final report

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2020 Vision for the Australian Feedlot Industry

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Abstract

This report examines the current Australian feedlot industry, the drivers for future feedlot development and possible constraints to future industry development across the states of Australia to 2021. Despite significant challenges posed by competitive market pressures (both domestic and export), climate, rising costs and increasing regulatory demands, the feedlot sector will continue to be a significant factor in the Australian beef industry.

The initial premise that all slaughter cattle would be grain fed at some time in the future was modified on the basis that there will continue to be a vibrant live export industry and in southern Australia cattle will continue to be finished off on high quality pasture and fodder crops.

At the industry wide level, drivers for feedlot expansion, namely ever-diminishing land resources and pressures to reduce greenhouse gas emissions, are also opportunities to improve the environmental performance of the Australian beef herd. Other opportunities relate to improved efficiency in production, particularly with respect to energy usage and waste stream resource (energy and nutrient) recovery. These resources may have a value in excess of $100M at 2006 industry throughput.

Moving the beef industry to a production system where all available sale cattle are channelled through the feedlot supply chain will see a doubling of the number of cattle on feed from approximately 906,000 head to 1.81M head between 2006 and 2021 and will result in an increase in the percentage of cattle slaughtered that have been grain fed from 32% to 69%.

Total value added (contribution to GDP) generated by feedlots nationally was forecast to increase from approximately $950M in 2006 to around $1.8B in 2021. The 2021 forecast impact is comprised of over $500M in direct value added and almost $1.3B in flow-on value added. The major contributors to the total national value added impact in 2021 are expected to be Queensland (55%) and New South Wales (24%).

At the national level, direct employment in feedlots is forecast to increase from around 1,450 in 2006 to almost 2,900 in 2021. Aggregate employment (direct plus flow-on) is forecast to rise from around 6,700 fte to almost 11,400 fte over the same period.

The projected value of the feedlot industry at the feedlot gate is estimated to increase from $3.9B in 2006 to $7.4B in 2021.

The report details the roadmap of priority activities that need to occur to enable the feedlot industry to reach its development potential in each Australian state.

A series of industry wide constraints have been identified including labour shortages, increased regulatory pressures on development, greenhouse gas regulations and water security.

A series of detailed recommendations for further work are presented to capitalise on opportunities and overcome identified constraints.

Executive Summary

A previous Meat Research Corporation (MRC) project, M.544 “Input requirements for cattle feedlot industry”, highlighted the managerial and economic benefits of stratification and differentiation of livestock production activities. Since that time, a number of the Australian beef industry operators have adopted and benefited from this strategy, turning cattle off breeding areas at an earlier age and transferring them into the feedlot production system. The feedlot sector believes that if the industry wide benefits of these strategies could be demonstrated and quantified, the pace of beef industry structural change would be accelerated, accruing benefits to all sectors of the industry.

FLOT.132 “A 2020 Vision for the Australian Feedlot Industry“ has been designed to evaluate and demonstrate the economic, environmental and social benefits of these feedlot industry development strategies going forward to the year 2020.

Study focus

As a focus for the study, the feedlot industry has set a target scenario where **‘all sale animals that leave the property go directly into the feedlot supply chain, at either weaning or culling’.** ***The target scenario excluded live export cattle and cull breeding stock.***

Using the target scenario set by industry as the initial focus, the study was principally a desk-top exercise that collected and collated available industry information and, with input from an industry-based Advisory Committee, developed a roadmap for moving the Australian beef industry from its current position to one where all available sale cattle are channelled through the feedlot sector.

Demand for beef protein likely to continue into the future

The initial stages of the study examined global beef industry drivers and the Australia wide feedlot industry structural, managerial, economic and social effects of moving to this highly differentiated and specialised production system within the northern and southern beef industries. The demand for animal protein will continue to grow, driven by markets in developing countries requiring higher levels of protein in their diets as those countries’ gross domestic product increase over time. While beef will have to compete with other forms of protein for human consumption, it will still be a preferred food source that will satisfy middle and top end demand for eating quality.

Feedlot development is currently concentrated in the eastern states

Feedlots have been developed across the Australian grain belt, particularly in Queensland, New South Wales and Victoria. Location is prompted by access to cattle, meat processing capacity, feed grain and water (Exhibit 1).

Despite significant grain production in Western Australia and South Australia, grain supply capacity has not been matched with comparable feedlot development in those states.

