REPORT

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An evaluation of MLA beef on-farm programs

Prepared for:

Meat & Livestock Australia

Centre for International Economics
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Glossary

ABARE	Australian Bureau of Agriculture and Resource Economics
AMLC	Australian Meat and Livestock Corporation
CIE	Centre for International Economics
CRC	Co-operative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DPI	Department of Primary Industries
EBV	Estimated Breeding Values
GVP	Gross value of production
IF	Integrated Framework
LPI	Livestock Product Innovation
MLA	Meat & Livestock Australia
MRC	Meat Research Corporation
TFP	Total factor productivity
RD&E	Research, development and extension

Summary

- This evaluation is concerned with on-farm, or production, research and extension in the beef industry between 2000-01 and 2007-08.
- Investments made by MLA and the state DPIs, are detailed, along with the key activities across three broad clusters or programs focus areas:
  - northern beef, southern beef and feedlots
  - total MLA expenditure amounted to nearly $75 million over this period.
- The scope of MLA investment across these programs and projects is substantial focusing on a number of areas, including:
  - genetics and reproduction
  - nutrition and management
  - adoption and animal welfare.
- Evaluation of such a wide range of projects and programs would ideally be built up by looking at individual projects or project clusters to add to a total outcome for each of the three programs. This faces a number of constraints including:
  - the vast number of projects and project clusters
  - accounting for inter-dependencies between projects and their contributors
  - recognition that projects included benefits to other commodities
  - the information requirement to support the analysis.
- The approach taken in both the northern and southern beef evaluations is a so-called 'top-down' approach, where observed total factor productivity for each of these regions is compared to an overall outcome for productivity in a 'without RD&E' scenario.
- In each case, assumptions are made concerning the level of productivity gain that would have been achieved without investment in RD&E by MLA and others.
- The approach taken for the feedlot program was a series of case studies from a sample of projects or project clusters. The benefits from case studies were primarily productivity savings from lower mortality and compliance costs.
  - In addition, a scenario was developed to reflect the benefits from better issues management by the industry. This was made under the assumption that the feedlot accreditation plan facilitated the expansion of feedlot capacity.
  - Without the program, capacity would have remained at 2005 levels.

- A requirement of this approach is the attribution of benefits between the key contributors — MLA and primarily the DPIs. Attribution not only recognises inputs of funding but also reflects leverage — where funding by MLA increased expenditure by other contributors.
  - MLA contributed 15 per cent to outcomes of the Northern and Southern Beef programs, and 100 per cent to the Feedlots program.
- Table 1 summarises the results for this evaluation. Across all contributors, the benefit-cost ratios were found to be positive and significant with an average of 2.5 to 1 across all programs during the evaluation period.
  - The payoff for the Southern program (3.1 to 1) was higher than for the Northern program (1.9 to 1) because of the underlying assumptions made about the relative contribution of MLA and others to overall TFP outcomes observed.

1 **Results summary — benefits calculated over the period 2001 to 2015[a]**

	Attribution	*Total benefits*	*Total costs*	*Benefit–cost ratio*	*IRR*
	%	$m	$m		%
Northern beef					
MLA on-farm	15	114	46	2.5	25
DPI and others on-farm	85	647	365	1.8	27
Total MLA/DPI	100	762	411	1.9	27
Southern beef					
MLA on-farm	15	193	44	4.4	44
DPI and others on-farm	85	1 094	370	3.0	43
Total MLA/DPI	100	1287	414	3.1	43
Feedlots[b]					
MLA on-farm	100	67	8	8.2	62
DPI on-farm	0	0	0	0.0	0
Total	100	67	8	8.2	62
Total on-farm (excluding feedlots)[c]					
MLA	15	307	90	3.4	38
DPI and others on-farm	85	1 742	735	2.4	36
Total	100	2 049	825	2.5	36

[a] Net present values calculated over 2001 to 2015 with a discount rate of 5 per cent, 2007-08 dollar equivalents. [b] Program benefits include both increased productivity and issues management. [c] Aggregate benefit–cost ratio excludes expenditure by other industry stakeholders.

Source: Agtrans (2008a), Agtrans (2008b), Agtrans (2008c), Integrated Framework and CIE calculations.

- Overall, the benefit-cost ratio for MLA on-farm beef programs ranges between 2.5 to 1 for the Northern beef program and 4.4 to 1 for the Southern beef program.
  - The outcome of the Southern program reflects the leverage that MLA has achieved from co-funding particularly from the DPIs and the Beef CRC.
- Case studies of selected feedlot projects revealed an average payoff of 3 to 1. Including the potential benefits from better issues management, the total payoff increases to 8.2 to 1.

Introduction

In 2005, the Centre for International Economics (TheCIE) was engaged to develop an evaluation framework for Meat & Livestock Australia (MLA). The framework is based on the Department of Finance and Administration framework for accountability to government. It is designed as a rigorous framework that maps program inputs to outputs, outcomes and impacts. The framework has the advantage that it is practical, consistent across programs, covers ex-post and ex-ante evaluations and incorporates triple bottom line assessments.

Using the evaluation framework, MLA is currently engaged in a wide-ranging evaluation program. A number of evaluations have already been completed; this report presents an evaluation of MLA investment in beef on-farm activities made through the Livestock Product Innovation (LPI) program. In addition to its own reporting and accountability requirements, one of the drivers of this program is the recently developed across rural RDC evaluation framework. This framework was developed by ACIL Tasman through the Council of Rural Research and Development Chairs.

This evaluation builds on previous analysis undertaken by Agtrans Research of MLA on-farm investment in the beef industry. In particular, it builds on analysis undertaken by Agtrans Research in three areas:

- feedlots
- northern beef
- southern beef.

MLA has been investing in on-farm RD&E since its formation in 1998. Prior to that MLA's predecessors (MRC and AMLC) were also involved in on-farm RD&E in these areas. This evaluation examines investments made between 2000-01 and 2007-08. In addition to MLA, there are also a number of other agencies that invest in on-farm programs, including state DPIs and CSIRO. It is important that this evaluation accounts for their input into achieving the observed outcomes and impacts in the beef industry over the period covered by this evaluation.

This report

Chapter 2 outlines MLA investments in northern beef and southern beef and feedlots. This material is largely a summary of the Agtrans analysis and includes a summary of the dollar investment, along the program activities (outputs). Chapter 3 broadly outlines the evaluation approach used in this analysis, while chapter 4 summarises the outcomes and impacts (quantified using the GMI/IF model). The outcomes (or shocks) that are used to quantify the benefits will be drawn from the Agtrans analysis. Chapter 5 summarises the results of the evaluating using the Integrated Framework model.

2 MLA and other investment in beef on-farm research

This evaluation is concerned with on-farm, or production, research in the beef industry between 2000-01 and 2007-08. This section details the magnitude of the investment made by MLA and the state DPIs (in dollar terms), along with the key activities across three broad clusters or program focus areas: northern beef, southern beef and feedlots. These activities effectively constitute the 'outputs' of the program. The information in this chapter is largely summarised from three evaluations undertaken by Agtrans:

- northern beef (Agtrans 2008a)
- southern beef (Agtrans 2008b)
- feedlots (Agtrans 2008c).

The approach taken by Agtrans in both the northern and southern beef evaluations is a so-called 'top-down' approach, where total productivity in the actual case for each of these regions is compared to an overall outcome for productivity in a 'without RD&E' scenario. In this case, there is an assumption that a level of productivity gain would have been achieved without investment in RD&E (by MLA and others), but it would have been lower than what has been achieved with the investment. This approach is discussed further in chapter 3.

The approach taken in the feedlot evaluation by Agtrans differed, in that it was a 'bottoms-up' approach where outputs and outcomes are linked more directly to impacts. The approach for the feedlot evaluation built on earlier analysis undertaken by Agtrans in 2006, which involved describing a random selection of 50 projects funded by LPI in terms of their objectives, outputs, outcomes and the economic, environmental and social benefits they produced. Of these, 30 projects were selected for quantitative economic evaluation, and of these, 5 were feedlot projects and through linkages to other projects lead to 15 projects that were analysed in the feedlot sample. This sample was taken from a total of 32 feedlot projects. The value of this sample represents 42 per cent of the total funding of the feedlot cluster.

MLA and other investment

Table 2.1 details the annual investment by MLA in each of the three areas.

2.1 MLA investment in beef production RD&E

	Northern beef	*Southern beef*	*Feedlot (total population)*	*Feedlot (analysed)*
	$m	$m	$m	$m
2000-01	3.500	3.378	0.136	0.000
2001-02	3.250	3.140	0.233	0.000
2002-03	3.890	3.754	0.655	0.296
2003-04	4.480	4.312	0.891	0.383
2004-05	4.110	3.967	0.961	0.506
2005-06	4.640	4.482	1.117	0.542
2006-07	6.000	5.790	0.844	0.436
2007-08	5.510	5.319	0.317	0.129
Total	**35.380**	**34.142**	**5.152**	**2.292**

Source: Agtrans 2008a, 2008b, 2008c.

The total investment in northern beef since 2000-01 has been around $35.4 million, while for southern beef, the total was around $34.1 million. The total investment for feedlots across the population amounted to $5.2 million, while for the projects analysed, the total investment was $2.3 million.

The approach adopted for the northern and southern beef evaluations requires identifying investment by other research and extension agencies that contributed to the outcomes achieved over the period. These agencies include state DPIs, CSIRO, universities and CRCs. Due to the wide range of agencies involved and the difficulty with estimating expenditure in a systematic way over a number of years, the approach taken in this analysis is to estimate costs for a single 12-month period. The size of this investment relative to MLA's investment is then used to estimate investment in other years. Using the 'top-down' approach, the share of the total benefits attributable to MLA is derived from the relative share of investment for MLA over the period. Table 2.2 shows estimated investment by others for northern and southern beef in 2007-08.

2.2 Investment by MLA and others in northern and southern beef: 2007-08

	Northern beef investment	*Share*	*Southern beef investment*	*Share*
	$m	%	$m	%
MLA	5.5	12.5	5.3	13.2
DPIs[a]	24.1	54.7	21.8	54.2
Others[b]	14.5	32.8	13.1	32.5
Total	44.1	100	40.2	100

[a] For northern beef, 'DPIs' and 'Others' include QLD DPI&F, NT DPIFM and WA DAF. For southern beef, 'DPIs' include NSW DPI, VIC DPI, WA DAF, TAS DPIW and SARDI. [b] 'Others' include CSIRO, CRCs and universities.

Source: Agtrans 2008a, 2008b.

The estimated investment in 2007-08 suggests that for northern beef, MLA constitutes around 19 per cent of total MLA and DPI investment (excluding other contributors) in RD&E, while for southern beef this share was 20 per cent. There is an argument that although the MLA share is relatively low, without it, the funding from other

sources would also have been lower. This leverage is an important consideration — whilst it is difficult to quantify, it does suggest that attributing benefits based on relative funding contributions is likely to underestimate MLA's contribution.

Summary of MLA activities

This section summarises the key activities in each of the three programs this evaluation is concerned with. These activities are in effect the 'outputs' of the MLA programs and are summarised largely from the Agtrans analysis. Further information can be found in the relevant reports for each of the programs.

Northern beef

MLA investment in northern beef production has focused on a number of areas, including:

- genetics
- reproduction
- nutrition and management
- adoption.

Breedplan

MLA has invested continuously in beef genetics research and genetic evaluation systems. Much of the investment concerned with improving genetic evaluation has occurred through the Animal Genetic and Breeding Unit located at the University of New England.

BREEDPLAN and BreedObject constitute Australia's principal genetic evaluation system for beef cattle. BREEDPLAN generates Estimated Breeding Values (EBVs) for a series of traits while BreedObject combines the individual BREEDPLAN traits into an economic $ index. The information captured provides reliable estimates of the genetic merit of animals in Australian breeding herds.

The MLA Northern program also supports the Tropical Beef Technology Services whose personnel conduct workshops on BREEDPLAN and promote outcomes of the Beef CRC.

Bullpower

This was a long standing MLA and QDPI&F investment associated with the reproductive efficiency of bulls, particularly a method of assessing bull fertility as a selection aid. Prior to these studies it was known that the calf output of individual bulls in multiple-sire herds was extremely variable.

Pasture improvement

Continued adoption of stylos and leucaena was manifested in the 2001-2008 period. MLA produced the Leucaena Management Handbook and further support was given to the leucaena network of producers. There were also projects funded in the area of psyllid resistance and the weed threat of leucaena was also addressed.

