/assessment be a good topic of a CRC.

John Gibson responded that he thought this would make a good theme within a CRC, but too limited for a whole CRC. Maybe a CRC on precision animal management?

Productivity

- Left over issues from yesterday - Meat quality, Growth, Reproduction
- Strategic objectives
 - Instant remote data capture and analysis to assess body energetic, reproductive status, precision grazing, survival, welfare (indices)
 - Integrated systems for data management and decision making – currently information goes to manager in a format that is too complex, not integrated, etc.
 - Biological understanding of the limits and G x E interactions to animal performance under commercial production systems – growth, reproduction including artificial breeding, survival, behaviour, welfare, feed intake/efficiency. Discussion - Is this in favourable environments or Australian environments? Is biological limit relevant to Australia? Economic constraints? Reduced size of the dam while retaining size of progeny (sexual dimorphism). One of main limiting factors in efficiency is maintaining the dam. Environment/management can be used to do this now – what else do we need to know? Can you select for fat in the female and muscle in the male?
 - Individual animal variation – how much, why. Once know ‘why’ can develop strategies to overcome this. Use in future and current generations. Overlap with Livestock Genomics Initiative. Links to phenotyping as raised by animal health group.
 - Expanded range of plant species selected in diet (plus supplement delivery) (mixed species) this may be more applied than strategic research.
 - Identification/development of technologies to support strategic objectives.
 - Novel production and delivery of nutrients e.g. algae in water, coupled with automated and cheap determination of animal nutritional status, replacing urea in the north to allow water supplementation

1. Environment & feedbase

- Environment – methane – large program in operation already, looking for new things, monitoring technology, manipulation of system, monitoring is the key, use of model what are the current limitations work to a certain extent maybe platforms are out of date Project areas – 1) monitoring technology (data management very important) 2) quantitative linkages between animal data and feedbase 3) intervention & testing

- Environment - water use efficiency & tapping water reserves with other sorts of plants, measuring and monitoring so can use more of what is grown, risk assessment tools, application of evolution computation/algorithm.
- Utilization of pasture and tools to measure and monitor
- Dry matter production and novel feed sources to fill feed gaps – re-visit with different purpose – specialized specific for particular uses, need imagination to fill feed gaps (can't afford protein supplementation in the north), animal adaption to fit within current feedbase.
- GM plants for specific purposes – what are the limitations at present?
- Biofuels – watching brief and review
- Plant attributes to modify selection
 - Soil health – P and pasture growth, soil biota & disease, soil carbon

Climate change/drought leading to loss of perennial plants – creating problems, not an issue in the past but an emerging issue now.

Learn from cropping guys – maybe reliance on perennial crops not best, move to extreme environments adapting new plants to this.

Heather – threats from groups wanting to maintain native species. Dennis – in any program there are strengths and weaknesses, assess what you are doing for biology and constraints (i.e. weed status).

Grains/supplements missing

John Gibson – think beyond livestock management to whole enterprise management – carbon sequestration, biofuels. Livestock vs. cropping re land management. Link between animal, feedbase and land management. Have to be able to measure accurately before you can manage better or more holistically.

A short discussion was then held on what the workshop might have missed.

- Weeds (did cover alternative use of weeds)
- Feral animals
- Strategic science funding model – linking strategic research across organisations
- Feedback systems to producers re product. (Terry – fits within monitoring and data)
- People – producers, researchers, next generation, engagement
- Meat as a functional food, nutraceutical value, human nutritional value of red meat.
- Researching future possibilities related to enterprise change, future issues and gaps. Used to inform industry moving forward

Several issues were also raised during the workshop but parked because of lack of information or because not appropriate for discussion

- Biosecurity
- Animal welfare
- Productivity Commission review of RDCs

Heather Burrows also raised the need to identify overlapping areas between the Livestock Genomics Initiative and the workshop outcomes.

MLA-CLI Strategic Science Beef & Sheepmeat RD&E Workshop

Just before closing the workshop Terry asked participants to provide comments on the workshop and whether another workshop should be held and if so, when:

Dennis Poppi said he enjoyed future trends presentation. Doesn't attend many workshops so found it stimulating. It can be hard to get out of day-to-day framework.

Heather Burrows thought some ideas and thinking limited by diversity, needed leading scientists in various areas – animal health, social sciences

Peter Johnstone said he found the workshop valuable; research environment is changing in relation to who is available to provide research etc.

Gene Wijffels said she was interested in another workshop if aimed at moving forward

Heather Burrows suggested a small group to review progress and suggest new areas of focus

Alex Ball said it would be valuable to do again, but time frame and who should participate depends on progress with R, D & E strategies

John Gibson supported re-grouping in 12 months because of the likely changes over next year (Productivity Commission review, CRC changes etc.)