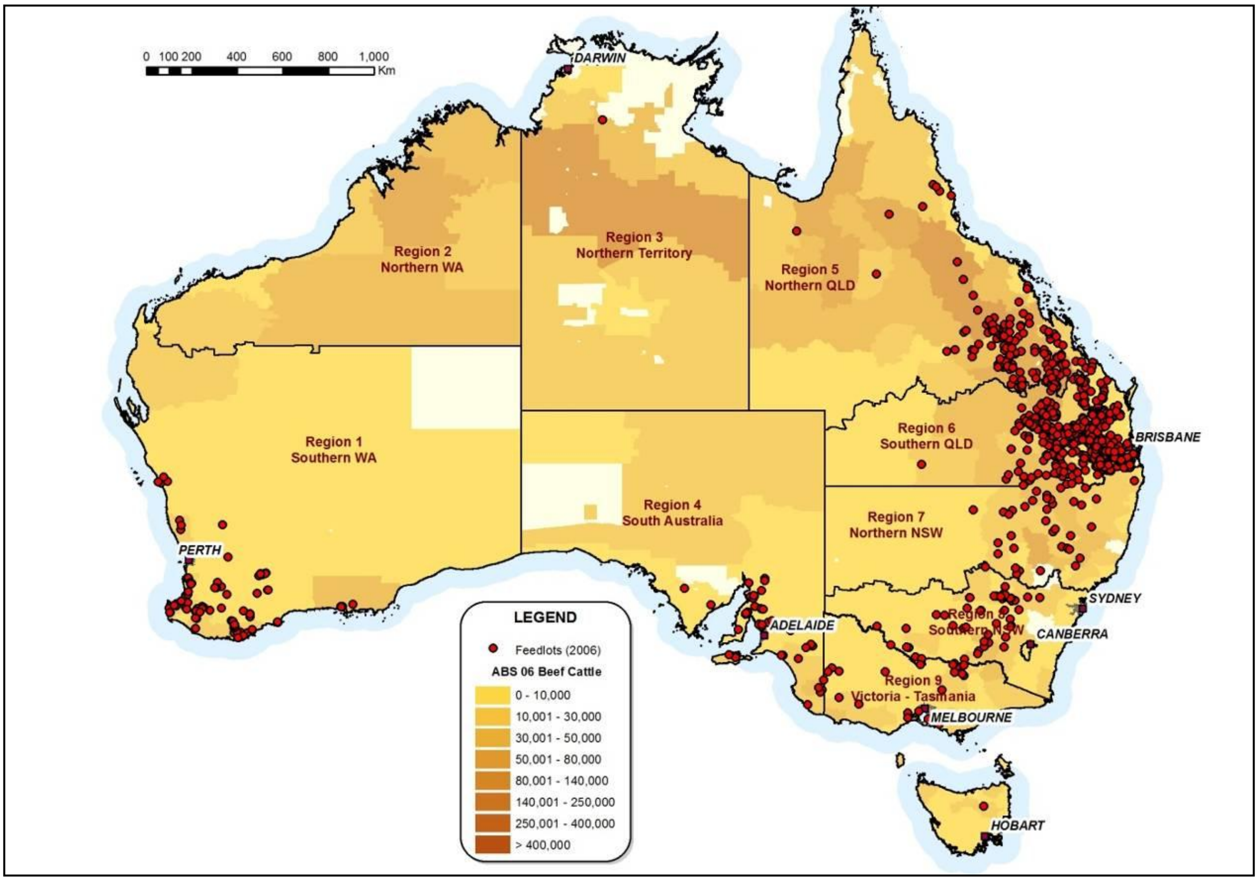

Exhibit 1 - Location of the Australian beef herd in relation to existing feedlot capacity

Feedlot expansion scenario modelled

The project developed an expansion scenario which sought to double the current average annual number of head on feed in Australian feedlots. The expansion assumed that current pen occupancy strategies would remain consistent with current practice (an average of 77% nationally), resulting in turnoff from feedlots representing approximately 69% of total annual slaughter. This figure is believed to be the sustainable capacity, representing the slaughter of all young cattle. Since average annual pen occupancy is to remain constant, expansion would be achieved through the construction of additional pen capacity.