Wet and dry season supplementation

It is now best practice for producers to feed supplements (licks) in both the wet (for example, phosphorus) and dry seasons (for example, urea) in the northern beef industry. Further investment in encouraging adoption of such supplementation has occurred over the period predominantly through EDGEnetwork® (nutrition and breeding courses) as well as more recently via Beef Up forums.

Early weaning

Early weaning is considered best practice in the northern beef industry. Such management reduces cow mortality and increases reproductive performance due to improved body weight and earlier cycling of cows. Increased adoption has been encouraged through EDGEnetwork®.

Wet season spelling

Much of the benefit from wet season spelling came from an investment (ECOGRAZE) that developed grazing management guidelines for open eucalypt woodlands in northern Australia. It was a $2.5 million long-term study (1992-93 to 2000-01) located on five commercial grazing properties on different land types in north-east Queensland. The findings from this study have been promoted extensively through EDGEnetwork® (GLM) and other forums after 2001. More current studies from experiments at Wambiana have added further outputs.

Faecal NIRS

This MLA funded initiative pioneered new technology that analyses animal faeces using Near Infrared Reflectance Spectroscopy which provides a low cost method of ascertaining nutrient deficiencies and taking appropriate action for management and supplementation.

Burning Strategies

Work on burning strategies has been continued including a producer demonstration site of the impact of burning strategies on woody weed control.

'Beef Up' forums

'Beef Up' forums commenced in the northern beef industry in 2007. They are one day forums held at various producer locations in northern Australia each year and are aimed at increasing profitability of producers. Discussions focus on the key profit drivers of beef businesses, including reproductive performance, liveweight gains and grazing land management.

EDGEnetwork®

EDGEnetwork® has been one of several methods of extension employed by MLA as part of its RD&E program since 2000. EDGEnetwork® is a series of structured learning workshops delivered to meat and livestock producers in all states of Australia through various arrangements with state and private sector agencies. EDGEnetwork® provides a vehicle for communicating the outcomes of its past R&D investment to meat and livestock producers so that they can improve their profitability and sustainability. EDGEnetwork® was initially set up to communicate R&D findings and increase general capacity in farm business.

With support from MLA, QDPI&F developed principles and practices for grazing land management in northern Australia through the identification, evaluation and synthesis of available information. This information was refined and adapted to accommodate the assessment of options for improving grazing land management on individual properties. The package produced was based on a learning outcomes approach, recognised prior learning, stressed continuous learning and provided the opportunity for the course to be accredited. The course is delivered through EDGEnetwork®.

BeefPlan

BeefPlan is one of several MLA initiatives designed to assist northern beef producers by improving their capacity to access, absorb and apply knowledge relevant to efficient beef production. Distinguishing features of BeefPlan include its reliance on group dynamics to bring about useful outcomes. This has been achieved in practice where group-generated strengths are systematically linked to the prerequisites of practice change such as identification of the need to change and information gathering and assessment. The program was initiated in 1998-99 and ceased in 2007 when 'Beef Up' forums commenced.

PIRDS(Producer-Initiated R&D)

The MLA PIRD program commenced in 1993 and has continued to 2007. The objective was to support new ideas from cattle and sheepmeat producer groups to improve their knowledge, awareness and profitability through group initiated research activities. PIRDs therefore represented a way for producers to explore

solutions to local farm management issues and to practically assess applicability of research to commercial enterprises. A range of issues have been addressed by these groups from grazing to marketing. Pasture, feed and grazing questions along with animal production, farm management and breeding were constant issue areas over the period from 2001 to 2007.

Frontier Magazine

Frontier Magazine commenced publication in May 2006 after interest was expressed by northern beef producers for a similar type of magazine to Prograzier in the south. The role of Frontier is to help raise producer awareness of, and interest in key R&D outcomes, to encourage producers to seek further information/training and to influence their management practices.

Beef CRC II and III

The Northern beef program of MLA has been a key partner in all three Beef CRCs. CRCII (CRC for Cattle and Beef Quality) (1997-2004) and CRCIII (CRC for Beef Genetic Technologies) (2005-2012) were active during the investment period of this evaluation. The role of the Beef CRC has increasingly broadened over time from an initial focus on eating quality (CRCI) to the inclusion of other economically important traits (CRCII) and then to use emerging gene technology to address an even broader range of beef industry priority issues but still including beef quality (CRCIII). The nine core partners for CRCIII include MLA, four State DPIs, three universities and Meat and Wool New Zealand.

Details of the Northern beef program

Table 2.3 describes the key outputs and outcomes for investment in beef genetics.

Table 2.4 outlines the key outputs and outcomes achieved in reproduction through the Northern beef program.

Table 2.5 outlines the key outputs and outcomes achieved in nutrition and management through the Northern beef program.

Table 2.6 outlines the key outputs and outcomes achieved in adoption through the Northern beef program.

2.3 Key outputs and outcomes: northern beef genetics

Project or program	*Outputs*	*Outcomes*
Beef genetics and BREEDPLAN	▪ Currently 2 300 Australian herds enrolled in BREEDPLAN. During 2007, BREEDPLAN processed weaning weights for 125 630 animals	▪ Higher proportion of seedstock producers being involved in BREEDPLAN and more commercial producers purchasing bulls selected using BREEDPLAN ▪ Growth rates of animals have increased and age of turnoff at the same weight have been reduced. ▪ The proportion of northern beef producers using EBVs or breeding indices in sire selection and purchase is 37 per cent. ▪ 20 per cent of bulls entering the market in the north have come from herds using BREEDPLAN and have EBVs on them. 80 per cent of bulls bred and used in northern Australia have either a sire or grand-sire that was bred in a herd using BREEDPLAN ▪ The average genetic gain across the year for Australian breeds for cattle that were born in the 5 year period from 2002 to 2006 were: – Maximum value+$3.80 per year – Minimum value +$0.30 per year – The larger breeds made over $2.00 average gain per year – The average rate of gain across breeds is about $1.75 extra gross margin per cow joined per year.

Source: Agtrans (2008a).

2.4 Key outputs and outcomes: northern beef reproduction

Project or program	*Outputs*	*Outcomes*
Bullpower	▪ Single-sire studies showed that pregnancy rates were reduced when bulls with less than 50% normal sperm were used. ▪ Bulls can be relocated without any adverse effects on reproductive traits. ▪ Sperm morphology at 14 months is no indication of its morphological status as a 2-year-old.	▪ A key finding was the importance of sperm morphology as part of a thorough breeding soundness examination of a bull. This has provided veterinarians and producers with confidence in the relative contributions of various bull reproductive traits to calf output. ▪ Higher calf turnoff from bulls with desired genetic traits – Calves born at optimal times – Productivity improved.

Source: Agtrans (2008a).

2.5 Key outputs and outcomes: northern beef nutrition and management

Project or program	*Outputs*	*Outcomes*
Pasture Improvement	▪ Stylos and leucaena promoted through EDGEnetwork® and Beef Up. ▪ Leucaena Guide produced on establishment and management. ▪ Significant progress made in a psyllid resistant hybrid leucaena.	▪ Improved effectiveness of establishment and management leading to higher weight gains and filling gaps in drought periods.
Faecal NIRS	▪ Twelve QDPI&F staff were trained as NIRS coordinators throughout the State. They were provided with technical training on the development of NIRS technology and how it has been adapted to tropical pastures. ▪ A field data collection sheet was developed for completion by producers when submitting a sample. ▪ Two NIRS Fact Sheets were prepared and circulated to producer cooperators, the QDPI&F Call Centre, beef extension officers within QDPI&F, to producers outside the project and to QDPI&F presenters and participants of the MLA Nutrition EDGE package. ▪ Over 150 producer cooperators across Queensland were involved in the establishment of sites within different land types in order to develop initial NIRS, cattle condition and pasture condition relationships. ▪ A database was developed to store the NIRS results as well as the data being collected and submitted on the field collection data sheet.	▪ Surveys showed that 88% of private enterprises and 94% of company enterprises believed the NIRS technology was useful for predicting diet quality in their district. ▪ Respondents have used the results and interpretation of NIRS in the following management decisions: – Better understanding of pastures (81%) – Commencing supplementary feeding (71%) – Selecting supplements (62%) – Continuing a supplementation program (60%) – Drought management strategies (56%) – Moving stock between paddocks (41%). ▪ Respondents were asked to rate how useful are the results provided to them. The proportion of respondents indicating they found the results useful or very useful are as follows: – Crude protein (77%) – Digestibility (74%) – Non-grass component (69%) – Faecal N (51%) – Liveweight gain (47%). ▪ 85% of respondents felt that the NIRS results adequately reflected what was occurring in the paddock. ▪ Regarding willingness to pay, 7% indicated they were willing to pay less than $10; 40% indicated they would be willing to pay between $11 and $20; 36% indicated a price of between $21 and $30, while 13% indicated a price between $31 and $50.

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2.5 Key outputs and outcomes: northern beef nutrition and management Continued

Project or program	*Outputs*	*Outcomes*
Wet and Dry Season Supplements	▪ Greater awareness and knowledge of supplementation technology due to MLA investment. ▪ Important components of EDGE courses and Beef Up.	▪ Higher level of adoption of effective and efficient supplementation. ▪ Improved nutritional management with increased reproductive performance, increased weight gains, and earlier turnoff ages.
Wet Season Spelling	▪ Long-term grazing trials demonstrated sustainable grazing management options optimising beneficial grasses for beef production while minimising soil and nutrient loss. ▪ The ECOGRAZE principles have been well developed and have gained considerable credibility in the industry, partly due to the work being undertaken on commercial properties and the messages being well documented, explained and promoted through various training programs.	▪ The economic advantages of using the guidelines produced by ECOGRAZE are the prevention of land in good condition from deterioration and can assist deteriorated land to recover to good condition. ▪ There is a small annual average cash return advantage to farms that use the principles in either of these two ways. There are also benefits to producers who use the principles to prevent their land from becoming irreversibly degraded and which is then unprofitable.

Source: Agtrans (2008a).

2.6 Key outputs and outcomes: northern beef adoption

Project or program	*Outputs*	*Outcomes*
Beef Up	▪ Range of Workshops held across Queensland in 2007 and 2008. ▪ In 2007, 13 beef forums were run, with producer participation numbering 720.	▪ Of forum participants in 2007, 46% surveyed stated they had changed management practices as a result of the forum attended. ▪ Over 60% of participants indicated they would attend further training while over 50% indicated that they would make changes from what they had heard.
EDGEnetwork®	▪ The Grazing Land Management education package produced from the QDPI&F and customised for different regions of northern Australia consisted of: – A technical manual. – Workbooks and other materials. – PowerPoint presentation. – Deliverer notes.	▪ Enhanced productivity of meat and livestock production through improved management decision making leading to increased net farm income of producers. ▪ A review by Hassall and Associates (2004) concluded a greater uptake of R&D findings due to EDGEnetwork® workshops, particularly regarding improvements in pastures, stocking rates and selection of breeding stock.

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2.6 Key outputs and outcomes: northern beef adoption Continued

Project or program	*Outputs*	*Outcomes*
EDGEnetwork® (continued)	▪ Records show that 10 970 participants attended EDGEnetwork® courses in the six years to June 2006. Courses delivered by EDGEnetwork® since 2000 that have been popular with northern beef producers include: ▪ Nutrition EDGE (1 086 attendees). ▪ Grazing Land Management (781 attendees). ▪ Breeding EDGE (Michael Goldberg, pers. comm., 2008).	▪ Producers consulted in the review indicated a 4% to 5.5% increase in productivity in the short term, with productivity increases up to 12% in the long term. ▪ Fifty-eight participants attended the GLM Workshops in 2003-04, the first year of it being offered under EDGEnetwork®. Numbers increased to 175 in 2005/06. ▪ Change in management practices as a result of attending the GLM course (73%) (Solutions Marketing and Research, 2004) or from attending MLA courses in general (65%) (Axiom Research, 2005).
BeefPlan	▪ Some outputs of Beefplan include: – Face to face and teleconference meetings. – QDPI&F presentation about benchmarking. – Bull selection days. – EDGE nutrition, breeding and marketing and workshops. – MLA Meat Profit day. – Cattle and Catchments workshop (RCS). – Grazing for Profit School (RCS). Benchmarking via RCS and Profit Probe. – CattleCare accreditation – Financial Planning workshops.	▪ Changed management practices as a result of group participation. ▪ Working together on some activities saved costs to individuals. ▪ Benchmarking activities resulted in more efficient record keeping and set the scene for monitoring changes and measuring improvements. ▪ Most enterprise in one group now have off-farm investments as a result of attending financial planning workshops. ▪ Work done on individual properties as a result of Envirofund and other grants resulting in more fencing to land type including fencing off degraded land, fencing off ephemeral waterholes, and fencing off areas of wildlife or indigenous interest.
PIRDS	▪ An estimated 20 000 producers connected to groups have had close or some contact with the meat PIRD scheme. Of these around 5 000 catlle and sheep producers would have been active or close to participants in the PIRDs.	▪ There are indications that 50% to 100% of PIRD participants have made and will make significant changes as a result of their involvement. ▪ A study in 1998 calculated return on investment of ten completed PIRDs with a total net present value of $11 million, which would have returned MLA's investment many times for all PIRDs up to that time.

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2.6 **Key outputs and outcomes: northern beef adoption** Continued

Project or program	*Outputs*	*Outcomes*
Frontier Magazine	▪ Current circulation in early 2008 was about 9 400. A survey in 2007 reported that most readers rated the magazine as good or excellent. The majority of readers (86%) felt that the magazine was useful or very useful.	▪ Just under half of Frontier readers had implemented a key action after reading Frontier; most commonly mentioned were seeking more information on land management and nutrition, changes to grazing management, early weaning and cattle management.

Source: Agtrans (2008a).

Summary of key drivers of change in the northern industry

Agtrans (2008a) outlines the key drivers of change for the northern industry. What follows is taken directly from that report — which was an input into this evaluation. For the full text and references please refer to Agtrans (2008a).

ABARE (2004) reports herd performance measures for beef specialist farms from 1977-78 to 2001-02 as shown in table 2.7. At least up until 2002, the northern beef industry demonstrated a faster growth of herd performance than its southern counterpart.

2.7 **Herd performance of northern beef farms** 1977-78 to 2001-02[a]

	Northern beef
	%
Branding rate	1.1
Turnoff rate	1.4
Death rate	4.9

[a] Average annual percentage changes.

Source: ABARE (2004)

The herd performance information readily available for the northern beef industry since 2001 is patchy and limited. The definition of the northern beef industry used here is all of the Queensland and Northern Territory production as well as the Pilbara and Kimberley regions of Western Australia.

Data provided in the Agtrans (2008a) analysis show:

- a small increase in cattle numbers over the period 2000-01 to 2007-08, compared to the average of the four years before the investment commenced;
- a small increase in slaughter numbers;
- stable branding rates;
- a small increase in turnoff rates;
- static Australian beef prices (in real terms);
- static beef production on an Australia-wide basis;

- static to declining live cattle exports from the northern region; and
- positive total factor productivities averaging 1 per cent to 3 per cent per annum for different parts of the Australian beef industry over different periods.

Nominating key drivers of these changes over a particular period is largely a subjective process. The key drivers of change over the period 2000-01 to 2007-08 have included the following.

Generic/integration factors

- Improved management of industry RD&E investment from MLA management and leadership including inputs from the North Australia Beef Research Council and the Northern Beef Program Industry Committee.
- MLA and State agencies clearly played important roles in planning, funding and coordination of RD&E. In addition, industry organisations and others (including CSIRO, breed societies, producer groups, private and public consulting and educational groups) were also critical players in the progress made.

Production drivers

- The ability via BREEDPLAN for producers to access improved genetic technology it provided, to deliver animals that could grow more quickly and with superior eating quality.
- The development of new technology in terms of reproduction and nutritional aids, grazing management, and continuing investment in fencing and water improvements. The availability of new knowledge regarding bull selection and nutritional aids such as use of NIRS, has assisted producers to refine their management systems with impacts on weight gains, age of slaughter and offtake levels.
- A higher level of uptake of both new and existing technology by northern beef producers as a result of increasing profitability as well as the industry investment in extension, communication and training packages and the ensuing technology application and skills development by producers. The various extension and communication programs assisted producers to adopt best practice in producing to market specifications and took advantage of the increased profitability of beef production in the north due to the live export market and higher carcase beef prices.
- The strong market for live cattle exports has resulted in fewer cattle slaughtered from the northern industry than otherwise, with higher numbers of younger cattle being turned off each year.
- Producing more beef with the same level of inputs or the same level of beef with less inputs as demonstrated by the total factor productivity changes. The productivity of labour (3.9 per cent per year) and capital (3.1 per cent per year)

inputs increased significantly up to at least 2002, followed by a lower increase in land productivity (1.63 per cent per year) and a small increase in the productivity of purchased inputs (0.9 per cent per year) (ABARE 2004).

- The latest and preferred estimate of productivity growth in the north (1985–2006) is 2.1 per cent per year. It could be assumed that this rate of improvement applies to the period of interest.

Southern beef

This section summarises the outputs and outcomes of the Southern beef program in three broad areas:

- genetics;
- nutrition, grazing and management; and
- adoption.

Some of the key sub-programs (such as BREEDPLAN) are common across northern and southern beef and as such the outputs and outcomes are the same in some instances.

Beef genetics and BREEDPLAN

The MLA Southern beef program has invested continuously in beef genetics research and genetic evaluation systems. Much of the investment concerned with improving genetic evaluation has occurred through the Animal Genetic and Breeding Unit located at the University of New England and through the support of the Beef CRCs.

BREEDPLAN and BreedObject constitute Australia's principal genetic evaluation system for both the southern and northern beef cattle industries. BREEDPLAN generates Estimated Breeding Values (EBVs) for a series of traits while BreedObject combines the individual BREEDPLAN traits into an economic $ index. The information captured provides reliable estimates of the genetic merit of animals in Australian breeding herds.

Sustainable Grazing Systems

The Sustainable Grazing Systems (SGS) program addressed declining pasture productivity and sustainability in grazing systems of the higher rainfall sheep and cattle producers in southern Australia (>600mm annual rainfall). The program commenced in July 1996 and evolved from a former program of the Meat Research Corporation called the Temperate Pasture Sustainability Key Program. The SGS program ran for five years with total funding of about $5.5 m per year.

While SGS was an MLA initiative, the program had several partners including Land and Water Australia, Murray Darling Basin Commission, State agencies and several

universities. Large numbers of producers also contributed to the program. SGS was developed in a cooperative framework between researchers, producers and State extension personnel. The framework for SGS was developed by a producer planning group in order to maintain producer ownership of the program.

PROGRAZE and Prograzer Magazine

PROGRAZE was developed by NSW Agriculture as a method for producers to learn the fundamentals of pasture and animal assessment to assist in grazing management. The course was first conducted in NSW in 1994 to 1996 with MRC support and then spread to other states. PROGRAZE was a constituent component of SGS where it was further developed.

The Prograzier Magazine commenced as a newsletter within SGS and is now produced four times per year. The role of the publication is to help raise producer awareness of and interest in key R&D outcomes, to encourage producers to seek further information/training, and to influence their management practices.

Grain and Graze

MLA is one of four partners in a research program called Grain & Graze (G&G). G&G was a program focused on enterprise integration within mixed enterprise farming systems with the aim of increasing profitability and enhancing natural resource condition across Australia's medium rainfall zone. The program was established in July 2003 and has run for five years until June 2008. The program is a cooperative effort of four Rural Research & Development Corporations (RDCs) — Australian Wool Innovation Ltd (AWI), the Grains R&D Corporation (GRDC), Land & Water Australia (LWA) and MLA. MLA is the largest financial contributor of the four RDCs. The program's investment is largely delivered through nine regionally focused projects (predominantly in southern Australia). The project regions use collaborative approaches with many partners involved, including State agencies.

Evergraze

The Evergraze initiative is developing and testing new farming systems in different environments of the high rainfall zone (>600 average annual rainfall) of southern Australia. The initiative involves combining different perennial pastures designed to meet the nutritional needs throughout the year of high performance animal production systems. Apart from increasing productivity and profitability on a whole farm basis, the pastures are envisaged to use excess water in the environment so lowering water tables and improving water quality in waterways. The project was funded by MLA, State agencies, the former Salinity CRC and catchment management authorities.

Biological control of weeds

A biological control research and development program for weeds was initiated by CSIRO in 1972. The initial biological control investment on Paterson's Curse (*Echium spp*.) was halted in 1980 following an injunction in the Supreme Court of South Australia, lodged by a group of graziers and apiarists. CSIRO recommenced work on biological control of *Echium* in 1987. The biological control program for thistles commenced at about the same time.

The Australian meat and wool industries also contributed funding to the CSIRO program, in addition to in-kind contributions of the NSW, Victorian, South Australian and Western Australian state departments and, since 1995, the Weeds CRC.

MLA, its predecessors and other research funding bodies have invested in biological weed control projects since at least 1987. Until 1996-97 Australian Wool Innovation (AWI) and MLA funded projects independently, with the work focusing mostly on the importation, host-specificity testing and initial establishment of agents at a small number of nursery sites.

From 1997-98 the projects were placed under one funding umbrella. By 2002-03 bio-control agents had been successfully identified, reared and released against the target species. Their impacts were being noted around release sites. The evidence was indicating that the combinations of the agents selected should be able to reduce the vigour of these weeds in the short term and their density in the long term. A new project was initiated in 2003-04 that released additional agents in the current sites. This new project was anticipated to speed up the delivery of benefits to landholders.

Pasture breeding, establishment and management

Apart from the large investment in pasture management and utilisation there was some investment in breeding improved pasture types including new varieties of tall fescue, perennial ryegrass and white clover. Investment into establishment of perennial pastures as well as low cost re-establishment was made.

More Beef from Pastures

This MLA program is an information and support program providing beef producers across southern Australia with tools and information to support decision making in their beef enterprise. The program commenced in 2004. Central to the program is the 'producers' manual' containing the essential processes for a successful beef business.

EDGEnetwork®

EDGEnetwork® has been one of several methods of extension employed by MLA as part of its R&D program since 2000. EDGEnetwork® is a series of structured learning

workshops delivered to meat and livestock producers in all states of Australia through various arrangements with state and private sector agencies. EDGEnetwork® provides a vehicle for communicating the outcomes of its past R&D investment to meat and livestock producers so that they can improve their profitability and sustainability.

EDGEnetwork® was initially set up to communicate R&D findings and increase general capacity in farm business (the working title of EDGEnetwork® during its development in Victoria was 'Business Skills Best Practice'). It is a delivery tool for R&D with the aim of promoting practice change in all aspects of the farm business (Michael Goldberg, pers.comm., 2008).

Beef cheque is a three year course that is offered only in Victoria and on a limited scale in South Australia. MLA is a one third owner together with Victorian DPI and the Beef Improvement Association (Michael Goldberg, pers. comm., 2008).

PIRDS

The MLA Producer Initiated Research and Development (PIRD) program commenced in 1993 and has continued to 2007. The objective was to support new ideas from cattle and sheepmeat producer groups to improve their knowledge, awareness and profitability through group initiated research activities. PIRDs therefore represented a research implementation pathway. A range of issues have been addressed by these groups from grazing to marketing. Pasture, feed and grazing questions along with animal production, farm management and breeding have been ongoing PIRD topics over the period from 2001 to 2007.

Beef CRC II and III

The Southern beef program of MLA has been a key partner in all three Beef CRCs. CRCII (CRC for Cattle and Beef Quality) (1997-2004) and CRCIII (CRC for Beef Genetic Technologies) (2005-2012) were active during the investment period of this evaluation. The role of the Beef CRC has increasingly broadened over time from an initial focus on eating quality (CRCI) to the inclusion of other economically important traits (CRCII) and then to use emerging gene technology to address an even broader range of beef industry priority issues but still including beef quality (CRCIII). The nine core partners for CRCIII include MLA, four State DPIs, three universities and Meat and Wool New Zealand.

Table 2.8 summarises the key outputs and outcomes achieved in genetics through the Southern beef program.

2.8 Key outputs and outcomes: southern beef genetics

Project or program	*Outputs*	*Outcomes*
Beef Genetics and BREEDPLAN	▪ The investment has enhanced the versions of BREEDPLAN and BreedObject being used by AGBU. ▪ There are currently 2 300 Australian beef herds (both from the south and the north) enrolled in BREEDPLAN. ▪ During calendar year 2007, BREEDPLAN processed weaning weights for 125 630 animals submitted from 1 600 herds.	▪ More efficient and effective industry servicing and faster rates of genetic progress in both southern and northern beef cattle herds. ▪ Higher proportion of seedstock producers being involved in BREEDPLAN and more commercial producers purchasing bulls selected using BREEDPLAN. ▪ Growth rates of animals increased and age of turnoff at the same weight have been reduced. ▪ The proportion of southern beef producers using EBVs or breeding indices in sire selection and purchase is 29%. ▪ 70% of bulls entering the market in the south have come from herds using BREEDPLAN and have EBVs on them. ▪ The average genetic gain across the year for all Australian breeds for cattle that were born in the 5 year period from 2002 to 2006 were: – Maximum value+$3.80 per year – Minimum value +$0.30 per year – The larger breeds made over $2.00 average gain per year. ▪ The average rate of gain across breeds is about $1.75 extra gross margin per cow joined per year.
	▪ Multi-breed performance data on several growth traits allowed scientists at AGBU to develop statistical models to compute adjustment factors (published in a table) that allow producers to directly compare the growth EBVs of a number of breeds.	▪ The multi-breed EBVs are being used to predict the expected differences in the progeny of animals from different breeds.
	▪ Knowledge of tradeoffs involved in selecting genetics, stocking rates and feeding regimes for southern beef production systems.	▪ Producers are now more likely to use sires with higher growth rates due to increased confidence there is no detriment to meat quality; also they are now better able to meet specific market requirements.