Modelled forecasts indicate that grain fed slaughter cattle percentages will increase to 69 % by 2021

Assessment of the development of the feedlot industry in the nine regions from 2006 to 2021 produced estimates of grain-fed cattle slaughtered as a percentage of the total herd slaughter (Exhibit 2). Modelling predicts that grain-fed cattle will rise to 69% of the total Australian slaughter by 2021. This number of grain fed slaughter cattle would be approximately equal to all the young cattle produced in 2006 (total slaughter minus cull cows and bulls). Given the comparatively high cost of gain in some southern states with cattle finished on crop and grass over autumn and winter, there would need to be an increased supply of feeder cattle to satisfy this potential demand.

Region No	Region	2006	2011	2016	2021
1	Southern WA	35%	61%	133%	152%
2	Northern WA	0%	14%	20%	49%
3	Northern Territory	4%	7%	10%	26%
4	South Australia	19%	31%	48%	48%
5	Nth Queensland	12%	26%	38%	51%
6	Sthn Queensland	98%	116%	130%	152%
7	Northern NSW	29%	35%	40%	45%
8	Southern NSW	55%	67%	77%	85%
9	Victoria and Tasmania	20%	24%	28%	31%
	Australia	32%	44%	57%	69%

Exhibit 2 - Estimated grain fed percentage of total herd slaughter

The number of cattle on feed estimated to double by 2021

Exhibit 3 shows the estimated number of head of cattle on feed for the nine regions from 2006 – 2021, increasing from 906,468 head to 1,812,936 head.

Region No	Region	2006	2011	2016	2021
1	Southern WA	47,076	73,935	162,772	184,968
2	Northern WA	0	12,000	16,545	41,363
3	Northern Territory	6,400	12,000	16,545	41,363
4	South Australia	20,169	27,320	42,376	42,376
5	Nth Queensland	99,922	201,000	311,770	415,694
6	Sthn Queensland	375,899	425,590	498,212	581,247
7	Northern NSW	132,241	145,800	167,518	188,458
8	Southern NSW	161,628	180,000	206,813	227,494
9	Victoria and Tasmania	63,133	71,190	81,794	89,974
	Australia	906,468	1,148,835	1,504,345	1,812,936

Exhibit 3 - Estimated numbers of head-on-feed

The estimated demand for feed grains by the feedlot sector will double by 2021

Based on the estimated ration composition, the demand for summer grain will be 2.3 times current demand (Exhibit 4) whilst demand for winter grain will grow by approximately 80% (Exhibit 5). Actual summer/winter grain usage, however, will depend on the availability and price of grain.

Region No	Region	2006	2011	2016	2021
1	Southern WA	0	0	0	0
2	Northern WA	0	34,215	47,173	117,934
3	Northern Territory	18,243	34,215	47,173	117,934
4	South Australia	0	0	0	0
5	Nth Queensland	192,346	386,973	600,232	800,309
6	Sthn Queensland	544,489	616,539	721,744	842,035
7	Northern NSW	128,568	141,777	162,896	183,258
8	Southern NSW	0	0	0	0
9	Victoria and Tasmania	0	0	0	0
	Australia	883,647	1,213,718	1,579,219	2,061,470

Exhibit 4 - Estimated Summer Grain Demand (tonnes)

Region No	Region	2006	2011	2016	2021
1	Southern WA	127,622	200,437	441,272	501,446
2	Northern WA	0	0	0	0
3	Northern Territory	18,243	34,215	47,173	117,934
4	South Australia	54,175	73,358	113,786	113,786
5	Nth Queensland	96,173	193,486	300,116	400,154
6	Sthn Queensland	544,489	616,539	721,744	842,035
7	Northern NSW	244,826	270,006	310,226	349,004
8	Southern NSW	466,054	519,116	596,443	656,087
9	Victoria and Tasmania	180,696	203,831	234,194	257,613
	Australia	1,714,035	2,076,773	2,717,781	3,120,126

Exhibit 5 - Estimated Winter Grain Demand (tonnes)

Expansion of the feedlot industry would provide security of production, a consistent product and a reduction in grazing pressure from cattle in breeding areas in each state of Australia. This, in turn, would enable expansion of the breeding herd and therefore greater national beef production. There may also be benefits to the environment with respect to greenhouse gas production from such a move.

Highest predicted levels of feedlot industry expansion will occur in northern and southern Queensland and southern Western Australia

Feedlot regions with the highest predicted expansion are northern and southern Queensland and southern Western Australia.