Source: Agtrans (2008b).

Table 2.9 summarises the key outputs and outcomes achieved in nutrition, grazing and management through the southern beef program.

2.9 Key outputs and outcomes: southern beef nutrition, grazing and management

Project or program	*Outputs*	*Outcomes*
Sustainable Grazing Systems	▪ The 'National Experiment' was undertaken on six sites (Albany, Hamilton, Rutherglen, Wagga, Orange and Tamworth) and for each of five themes (water, nutrients, pastures, animals and biodiversity). Regional committees of producers were established that assisted in the development of sustainable grazing systems and in quickly transferring information to producers. There were 100 producer driven regional sites that had strong credibility with producers. Two SGS National Farm Walks (1999 and 2001) were conducted that attracted 6 400 producers and involved 135 regional and national sites	▪ Surveys reported that the 8 000 participants in SGS were more likely than non-participants to rotationally graze; have higher stocking rates; more perennial pasture; assess their pasture, dry matter and digestibility value; calculate a fodder budget, weight and fat scores for livestock; soil test and apply fertiliser and lime; and focus on specific markets. Among participants in SGS, 81% and 85% respectively stated that the changes they had implemented would increase profitability and sustainability. Involvement in SGS had assisted in their management of animal, pastures, nutrients and water as well as sharing information among their peers
PROGRAZE and PROGRAZIER	▪ The PROGRAZE course (developed further within SGS) provided technical information and assessment skills, used discussion groups, visits and revisits to grazing properties, and provided takeaway manuals and guidelines for use after the course. The course was based on learning from others, solution seeking and active learning with emphasis on building the capacity to make changes. ▪ By the end of 1996 nearly 4 000 producers had undertaken the course. By 2002, some 8 500 producers had undertaken the course. These 8 500 (6 400 businesses) were all from the high rainfall zone of southern Australia. MLA subsumed the PROGRAZE workshops into their EDGEnetwork® education and training program when it commenced in 2000-01. ▪ Up until 2008, 12 269 producers have participated in PROGRAZE (including 8 500 under SGS and a further 3 769 under EDGEnetwork® from 2001 to 2008.	▪ A high proportion of PROGRAZE participants surveyed (86%) indicated that participating in PROGRAZE would increase profitability and 90% indicated participation would improve the sustainability of their pasture base; 41% of participants changed their grazing approach, many to rotational grazing with 2 460 businesses attributing this to PROGRAZE alone. ▪ Confidence in decision making has been often reported by participants as a result of participating in PROGRAZE. This is translated 12 months after completing PROGRAZE to changes being made on the farm. ▪ It was reported that PROGRAZE was the most successful training program ever offered in the red meat industry. ▪ There has been extensive participation by producers with independent verification of changed behaviour and adoption.

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2.9 Key outputs and outcomes: southern beef nutrition, grazing and management
Continued

Project or program	*Outputs*	*Outcomes*
PROGRAZE and PROGRAZIER (continued)	▪ Prograzier had a subscriber base of 20 000 across the southern states of Australia in 2008.	▪ In a 2004 survey, Prograzier emerged as the source of information most likely to influence producers to change livestock or pasture management practices, with rural newspapers second, field days third, Department of Agriculture fourth, and ABC Radio fifth (Taverner Research Company, 2004).
Grain and Graze	▪ The program produced a range of models, tools and knowledge in both the national projects and the individual regional projects. Knowledge related to economics, biodiversity, feed base management and social aspects of mixed farming systems. Examples include perennial pasture establishment and management, managing pasture rotations, stubble grazing kit, an IPM guide, a stubble management course, a feedbase information package, options to fill an autumn feed gap, and management packages for grazing cereals. More than 4 000 producers were actively engaged in Grain and Graze activities. It is estimated that more than 8 000 passively participated. ▪ More than 230 research and demonstration sites operated for some part of the 5 year program.	▪ The likely outcomes from the G&G program are increased average profitability and improved risk management outcomes for mixed farming enterprises. Mechanisms for dong this will most likely involve: – Choice of new combinations of existing farm enterprises to increase average income and reduce income risk in the long term. – Utilise resources such as different land and soil types more efficiently. – Introduce new enterprises into their farming systems. – Introduce new components or aspects of a production process into their farming system. ▪ More than 1 800 producers are trialling Grain and Graze recommended practices. ▪ More than 1 000 producers have already adopted recommended practices and have attributed the changes to Grain and Graze participation. ▪ Approximately 800 participants claim to have ceased poor farming practices specifically on Grain and Graze advice. ▪ The average increase in profit achieved across the regions from adoption of Grain and Graze recommended practice is 9%.

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2.9 Key outputs and outcomes: southern beef nutrition, grazing and management
Continued

Project or program	*Outputs*	*Outcomes*
Evergraze	▪ Many producers are aware of Evergraze and the project is well recognised in the temperate high rainfall zone. There is increased awareness in livestock industries of the potential for farming systems based on perennial plants that can also reduce recharge to control dryland salinity. The next step is to achieve adoption and practice change through demonstration and validation of new systems and development of guidelines for producers for the application of these systems.	▪ As the principal implementation phase of this investment is still being completed, it is too early to report on any significant outcomes in terms of new knowledge, validation and demonstration of systems. ▪ The target outcomes are a reduction in recharge by 50% (or an appropriate amount for each region) over current farming systems and an increase in profitability by 50% across the whole farm (above best practice animal enterprises).
Biological Control of Weeds	▪ Up to 2006, there had been 4 000 releases of specific biological control agents for Patersons' curse, Onopordum thistles, horehound and blue heliotrope. A network of more than 1 700 graziers was involved in the project and was integrating biological control into its pasture management regimes. There had been 322 weed control training workshop, talks, interviews and field days held across Australia (CSIRO Entomology, 2006). ▪ The total number of agents released more than doubled over the two years to 2006 compared to the previous seven years. This increased rate of release is due to the success in regional field collections so that the need to rear insects in the laboratory has been by-passed.	▪ There has been a reduction in direct costs (e.g. weed toxicity, herbicide use, low pasture productivity) and indirect costs (stock management issues) associated with the targeted weeds. ▪ Also, there has been an improved understanding by producers of weeds in farming systems and of the benefits of an integrated weed management approach incorporating the concepts of biological control, herbicide control, grazing management and pasture renovation. ▪ The active participation by producers has led to ownership of the process and outcomes in the context of a community based distribution system.
Pasture Breeding, Establishment and Management	▪ Pasture breeding programs have generated improved types of ryegrass, tall fescue, lucerne, white clover and other legumes. ▪ Development of grazing and supplementary feeding strategies which overcame the reduction in growth rate that occurs in cattle when grazing tagasaste in late summer and autumn.	▪ Continual adoption of new pasture species and cultivars by producers in temperate Australia. Establishment costs of perennial species have been lowered. ▪ Knowledge of the tagasaste plant and its interactions with cattle, has led to the use of lupins for supplementary feeding; lupins have been adopted widely and quickly for those grazing on tagasaste.

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2.9 Key outputs and outcomes: southern beef nutrition, grazing and management
Continued

Project or program	*Outputs*	*Outcomes*
Pasture Breeding, Establishment and Management (continued)	▪ Indices of potential pasture growth for the current growing season and accumulated potential pasture growth from the start of the season. The indices allow an assessment of how the current season is unfolding relative to previous seasons, and what the prospects ahead are based on a seasonal climate forecast.	▪ The information is being promoted for use in strategic applications, for example choosing time of joining by assessing seasonal reliability of pasture growth, and in tactical applications in feed budgeting.

Source: Agtrans (2008b).

2.10 Key outputs and outcomes: southern beef adoption

Project or program	*Outputs*	*Outcomes*
More Beef From Pastures	▪ The 'More Beef from Pastures Producers' manual includes modules on setting directions, tactical stock control, pasture growth, pasture utilisation, cattle genetics, weaner throughput, herd health and welfare, and meeting market specifications. ▪ The program also supports a newsletter, producer forums and workshops, demonstration sites, producer tools and calculators such as the cost of production calculator, and website information. ▪ Over 12 000 producers have directly engaged with the program.	▪ Surveys in 2006 and 2007 reported that 60% and 70% of southern beef producers respectively were aware of the program. Of those who participated in the program 44% in 2006 and 50% in 2007 stated in a survey that they had changed management practices as a result of their participation (Axiom Research, 2007). ▪ The impact of program tools and procedures have had most impact on productivity increases and better natural resource management; productivity increases were ranked first as the most important aspect of management changes made. The three areas that survey respondents reported where impact was greatest were profitability, pasture persistence and cost of production (Axiom Research, 2007).

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2.10 **Key outputs and outcomes: southern beef adoption** Continued

Project or program	*Outputs*	*Outcomes*
EDGEnetwork®	▪ Records show that 10 970 participants attended EDGEnetwork® courses in the six years to June 2006. ▪ Since the year 2000, the most frequently attended EDGEnetwork® courses for southern beef producers were Prograze (3 769 lamb and southern beef producers), and Beefcheque (869 year 1 participants, 820 cumulative year two participants and 602 year 5 participants).	▪ Enhanced productivity of meat and livestock production through improved management decision making leading to increased net farm income of producers. ▪ Hassall and Associates (2004) undertook a review of EDGEnetwork® with a focus on the impact and management arrangements. The review concluded that there had been a greater uptake of R&D findings due to EDGEnetwork® workshops, particularly regarding improvements in pastures, stocking rates and selection of breeding stock. These improvements had been translated into increases in farm cash income. ▪ Animals, business/ finance and feedbase/ pasture workshops contributed 90% of all participant attendances. Prograze and Prograze Update workshops contributed 69% of feedbase workshops attended. ▪ Producers consulted in the review indicated a 4% to 5.5% increase in productivity in the short term, with productivity increases up to 12% in the long term. ▪ MLA surveys indicate that 75% of these changed management practices occurred as a direct result of EDGEnetwork® courses.
PIRDS	▪ An estimated 20 000 producers connected to groups have had close or some contact with the meat PIRD scheme. Of these around 5 000 catlle and sheep producers would have been active or close to participants in the PIRDs (Welsman, 2001).	▪ There are indications that 50% to 100% of PIRD participants have made and will make significant changes as a result of their involvement. A study in 1998 calculated return on investment of ten completed PIRDs with a total net present value of $11 million, which would have returned MLA's investment many times for all PIRDs up to that time.

Source: Agtrans (2008b)

Summary of key drivers of change in the southern industry

Agtrans (2008b) outlines the key drivers of change for the southern industry. What follows is taken directly from that report — which was an input into this evaluation. For the full text and references please refer to Agtrans (2008b).

ABARE (2004) report herd performance measures for beef specialist farms from 1977-78 to 2001-02 as shown in table 2.11.

2.11 **Herd performance of Southern Beef Farms** 1977-78 to 2001-02[a]

	Southern beef
	%
Branding rate	0.3
Turnoff rate	0.9
Death rate	2.6

[a] Average annual percentage changes.

Source: ABARE (2004)

The recent performance information available for the southern beef industry since 2000-01 is limited as most performance data refers to the Australian beef industry. Data provided in the Agtrans (2008b) analysis show:

- static cattle numbers over the period 2000-01 to 2007-08;
- static slaughter numbers;
- static branding rates;
- higher carcase weights ;
- static Australian beef prices (in real terms); and
- total factor productivities varying between -0.5 per cent and 2.9 per cent per year, depending on the period over which the estimates are made.
  - The latest and most authoritative estimate for the southern beef industry is for a productivity gain of 1.3 per cent per year over the period 1977-2006. However, the estimates suggest that this may have been affected by higher productivity growth in the early part of this period with flat growth during the 1990s followed by increased variability of growth since 2000-01 (possibly due to a series of drought years in the south).
- The average productivity gain in the southern industry has been driven predominantly by growth in outputs rather than reduction in inputs (ABARE 2008a).

Nominating key drivers of change over a particular period is partly a subjective process. The key drivers of change over the period 2000-01 to 2007-08 for southern beef are assumed to have included the following:

Generic/integration factors

- Improved management of industry RD&E investment from MLA management and leadership including inputs from the Southern Australia Beef Research Council.
- MLA and State agencies clearly played important roles in planning, funding and coordination of RD&E. In addition, industry organisations and others (including CSIRO, breed societies, producer groups, private and public consulting and educational groups) were also critical players in the progress made.
- The CRC for Beef Genetic Technologies has played a role in coordinating beef genomics across agencies.

Production drivers

- The ability via BREEDPLAN for producers to access improved genetic technology it provided, to deliver animals that could grow more quickly to a given weight or reach a higher weight with the same level of inputs and with superior eating quality.
- The development of new technology in terms of nutrition, interaction of nutrition with genetics and better meeting market specifications, and sustainable grazing management strategies including feed budgeting.
- A higher level of uptake of both new and existing technology by southern beef producers as a result of investment in extension, communication and training packages and the ensuing technology application and skills development by producers. The various extension and communication programs assisted producers to adopt best practice in producing to market specifications.
- Producing more beef with a similar level of inputs has been indicated by the composition of the total factor productivity changes.

Feedlots

Agtrans (2008c) describes the approach taken for the evaluation of feedlot projects. In total, 15 projects out of 32 in total were evaluated as identified in table 2.12. These 15 projects accounted for $2.3 out of $5.2 million of total MLA expenditure on the feedlots program over the evaluation period.

2.12 **Sample of feedlot projects**

Project title	*Projects*	*MLA funding*
	No	000's
Review of Options to reduce Feedstuff Supply variability in Australia	1	118
Reducing the Risk of heat Load for the Australian Feedlot Industry	12	149
Measuring the microclimate of Eastern Australian Feedlots	1	223
Devitalisation of Imported Feed Grain by Fumigation	1	450
MLA contribution to the Cattle & Beef Quality CRC	1	630

Source: Agtrans (2008c).

Table 2.13 details the key outputs and outcomes from the feedlots program.

2.13 Key outputs and outcomes: feedlots

Project	*Economic benefits*	*Environment benefits*	*Social benefits*
Feedstuff Supply Variability	▪ Likelihood of strategies that will reduce the supply variability of feed grains to end users. ▪ Integration of climatic and economic models to generate more timely and accurate predictions of grain supply outlook. ▪ Greater cognizance of market failure and the need to look for solutions beyond the micro scale. ▪ Development of a structurally sound industry that will be sustainable over the long term. ▪ A larger intensive animal industry with correspondingly larger dividends for operators and associated communities.	▪ The natural environment will be 'saved' during drought events to the extent that feedlots and intensive feeding generally remain economic because of less price variability and a more rapid supply-side response to the needs of the livestock feeding industry. Cattle will move quicker to intensive feeding and thereby save pasture and reduce soil degradation.	▪ Scope for industry expansion leading to flow-on benefits to regional communities especially jobs. ▪ Job and income security for people working directly in the feed processing and delivery industry. ▪ Animal welfare during drought events due to greater confidence that intensive feeding will be relatively durable in the face of drought. ▪ Enhancement of industry's understanding of how markets work to address severe events.
Heat Load in feedlots	▪ Lowered mortality rates in feedlots, particularly from extreme events. ▪ Lowered probability of uneconomic mandatory regulations industry (for example, to increase shade in feedlots to 100% capacity without any significant risk improvement) with a higher probability of a lower cost risk management approach to addressing heat stress events.	▪ Reduced odours emanating from feedlots via reduced cattle concentrations and improved pad management.	▪ Delivery of a higher level of animal welfare by feedlot managers resulting in reduced loss of animal life and stress.

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2.13 **Key outputs and outcomes: feedlots** Continued

Project	*Economic benefits*	*Environment benefits*	*Social benefits*
Devitalisation of imported feed grain	▪ Ability to import feed grain during supply shortages will provide confidence and continuity to intensive animal industries and lower input prices. This could lead to potentially larger intensive animal industries. Any financial benefit needs to be offset against any losses imposed on the Australian feed grains producing sector. ▪ Potentially a reduced risk to agricultural industries of weed seeds and diseases entering Australia through imported feedstuffs. ▪ Development of structurally sound intensive animal industries which are sustainable over the long term.	▪ Reduced risk to the environment from superior phytosanitary standards applying to imported feedstuffs – due to the superiority of devitalisation over QA practices such as inspection and random audits. ▪ The natural environment will be 'saved' during drought events to the extent that feedlots and intensive feeding generally remain economic because of less price variability and a more rapid supply-side response to the needs of the livestock feeding industry. Cattle will move quicker to intensive feeding and thereby save pasture and reduce soil degradation.	▪ Scope for industry expansion leading to flow-on benefits to regional communities especially jobs. ▪ Job and income security for people working directly in the feed processing and delivery industry. ▪ Improved animal welfare during drought events due to greater confidence that intensive feeding will be relatively durable in the face of drought.
Grainfed Investment in CRC II	▪ Increased productivity of beef production systems through increased rate of genetic gain. ▪ Product enhancement to better meet market demand and consumer requirements.	▪ Improved effectiveness of feed utilisation with a lowering of methane outputs.	▪ Delivery and training initiatives have enhanced the capacity of the industry.

Source: Agtrans (2008c)

3 Evaluation approach

Chapter 2 described the outputs and outcomes of over 20 major programs and projects. These programs and projects cover a mix of R&D outputs and the extension necessary to deliver those outputs to beef producers.

An ideal approach

The ideal approach to this evaluation would be the evaluation of separate components of these three programs on a project-by-project basis. This would involve:

- Identifying the impact of the program outputs on key drivers of production and profitability. These drivers would include:
  - higher and more consistent turnoff and slaughter weights including capacity to better meet market specifications;
  - turnoff out-of-season to capture premiums;
  - better feed conversion or utilisation of pasture; and
  - increased labour productivity.
- Identification of additional on-farm costs involved in obtaining those productivity gains:
  - these additional costs are likely to include inputs to increase pasture utilisation or supplementary feeding — also additional costs of required management inputs.
- Quantifying the adoption of program outputs:
  - this involves not only number of business using program outputs but also their contribution to total production or sale.

The measurement of the impacts from a project or program on key drivers of production and profitability need to be established by comparing outcomes for those drivers after completion of the project (after-project) with a suitable baseline or 'before-project' case.

The design of the evaluation should also incorporate collection of information that shows MLA's contribution to changes in those key drivers by:

- establishing a link between the project and the measured outcomes;

  - for example, by asking producers if changes in drivers were the result of this project or program or did the information come from other sources?
- recognition that many projects or programs are run collaboratively between MLA and other stakeholders:
  - that is, what was the contribution of MLA, both financial and through leverage, to the total project outcome.

Constraints to the ideal approach

While ideal, there are a number of practical constraints to this approach relating to the sheer scale of the evaluation task, in particular the:

- large number of often inter-related projects; and
- information requirement across a range of economic factors.

Many programs and projects are often strongly inter-related so that they logically lead to the clustering of projects where:

- the output of a project may simply be an input into another project;
- it was cost-effective to extend or lever-off an existing project;
- R&D and extension components are naturally inter-related but run as separate projects;
- benefits may accrue to other activities in a cross-enterprise program;
  - programs such as Sustainable Grazing Systems, Grain & Graze and Evergraze all have elements for sheep;
- there may be a number of different collaborators involved at different stages.

In terms of the information requirement of an after-the-fact evaluation, key components of the database for each cluster of projects would include:

- establishing the 'without' case for each program or project. This would include:
  - not only the changes in key drivers as a result of a program or project outputs but also the adoption of outputs; and
  - an assessment of those businesses that would have adopted the technology anyway;
- attribution of benefits between contributing programs or clusters of projects; and
- abstracting from the impacts of other non-program influences such as market trends and seasonal variations.

To date, the design of many programs and projects across MLA and DPI activities has not included the data capture required to address an after-the-fact evaluation.

Approach used in this evaluation

Rather than building-up from program outputs, to outcomes and impacts, this evaluation uses a so-called 'top-down' approach to quantify the benefits of concerted action by the MLA and other contributors.

The approach taken in this evaluation is to establish a common baseline, or 'without' scenario, for the key outcomes across the beef industry. In a 'bottoms-up' evaluation, this is simply what would have happened in the absence of a program or project. This approach will be supported by a number of case studies of specific investments made over the period as described in Agtrans (2008a, 2008b, 2008c).

The differences in the benefits for the 'with' and 'without' research investments are valued and their timing over varying periods from the year of last investment specified. This benefit stream is then matched with the RD&E investment by MLA and others over the period 2000-2001 to 2007-2008. In chapter 4, we use estimates of total factor productivity (TFP) as an indicator of the net benefits of the integrated programs of MLA and other contributors across the northern and southern industries. Box 3.1 explains more about TFP and how it is used to assess the performance of an industry.

3.1 Total factor productivity

Productivity reflects the ability to produce goods and services (outputs) given the available resources (inputs). Total factor productivity (TFP), also known as multifactor productivity, compares total outputs with the total inputs used in production of the output. Growth of TFP is derived by dividing an index of total outputs by an index of the total inputs used to produce this output combination. Alternatively, partial factor productivity measures output relative to a single input factor such as labour, capital or land.

A TFP estimate of 1 per cent can represent a 1 per cent increase in the value of output for the same level of costs or alternatively the same value of output produced for 1 per cent less cost. Key partial measures of productivity for the cattle industry are feed or pasture productivity and the productivity of hired labour.

The major challenges for TFP studies are:

- abstracting away from the impact of seasonal variations – the largest contributor to changes in production and often costs; and
- incorporation of unpriced inputs such as the owner-operators and other family labour.

The case studies draw on past economic analyses reports on RD&E investments and are already included in the 'top-down' approach. However, these more specific investment analyses provide more detail on the benefits derived and support the assumptions made and results achieved in the 'top-down' approach.

Attribution is required

As the 'top-down' approach defines aggregate impacts and outcomes to estimate the impacts resulting from beef on-farm programs, attribution is required.

At a broad level, this involves determining the proportion of the benefits of a particular outcome or impact that is attributable to MLA. Given that MLA generally works with a range of contributors on any given program, attribution is an important consideration. Where possible, attribution is generally determined on a share of cost basis. This can be difficult where:

- the contribution of other stakeholders is not easy to value — because of in-kind contributions and the use of shared infrastructure; and
- leverage from additional funding has been possible, that contributed to a larger project and better outcome that would be possible from the direct contribution alone.

Funding contributions from the DPIs and other contributors were outlined in chapter 2 and will be used to assist with attribution of benefits arising from the on-farm program. Attribution is discussed further in chapter 5.

Feedlots

A case study approach was taken to the evaluation of the feedlot program. As described by Agtrans (2008c), a sample of 15 of 32 projects in total was evaluated. Table 2.1 shows that these projects accounted for $2.3 million out of $5.2 million of program expenditure.

For the analysis presented in this evaluation, we will assume that benefit-cost outcomes for the 15 sample projects are representative of the total program.

Risk management

As identified in this report, the underlying objective of the MLA feedlots program is risk management. Two of the pillars of the program are concerned with:

- animal welfare (heat load management); and
- environment (understanding micro-climates of feedlots).

The analysis by Agtrans (2008c) focused on the direct benefits of these programs by including the benefits of:

- reduced mortality (and so higher turnoff); and
- preventing potentially higher compliance costs from unnecessary regulation.

Another benefit of the program — that is more difficult to quantify — is from the feedlot sector facing fewer constraints on the expansion than otherwise would be the case, taking an industry-wide perspective.

Adverse events in feedlots such as high mortality, odours and flies could potentially result in additional planning regulations at both local and state government levels that would restrict the ability of the industry to expand in response to market opportunities. An example of such an event was the death of 1 000 feedlot cattle due to heat stress in a number of feedlots in southern NSW.

4 With and without RD&E

Consistent with the 'top-down' approach used in this report for northern and southern industries — the next step is to establish the 'with' and the 'without' RD&E investments by MLA and other contributors.

On-farm programs

Agtrans (2008a and 2008b) set out the logic for the 'with' and 'without' cases summarised in table 4.1. ABARE (2008a) estimated that trend TFP growth in the beef industry has been:

- 2.1 per cent per year for northern beef between 1985-86 and 2005-06; and
- 1.3 per cent per year for southern beef between 1977-78 and 2005-06.