The expansion of lot feeding in southern Queensland will result in higher numbers of cattle being transported from north to south, tightening of grain supplies and a shift of feedlots to sparsely populated areas with high security water supply. Expansion is expected to stretch feed grain supplies and lead to regular importing of grain from southern regions and possibly further afield. Significant expansion on the western Darling Downs and in the New South Wales border region could occur through the construction of approved developments and expansion of current feedlots.

Industry expansion in northern Queensland is favoured by the availability of land and water and location in the tick zone, eliminating the need to dip cattle en-route from northern regions. There are few region-specific limitations to expansion.

In southern Western Australia, the potential for expansion is facilitated by large grain supplies and potential access to reliable groundwater in some areas. Expansion could occur by sourcing northern cattle to feed through the winter. Constraints to development include state environmental regulations and current limitations in processing capacity.

Projected industry expansion in southern States will be constrained

Expansion of the feedlot sector in northern and southern New South Wales and Victoria/Tasmania is expected to be less than in the regions discussed above.

There are good opportunities for expansion in northern New South Wales, based on the abundant grain supply, cattle supply and availability of land. This may favour development in this region in preference to southern Queensland. However, OH&S regulations in New South Wales and competition for cattle from grass fed markets may be a constraint.

Southern New South Wales has potential for expansion through further development of existing feedlots and proposed new feedlots currently approved. Potential for sourcing water and sites available for very large developments mean there are opportunities in this region. However, expansion would require cattle to be sourced from northern New South Wales and Victoria. Constraints in this region include existing abattoir capacity and availability of labour, OH&S compliance costs and livestock transport loading standards inconsistent with other states.

Victoria and Tasmania are predicted to expand at a relatively slow rate. Expansion is likely to occur in western Victoria where land and water are available for developments. Development in Victoria is constrained by tight regulations from local councils and development controls in many river catchments. The Wimmera-Mallee region may provide the best options for development in response to additional secure water entitlements being made available from the Wimmera Mallee Pipeline Project.

Feedlot production in Tasmania is not expected to expand significantly, largely due to the low availability of grain, a less favourable climate and competition for cattle from grass finishing operations.

Feedlot development in new regions (northern Western Australia, the Northern Territory and South Australia) generally have less potential for feeding large numbers of cattle on traditional grain rations, although significant expansion above current levels would be achieved with the construction of just one medium sized feedlot (>10,000 head) in each of these regions.

In northern Western Australia and the Northern Territory there will be strong competition for feeder cattle from the live export trade, though opportunity exists for expansion of short term silage based feedlots that are integrated into the live export supply chain. Considering the need for infrastructure and labour to develop a feedlot in northern Australia, expansion would favour large, vertically integrated companies already involved in the live export industry.

Expansion of the South Australian industry is favoured by a readily available supply of feed grain. However, water security and processing capacity will present challenges to expansion.

There are some significant environmental drivers favouring feedlot industry expansion

At the industry-wide level, environmental drivers for feedlot expansion include:

- Opportunity to reduce the impact of cattle production on the natural environment by reducing stocking rates and transferring young animals to feedlots.
- Opportunity to reduce GHG production through feeding young cattle in feedlots in preference to low productivity grazing system and the opportunity to introduce feed additives if developed to reduce enteric methane emissions. In the broader context of the Australian beef industry, lot feeding of beef cattle will lead to lower overall GHG emissions per kg of beef compared to standard grass-fed production systems.
- Opportunity to make significant financial gains through energy and nutrient recovery from the feedlot waste stream. Nutrient value at 2006 feedlot throughput levels may be as high as $199M, if the total excreted nitrogen could be captured, or close to $102M under current management systems (based on a simplistic calculation from current fertiliser values). Additional benefits from this process may include:
    - Reduction of GHG emissions through capture and utilisation of methane, and potentially a reduction in nitrous oxide from manure management,
    - Reduction of odour from manure stockpiles and effluent ponds,
    - Elimination of pathogen risk from manure/effluent reuse,
    - Potential government funding for developments that generate green energy.

Environmental and infrastructure constraints to expansion that relate to the whole industry include:

- Shortages of skilled and un-skilled labour.
- Increasingly stringent and complex development regulation and appeal processes: these largely relate to odour, nutrient management and new topics of concern such as air-borne pathogens.
- Greenhouse gas regulations: site-based mandatory reporting of GHG, efficiency targets and the inclusion of agriculture in the proposed ETS represent a very significant reporting and financial burden if progressed as planned.
- Water costs: with the introduction of water trading and a cap on the overall resource, the capacity of feedlots to compete for water may be limited considering water costs may be considerable.
- Increasing environmental regulation problems relating to nutrient reuse at feedlots.