These estimates compare to 2 per cent TFP for broadacre cropping in Australia over 1977-78 to 2005-06, which was driven by gains from increasing mechanisation and scale of operations and an underlying genetic improvement in grains. Prior to and throughout the evaluation period, northern beef also experienced strong productivity growth equivalent to that of broadacre cropping but also higher than that observed in southern beef.

The Agtrans analysis was based on TFP estimates by ABARE (2008a). These estimates have subsequently been updated by ABARE (2008b) to include 2006-07 survey data and changes in methodology. The revised TFP estimates are shown in table 4.1. To maintain consistency by Agtrans (2008a and 2008b), the revised TFP estimates were updated for the corresponding time periods used in the original analysis.

4.1 **Updated TFP estimates for the on-farm beef industry**

	Northern beef	*Southern beef*
	%	%
1977-78 to 2006-07	1.05	**1.16**
1985-86 to 2006-07	**1.74**	0.32

Note*:* Bold numbers show the latest official TFP estimates that have been used in this analysis corresponding to those used in Agtrans (2008a and 2008b).

Source: ABARE 2008a

A key feature of this type of analysis is the extreme sensitivity of the overall TFP estimate to the timeframe considered as shown in table 4.1. In addition to this variation, the results for a similar time period will also change with the revision of the underlying survey dataset and changes in assumptions of the underlying model (partially explaining changes in TFP between ABARE reports).

The next step in the Agtrans analysis was to make a series of assumptions concerning the MLA contribution to the overall estimated TFP outcome. The first step was to recognise what information the TFP estimate captures — which is summarised in table 4.2.

4.2 Factors contributing to TFP estimate

TFP growth factors	*MLA contribution*
Seasonal variation	▪ MLA programs would contribute to how producers respond to seasonal changes. ▪ A large factor especially in the variation we see in the Southern industry especially for a year-on-year drought. ▪ Incorporation of seasonal changes significantly more difficult than for grain TFP studies.
Underlying productivity growth	▪ This is where we would expect that majority of the MLA contribution to be. ▪ This would be expected to be a changing at a constant rate which may not be independent of other factors such as structural change.
Structural change in the industry	▪ A significant factor to industry performance with little or no MLA contribution. – In the North, the change of the Northern system from bullocks to cow-calf in response to the live trade. – In the South, feeding cattle would have a significant influence. ▪ Not easily incorporated into TFP framework.
Model and data misspecification	▪ Not easily improved. – The underlying survey database is as probably as good as we can realistically expect.

Source: The CIE.

Underlying productivity growth is one part of the TFP estimate. Seasonal variations in the southern industry, especially post-2000 and structural change in the northern industry have also had profound impacts on observed TFP outcomes.

> Australia's success in meeting the growth in south east Asian demand for live feeder cattle in the early to mid-1990s was made possible by some important changes to the breeding and management systems of northern Australian properties. Traditional breeding and fattening systems that turned off bullocks at four to five years of age were converted to enterprises with a higher proportion of breeders turning cattle off at a younger age. This was a major contributing factor to the steady increase in turnoff rates observed in northern Australia over the past fifteen years (ABARE 2007).

Accounting for these factors within the constraints of the existing farm survey methodology and the TFP framework is very difficult.

The next step was to recognise that of the underlying productivity growth component of the TFP estimate, only part can be claimed by concerted MLA/DPI programs. Mullen (2007, pp. 20) explores some of the sources of productivity growth:

> The long-term trend in productivity, which is possibly in the vicinity of 2.5% p.a. for broadacre agriculture in Australia, reflects the influence of slow moving factors like research-induced technological change, the education levels of farmers, and the state of public infrastructure in the form of transport and communications. Another slow moving variable is farm size.

Table 4.3 sets out the potential sources of underlying productivity growth in the beef industry. Mullen (2007) assumes that for broadacre agriculture, the domestic and imported split of R&D is around 60:40. Underlying productivity will in reality be contributed from each of these sources — they are also inter-related with structural change in the industry and adoption lags. That is, larger farms are more likely to be early adopters of technology.

4.3 Sources of R&D and innovation for Australian cattle industry

Sources and influence	*Description or contributing factors*
Domestic research	
▪ Public	▪ MLA/DPI. CRCs and CSIRO.
▪ Private	▪ Producer initiated research or by private companies.
▪ Embodied in new products	▪ Input providers (chemical and machinery manufacturers etc).
Imported research	
▪ Technology transfer	▪ Public and privately funded research from overseas.
▪ Embodied in new products	▪ MLA/DPI funds required for adaptation to Australian conditions.
	▪ Input providers (chemical and machinery manufacturers etc).
Structural change	
▪ Farm size consolidation	▪ Economies of scale and scope from consolidation.
▪ Public infrastructure	▪ Mainly improved access to transport.
Lags in uptake of new R&D	▪ Potentially long lags between initial R&D and adoption.
	▪ Education levels and business models key factors.

Source: Mullen (2007) and CIE.

The bottom line is that confident attribution of observed TFP back to an underlying productivity component, that itself can be reasonably attributed to MLA/DPI programs, is not possible. The necessary data and appropriate methodologies simply do not exist at this time. Therefore, assumptions need to be made on the MLA/DPI contribution to the observed TFP outcome.

Agtrans therefore assumes that the observed rates of TFP would have been significantly lower without MLA/DPI programs as follows:

- 60 per cent of the observed TFP or 1.04 per cent per year in the North; and

- 20 per cent of the observed TFP or 0.23 per cent in the South.

The 'without' case reflects an assessment of the contribution RD&E makes to the overall TFP outcome. Therefore it has been assumed that RD&E contributed:

- 40 per cent to the TFP outcome in the North; and
- 80 per cent to the TFP outcome in the South.

Table 4.4 shows how these TFP rates are assumed to decay over time for the observed and baseline scenarios:

4.4 Assumed TFP for the baseline and observed beef industry outcomes

Year	*Assumed TFP growth*[a]		*Cumulative TFP index*[b]	
	Northern	*Southern*	*Northern*	*Southern*
	%	%	Index	Index
Baseline				
1999-00	1.74	1.16	100.0	100.0
2000-01	1.74	1.30	101.7	101.3
2001-02	1.57	1.03	103.3	102.3
2002-03	1.39	0.77	104.8	103.1
2003-04	1.22	0.50	106.0	103.6
2004-05	1.04	0.23	107.2	103.9
2005-06	1.04	0.23	108.3	104.1
2006-07	1.04	0.23	109.4	104.4
2007-08	1.04	0.23	110.5	104.6
2008-09	1.04	0.23	111.7	104.9
2009-10	1.04	0.23	112.9	105.1
2010-11	1.04	0.23	114.0	105.3
2011-12	1.04	0.23	115.2	105.6
2012-13	1.04	0.23	116.4	105.8
2019-20	1.04	0.23	125.2	107.6
Observed				
1999-00	1.74	1.16	100.0	100.0
2000-01	1.74	1.30	101.7	101.3
2001-02	1.68	1.21	103.5	102.5
2002-03	1.62	1.12	105.1	103.7
2003-04	1.57	1.03	106.8	104.7
2004-05	1.51	0.94	108.4	105.7
2005-06	1.45	0.86	110.0	106.6
2006-07	1.39	0.77	111.5	107.5
2007-08	1.33	0.68	113.0	108.2
2008-09	1.28	0.59	114.4	108.8
2009-10	1.22	0.50	115.8	109.4
2010-11	1.16	0.41	117.2	109.8
2011-12	1.10	0.32	118.4	110.2
2012-13	1.04	0.23	119.7	110.4
2019-20	1.04	0.23	128.7	112.2

[a] Annual growth in total factor productivity. [b] Index base 1999-00=100.

Source: Agtrans (2008a), Agrtans (2008b) and The CIE.

- for the observed or with RD&E case, if the programs ended in 2007-08, decay in TFP is assumed to occur through to 2013-14 before it returned to its 'without' investment level; and
- for the baseline or 'without' RD&E case, TFP is assumed to decay immediately and return to the 'without' RD&E level by 2004-05.

The logic for this attribution comes about after subjectively accounting for all of the contributing factors identified above. For example, increased corporate involvement and a period of significant structural adjustment in the northern industry were significant factors in explaining this assessment.

Table 4.4 also shows how assumed annual TFP growth is accumulated over the evaluation period. For example, the observed TFP index for northern beef reaches 128.7 by 2019-20. That is, total factor productivity would be 28.7 per cent higher than levels in 1999-00. For this evaluation, the *observed* result for 2019-20 is compared to the *baseline* TFP result for the same year where the index is equal to 125.2 for northern beef.

Table 4.5 shows the changes in total factor productivity between the *baseline* ('without' RD&E case) and the *observed* ('with' RD&E) outcomes.

4.5 Changes in TFP as a result of on-farm RD&E

	Northern beef	*Southern beef*
	%	%
1999-00	0.0	0.0
2000-01	0.0	0.0
2001-02	0.1	0.1
2002-03	0.3	0.4
2003-04	0.6	0.7
2004-05	1.1	1.2
2005-06	1.5	1.7
2006-07	1.8	2.0
2007-08	2.0	2.3
2008-09	2.3	2.6
2009-10	2.4	2.7
2010-11	2.5	2.9
2011-12	2.6	2.9
2012-13	2.6	2.9
2019-20	2.6	2.9

Source: CIE calculations.

Table 4.5 shows that, given the series of assumptions made above, by 2019-20, on-farm total factor productivity with RD&E would have been:

- 2.6 per cent higher for northern beef than otherwise the case; and
- 2.9 per cent higher for southern beef than otherwise the case.

At first glance, the difference in cumulative growth in TFP between the baseline and the observed outcome may not appear to be significant. But this improvement, at the total output level, will translate to significantly higher percentage increases in farm value-added. If on average, farm value-added for Australian beef is around 15 per cent of farm level GVP, a 3 per cent increase in TFP translates to a 15 per cent increase in farm value-added (assuming no change in output prices or farm costs).

But changes in TFP do *impact* on prices and costs — to measure the extent of this impact and the flow-on to farm level value-added, we need to use a framework that accounts for these interactions. The changes in table 4.2 represent the 'shocks' to the Integrated Framework.

Feedlots – risk management

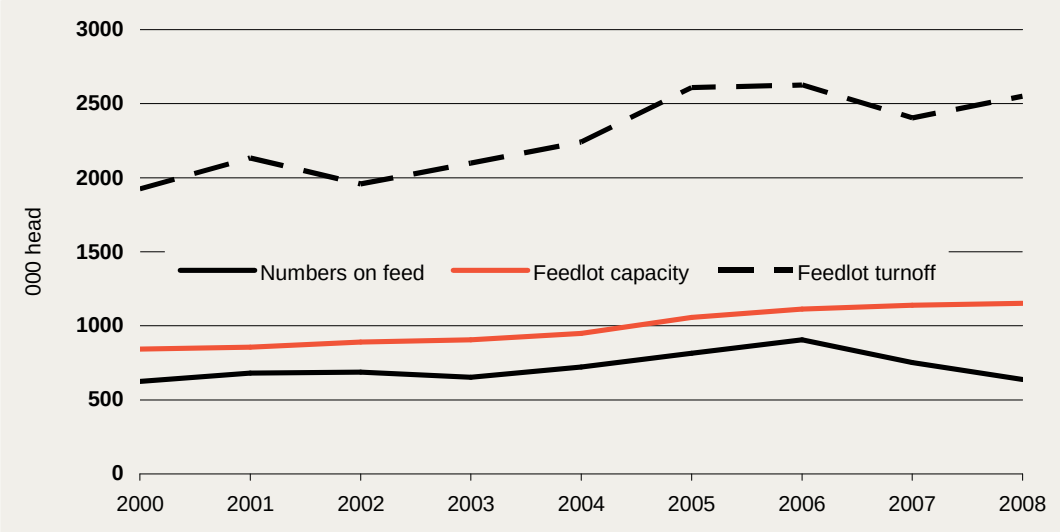
To evaluate these benefits, we need to develop a realistic scenario concerning the capacity of the feedlot sector. Chart 4.6 shows key feedlot data from 2000 to 2008. The key indicators shown in table 1 are:

- average numbers on feed and average feedlot capacity; and
- feedlot turnoff (turnoff is higher than average numbers and capacity because cattle spend an average of 120 days in a feedlot and days on feed has declined over this period, hence turn-off has increased more than numbers on feed).

Chart 4.6 shows that establishing the 'without' program case or the baseline depends critically on which variable is being observed:

- feedlot capacity depends broadly on the medium to long term profitability of the industry and is subject to a range of state and local government planning approvals;

4.6 **Feedlot numbers, capacity and turnoff[a]**



[a] Numbers on feed and feedlot capacity are averages across each calendar year.

Data source: ALFA and MLA.

- numbers on feed or utilisation of feedlot capacity depends on short term market conditions within the industry particularly in relation to the differential between grainfed beef prices received and the cost of grain; and
- turnoff depends not only on numbers on feed but also the combination of short, middle and long day feeding that occurs across the industry — which itself depends on relative profitability between market segments and the extent of forward contracts that industry has committed to.

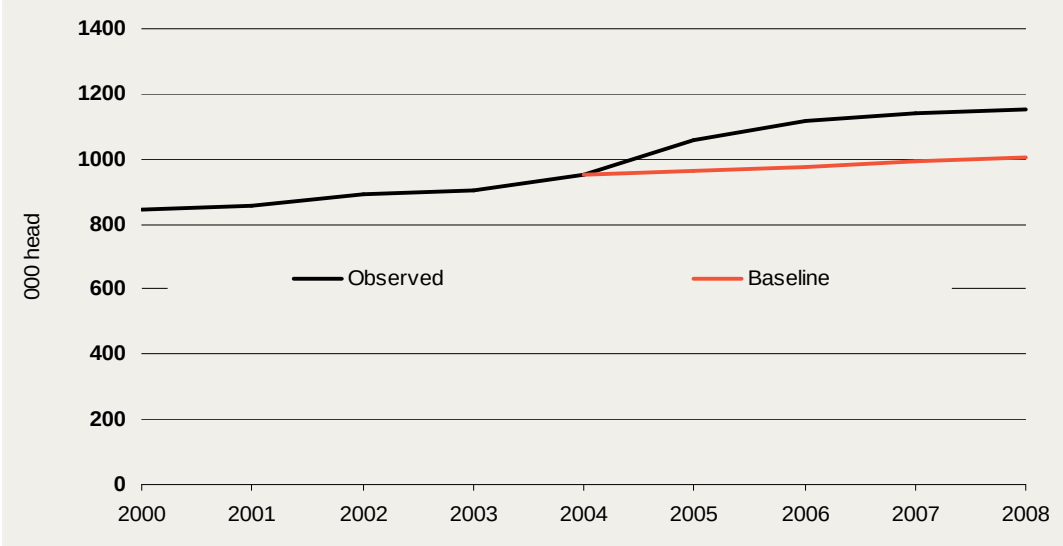
The next step is to develop a scenario to reflect the fact that better issues management as a result of the Feedlot R&D program permitted the industry to larger and more flexible than otherwise it may have been as a result of greater controls at the local and state government level. To establish the baseline or 'without' program case a number of assumptions were made:

- The outputs of the program were uniformly implemented across the industry as part of the National Feedlot Accreditation Scheme starting in early 2005. The benefits of the program are realised from 2005 onwards.
- The growth in feedlot capacity could have been 30 per cent lower than that which was observed.

The observed and baseline outcomes for feedlot capacity are shown in chart 4.7. By 2008, total feedlot capacity could have increased under the baseline but would be 12 per cent lower than that observed.

But due to the nature of changing community expectations these benefits are assumed to persist for only 5 years after the end of the evaluation period in 2007-08 where they diminish through to 2012-13. The logic behind this assumption is that it is likely that the industry will have to address a range of additional animal welfare and environmental concerns — the program will have to adapt to manage these risks.

4.7 **Observed and baseline feedlot capacity with MLA program**



Data source: The CIE and Des Rinehart, pers. comm., October 2008).

5 *Estimating the impact of beef on-farm activities*

Chapter 4 summarises the levels of TFP that the Australian beef industry may have achieved without the investments made by the MLA and DPIs compared to what the industry looks like now.

The objective of this chapter is to estimate the benefits to the beef industry as a result of these outcomes that can be attributed back to MLA and the DPIs. To estimate the impact of MLA's on-farm beef programs, a series of assumptions must be made in-line with the 'top-down' approach set out in chapter 3.

Evaluation approach

A starting point is to reiterate what is included and what is not considered as part of this evaluation. The program evaluation framework developed by the CIE (2005) identifies three types of benefits — as part of a triple-bottom-line approach:

- economic
- environmental
- social.

The MLA beef on-farm programs are targeted at improving productivity in the beef industry through research and adoption. This means that the benefits generated by the programs would be primarily economic, although it is acknowledged these programs should generate flow-on benefits to regional communities that are more social in nature. In addition, these programs are run concurrently with other programs that are targeted at environmental benefits. However, due to the difficulty in explicitly identifying the nature and magnitude of these impacts, we make no attempt to identify or quantify flow-on benefits resulting from these programs in this evaluation.

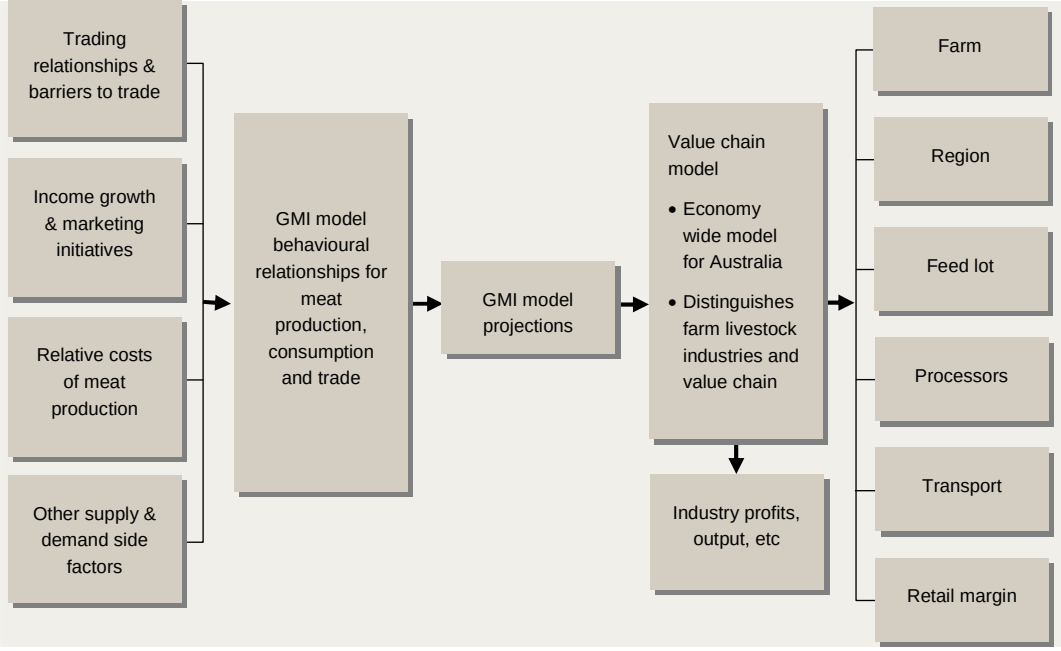
Integrated Framework

The results presented in this chapter are generated according to the guidelines provided in the economic module of the evaluation framework. This module provides a set of 'rules of thumb' for estimating industry benefits arising from changes in demand and supply. However, the economic module only distinguishes

between domestic and export markets in aggregate. Because of this, the GMI model is linked with the Integrated Framework (IF) model to estimate the benefits to the industry. This approach is illustrated in chart 5.1.

The GMI model provides a global representation of production, consumption, trade and prices at the bilateral level for meat (beef, sheepmeat, pigmeat and poultry) and live animals (cattle and sheep). It measures payoffs to Australian beef and sheepmeat producers in terms of changes in prices, production and gross value of production at an aggregate industry level. But the GMI model is purely a meat industry model and as such, it does not measure effects on other industries or the economy as a whole.

5.1 Linked GMI and Integrated Framework



Data source: TheCIE.

The Integrated Framework is a model of the Australian economy. It captures interactions between the red meat value chain and other sectors of the economy. These interactions include purchased input use at the farm level and value adding factors such as capital and labour. In terms of red meat sector coverage, the IF includes farm production, feedlots, processing, wholesaling, retailing, domestic consumption and exports. The IF measures the effect of changes on each industry (in terms of output, prices, net income etc.) and the economy as a whole (in terms of GDP, employment, consumption, trade balance etc.). The linked GMI/IF system as shown in chart 5.1 then links the outcomes in specific global markets with details at the domestic industry level and broader economy.

Of relevance to this evaluation, the IF identifies relevant industry detail including:

- northern and southern beef; and
- feedlots.

In terms of key markets, the IF identifies for each industry the exposure to each of the markets through the:

- export of live cattle;
- slaughter of cattle — for domestic and export markets; and
- sale of feeder cattle into feedlots.

Therefore IF is ideally suited for this task.

Putting the program into perspective

To put this evaluation in context, table 5.2 calculates the total investment in on-farm beef programs as a percentage of industry GVP. It is important to note that the GVP numbers in table 5.2 are not directly comparable to official ABARE GVP estimates because of differences in methodology and the treatment of feeders sold to lotfeeding. ABARE measures GVP at two points: where cattle are slaughtered and at the point of export.

GVP, as calculated in table 5.2, for northern and southern industries include estimates of cattle sales of:

- feeders for grain finishing (the cost of feeders accounts for roughly two-thirds of GVP of lotfeeding); and
- sales of cattle for live export.

Over the period, the northern industry accounted for 38 per cent of total farm level GVP (excluding lotfeeding). Total RD&E investment as a proportion of GVP over the period 2000-01 to 2006-07 was:

- 1.9 per cent for northern beef; and
- 1.2 per cent for southern beef.

5.2 **RD&E share of beef industry GVP**

Year	*Gross value of production*[a]				*RD&E share of GVP*			
	Northern	*Southern*	*Feedlots*	*Total*	*Northern*	*Southern*	*Feedlots*	*Total*
	$m	$m	$m	$m	%	%	%	%
2000-01	1 880	2 559	1 037	5 476	1.8	1.5	0.1	1.0
2001-02	2 341	2737	1 025	6 104	1.5	1.4	0.1	0.9
2002-03	2 437	3 441	2 343	8 221	1.5	1.1	0.0	0.7
2003-04	1 981	3 504	2 170	7 654	1.9	1.1	0.1	0.8
2004-05	2 425	4 867	2 680	9 973	1.6	0.8	0.0	0.7
2005-06	2 715	4 592	3 420	10 727	1.5	0.9	0.0	0.6
2006-07	2 840	4 548	3 239	10 626	1.5	0.9	0.0	0.7

[a] Not comparable with ABARE estimate due to treatment of feeders sold to lotfeeding.

Source: Agtrans(2008a), Agtrans(2008b),and CIE estimates of beef industry GVP.

The share of total investment in feedlots is exaggerated by the nature of the GVP calculation and so is not directly comparable to the farm-level industries. That is, the cost of feeders generally represents 60 per cent of total feedlot costs across animals that are short and long-fed.

An important variable in the following benefit–cost calculations is beef industry value-added. One consistent source of information on farm value-added is from the MLA/ABARE Farm Survey which spans the period of this evaluation. From this source, farm value-added is defined as the difference between total receipts and total cash costs including wages to hired labour.

- This data recognises the fact that beef is produced on farms with multiple enterprises that share common or fixed costs.
- Over all enterprises, receipts from all cattle sales account for half of all activities. In the North, cattle accounts for 70 per cent of total receipts.

Over the period 2001 to 2007, the MLA/ABARE farm surveys reported that farm value-added represented 25 per cent of total farm receipts on average. Table 5.3 presents estimates of Australian industry value-added. By 2006-07, the direct contribution of the beef industry to gross domestic product was valued at around $1.5 billion — which has been remarkably stable. At the farm level, this total contribution is shared equally between the northern and southern industries.

5.3 **Beef industry value-added**[a]

	Northern	*Southern*	*Feedlots*[b]	*Total*
	$m	$m	$m	$m
2000-01	525	498	53	1 076
2001-02	634	509	52	1 195
2002-03	639	611	126	1 376
2003-04	503	592	117	1 213
2004-05	595	781	140	1 516
2005-06	643	698	171	1 513
2006-07	649	653	156	1 458

[a] Farm income plus wages to hired labour. [b] Assumed to be 15 per cent of the difference between industry GVP and cost of feeders.

Source: ABARE farm surveys and CIE estimates.

Attribution

Chapter 4 established the 'with' and 'without' whole-of-RD&E contribution to observed changes in TFP in the beef industry. That is, it asked the question: what part of observed TFP gains can be attributed back to RD&E funded by MLA, DPIs and the other contributors?

The changes in TFP as a result of on-farm RD&E shown in table 4.5 — in combination with the base data shown in tables 5.2 and 5.3 that sits behind the IF — will

determine the overall size of the benefits or payoffs from on-farm RD&E. The next step required is to then allocate this total benefit between on-farm contributing agencies.

This requires another set of assumptions concerning the attribution of program benefits made by the MLA relative to that made by the DPIs and others. Two factors were taken account of in this judgement:

- the contribution made on the basis of expenditures by MLA relative to other contributors predominantly the DPIs;
  - the inclusion of allowances for overhead costs for DPIs has a significant impact on funding shares but may not truly reflect the overall contribution by individual programs and projects;
- the leverage of funds by MLA from other contributors.

To account for these factors, funding contributions are calculated 'with' and 'without' the allowance for DPI overheads. Table 5.4 shows with the inclusion of DPI overheads, that MLA contributed 11 per cent to total on-farm funding for the beef industry when accounting for all contributors are between 16 and 17 per cent of the combined expenditure by MLA and the DPIs.

5.4 **MLA contribution to total funding** 2001-01 to 2007-08[a]

	Northern region	*Southern region*
	%	%
Including DPI overhead costs		
MLA plus DPI only	17.0	16.5
Across all contributors	11.3	11.0
Excluding DPI overhead costs		
MLA plus DPI only	23.5	22.8
Across all contributors	13.9	13.5

[a] Values in nominal terms.

Source: Agtrans (2008a) and (2008b).

The MLA contribution rises — when DPI overheads are excluded — to between 13.5 and 14 per cent across all funding sources.

Leverage is also very important. This reflects that total on-farm investment by other contributors would have been less in absolute terms without the MLA funding. Again, this is very important when around 60 per cent of the total DPI contribution is accounted for by overheads that are not specifically program or project related.

Again confident attribution of benefits back to contributors is not possible. Attribution then requires assumptions informed by these data. Agtrans (2008a and 2008b) analysis suggests attribution of benefits to MLA of 20 per cent for northern and southern beef. Table 5.5 shows the assumed attribution used for this evaluation

which reflects a compromise between the funding shares and the Agtrans assumptions.

5.5 Attribution of benefits used in analysis

	MLA	*Other contributors*[a]
	%	%
Northern beef	15	85
Southern beef	15	85
Feedlots	100	0

[a] Includes DPIs, CSIRO and CRCs.

Source: Agtrans (2008a) and (2008b).

In the case of the Feedlots program, 100 per cent of the benefits are attributed back to MLA programs. Without this funding, the benefits described earlier would not have been realised.

Results

Table 5.6 shows the summary results for this evaluation — changes in TFP from table 4.2 and using an assessment of the attribution of these benefits to each of the contributing groups.

5.6 Results summary — benefits calculated over the period 2001 to 2015[a]

	Attribution	*Total benefits*	*Total costs*	*Benefit–cost ratio*	*IRR*
	%	$m	$m		%
Northern beef					
MLA on-farm	15	114	46	2.5	25
DPI and others on-farm	85	647	365	1.8	27
Total MLA/DPI	100	762	411	1.9	27
Southern beef					
MLA on-farm	15	193	44	4.4	44
DPI and others on-farm	85	1 094	370	3.0	43
Total MLA/DPI	100	1287	414	3.1	43
Feedlots[b]					
MLA on-farm	100	67	8	8.2	62
DPI on-farm	0	0	0	0.0	0
Total	100	67	8	8.2	62
Total on-farm (excluding feedlots)[c]					
MLA	15	307	90	3.4	38
DPI and others on-farm	85	1 742	735	2.4	36
Total	100	2 049	825	2.5	36

[a] Net present values calculated over the 2001 to 2015 with a discount rate of 5 per cent, 2007-08 dollar equivalents. [b] Program benefits include both increased productivity and issues management. [c] Aggregate benefit–cost ratio excludes expenditure by other industry stakeholders.

Source: Agtrans (2008a), Agtrans (2008b), Agtrans (2008c), Integrated Framework and CIE calculations.

Across all contributors, the benefit-cost ratios were found to be significant: an average of 2.5 to 1 across all programs during the evaluation period. The payoff for the Southern program (3.1 to 1) was higher than for the Northern program (1.9 to 1) because of the underlying assumptions made about the relative contribution of MLA and others to overall TFP outcomes observed in the industry in chapter 4.

Overall, the benefit-cost ratio for MLA on-farm beef programs varies between 2.5 to 1 for northern beef and 4.4 to 1 for southern beef. The outcome of the Southern program reflects the leverage that MLA has achieved from co-funding particularly from the DPIs and the assumed contribution to TFP of that sector.

The case studies conducted by Agtrans (2008c) of selected feedlot projects revealed an average payoff of 3 to 1 — largely as a result of higher productivity. The additional scenario concerning the benefits from risk management for the feedlots sector demonstrated larger benefits beyond that indicated by Agtrans (2008c) bringing the potential overall payoff of the Feedlots program to over 8 to 1.

Sensitivity analysis

The timing or flow of benefits from the investments made over the period 2001 to 2007 has a significant impact on the bottom-line payoffs. As a check on the headline results, program payoffs were also calculated by considering only benefits from the period corresponding to the investment. This asks the question: what would be the payoff if the MLA and other investments had to pay for themselves over the period from 2001 to 2007? The results are shown in table 5.7.

Table 5.7 shows that under this scenario — based on the same attribution as the headline analysis — the payoff to MLA expenditures over both the northern and southern regions becomes marginal and significantly reduced relative to the headline analysis. When benefits are constrained to the evaluation timeframe, the net benefits of the northern industry program are slightly negative.

Given the lags involved in adoption profiles and the long-term nature of underlying productivity gains these results show that the headline results are reasonably robust — demonstrating that with all likelihood MLA programs have delivered net benefits to levy payers.

Table 5.8 summarises the net benefits of increasing the benefit period by 5 years from the headline analysis to 20 years. Total payoff, in terms of benefit-cost ratio increases from 2.5 to 1 to 3.5 to 1 while attribution remains unchanged by assumption.

5.7 Results summary — benefits calculated over the period 2001 to 2007[a]

	Attribution	*Total benefits*	*Total costs*	*Benefit–cost ratio*	*IRR*
	%	$m	$m		%
Northern beef					
MLA on-farm	15	35	46	0.8	-12
DPI and others on-farm	85	199	365	0.5	-2
Total	100	234	411	0.6	-3
Southern beef					
MLA on-farm	15	65	44	1.5	27
DPI and others on-farm	85	366	370	1.0	27
Total	100	431	414	1.0	27
Feedlots[b]					
MLA on-farm	100	44	8	5.4	47
DPI on-farm	0	0	0	0.0	0
Total	100	44	8	5.4	47
Total on-farm (excluding feedlots) [c]					
MLA	15	100	90	1.1	18
DPI and others on-farm	85	565	735	0.8	15
Total	100	665	825	0.8	16

[a] Net present values calculated over the 2001 to 2015 with a discount rate of 5 per cent, 2007-08 dollar equivalents. [b] Program benefits include both increased productivity and issues management. [c] Aggregate benefit–cost ratio excludes expenditure by other industry stakeholders.

Source: Integrated Framework and CIE calculations.

5.8 Results summary — benefits calculated over the period 2001 to 2020[a]

	Attribution	*Total benefits*	*Total costs*	*Benefit–cost ratio*	*IRR*
	%	$m	$m		%
Northern beef					
MLA on-farm	15	160	46	3.5	27
DPI and others on-farm	85	909	365	2.5	29
Total	100	1 069	411	2.6	29
Southern beef					
MLA on-farm	15	267	44	6.1	45
DPI and others on-farm	85	1 516	370	4.1	44
Total	100	1 783	414	4.3	44
Feedlots[b]					
MLA on-farm	100	76	8	9.3	62
DPI on-farm	0	0	0	0.0	0
Total	100	76	8	9.3	62
Total on-farm (excluding feedlots) [c]					
MLA	15	428	90	4.8	39
DPI and others on-farm	85	2 424	735	3.3	37
Total	100	2 852	825	3.5	37

[a] Net present values calculated over the 2001 to 2015 with a discount rate of 5 per cent, 2007-08 dollar equivalents. [b] Program benefits include both increased productivity and issues management. [c] Aggregate benefit–cost ratio excludes expenditure by other industry stakeholders.

Source: Integrated Framework and CIE calculations.

Breakeven analysis

Another method of testing the robustness of the results is to examine the 'breakeven' point at which MLA programs pay for themselves. In practice, this point can be expressed in terms of any of the key variables involved in an evaluation. In the case of this evaluation, due to the 'top-down' approach that has been adopted, the most sensible breakeven analysis is around:

- the overall RD&E contribution to observed TFP growth in northern and southern beef industries; and
- the attribution of overall benefits between MLA and other contributors;

The simplest way to determine the breakeven attribution for each of the MLA on-farm programs is by asking: what contribution does each of the programs need to make to pay for the total investment in net present value terms?

Table 5.9 shows that, at minimum so that MLA programs could pay for themselves, the overall RD&E contribution to observed TFP would have to be at least:

- 30 per cent for the northern industry (compared to 40 per cent); and
- 50 per cent for the southern industry (compared to 80 per cent).

5.9 **Breakeven analysis of key assumptions in in-farm beef program[a]**

	Baseline	***Breakeven***
	%	%
RD&E contribution to observed TFP		
Northern beef	40.0	30.0
Southern beef	80.0	50.0
MLA contribution to benefits		
Northern beef	15.0	6.0
Southern beef	15.0	5.0

[a] Breakeven of MLA programs.

Source: Integrated Framework and CIE calculations.

In terms of the MLA contribution to total benefits which is assumed to be 15 per cent in the baseline, MLA programs would pay for themselves if MLA contributed just:

- 6 per cent to total benefits for the northern industry; and
- 5 per cent for the southern industry.

Supporting evidence

Table 5.10 summarises the supporting evidence from Agtrans (2008a) and Agtrans (2008b) from:

- case studies of individual projects or project clusters; and

- a separate 'top-down' evaluation of the Northern and Southern beef programs.

5.10 **Summary of payoffs from MLA beef case studies and programs[a]**

	Benefits	*Costs*	*NPV*	*Benefit cost ratio*	*IRR*
	$m	$m	$m		%
Northern beef					
Bullpower	29	2	27	16.6	29
Grazing Land Management	29	1	28	35.4	27
Faecal NIRS	26	3	23	7.9	38
Quantitative Genetics Research	17	5	12	3.6	38
EDGEnetwork®	59	15	45	4.0	19
Weighted average of case studies	159	25	134	6.3	28
Total Northern Beef program	1 724	412	1310	4.2	29
Southern beef					
Quantitative Genetics Research	10	3	7	3.6	na
Regional Systems to Meet Market Specifications	84	10	74	8.5	21
Sustainable Grazing System Program	192	53	138	3.6	25
Grain & Graze	206	32	175	6.5	28
Evergraze program	90	15	76	6.2	20
EDGEnetwork®	59	15	45	4.0	12
Weighted average of case studies	641	127	514	5.1	23
Total Southern Beef program	1 334	416	918	3.2	21

[a] Net present values calculated over 25 year time horizon with a discount rate of 5 per cent, 2005-06 dollar equivalents.
Source: Agtrans (2008a) and Agtrans (2008b).

The key point from the evidence presented in table 5.10 is that the results from Agtrans confirm those from the headline analysis in terms of benefit-cost ratios. It should be noted that the time period over which the benefits are calculated and the base period are different. Agtrans (2008a, 2008b) uses:

- a base year of 2005-06 (compared to 2007-08 for this evaluation); and
- a time horizon of 25 years (compared to 15 years).

Other key points are:

- average payoffs from the case studies are higher than those across the entire program;
  - this is often the case, even in a cluster analysis, when individual projects or programs selected for evaluation are above-average performers or have the best-supporting data;
- relative payoffs between the Northern and Southern programs are reversed compared to the headline analysis with the Northern program — the better performer;

- this result can be explained by differences in methodologies used by Agtrans and the IF approach used in this report:
  - The 'bottoms-up' analysis was conducted on a sample of 52 projects and was focused on MLA's investment across separate research portfolios — northern, southern, and feedlots — over the period 2000-01 to 2006-07. The results were then aggregated to provide a total NPV and an average BCR for each cluster.
  - It is important to note that this sample of 52 projects represented only 9 and 46 per cent of the total MLA investment in the North and South, respectively.
  - Lack of historical data limited the number of projects that could have any outcomes quantified. This was especially a problem for projects in the North where better performing projects were those with data available.
  - A conclusion is that the 'top-down' analysis, conducted over the same period, should be more representative across all MLA and DPI activities.

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