Other constraints identified by this project include the lack of accurate, detailed data on current industry year round occupancy and capacity, and annual grain use in feedlots.

A series of detailed recommendations for further work are presented in the report, with attention being placed particularly on water, greenhouse gas emissions, nutrient management and issues related to regulation.

Projected feedlot industry expansion will increase the industry value at the feedlot gate to approximately $7.4B

The growth in feedlot activity required to generate this increased capacity and production will have a significant impact on the regional economies of Australia. The estimated impacts, measured in terms of employment and value added are shown in Exhibit 6 and Exhibit 7.

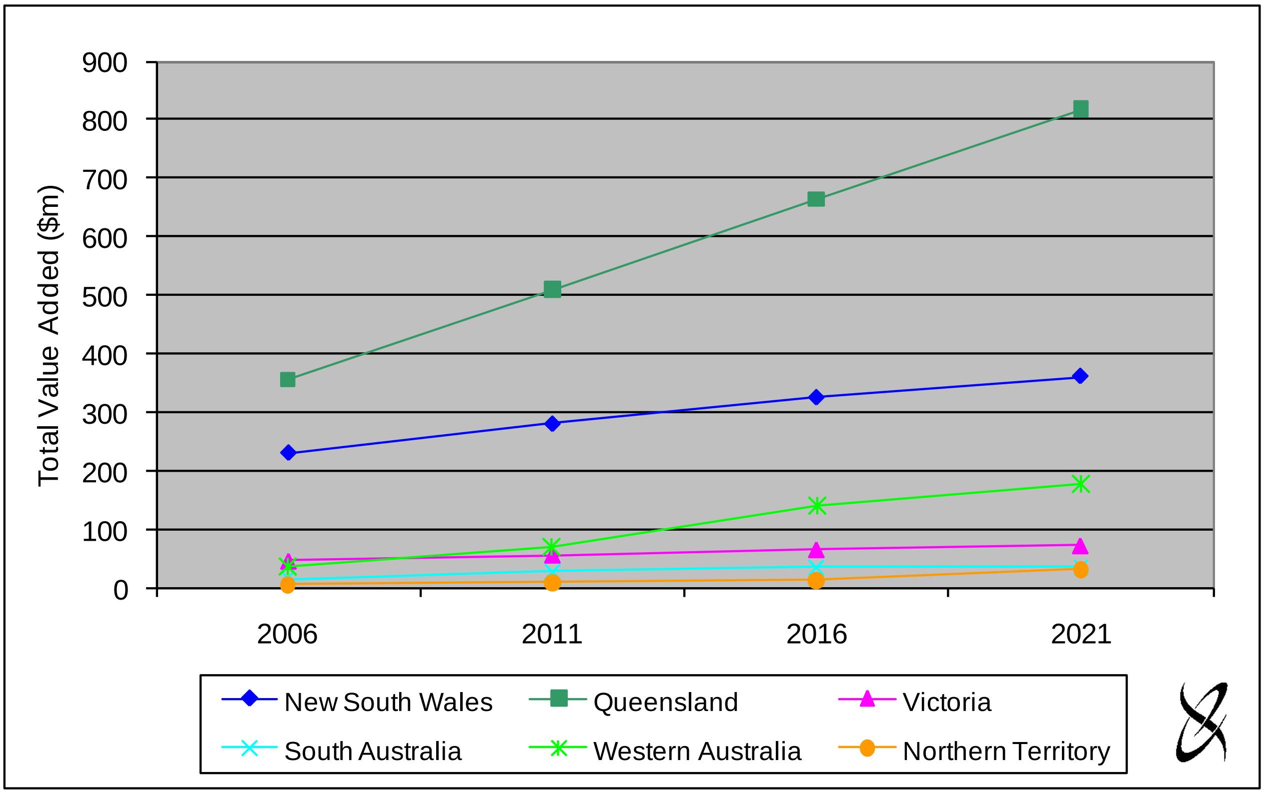

Exhibit 6 - Total value added impact of feedlots at the state level, 2006 to 2021

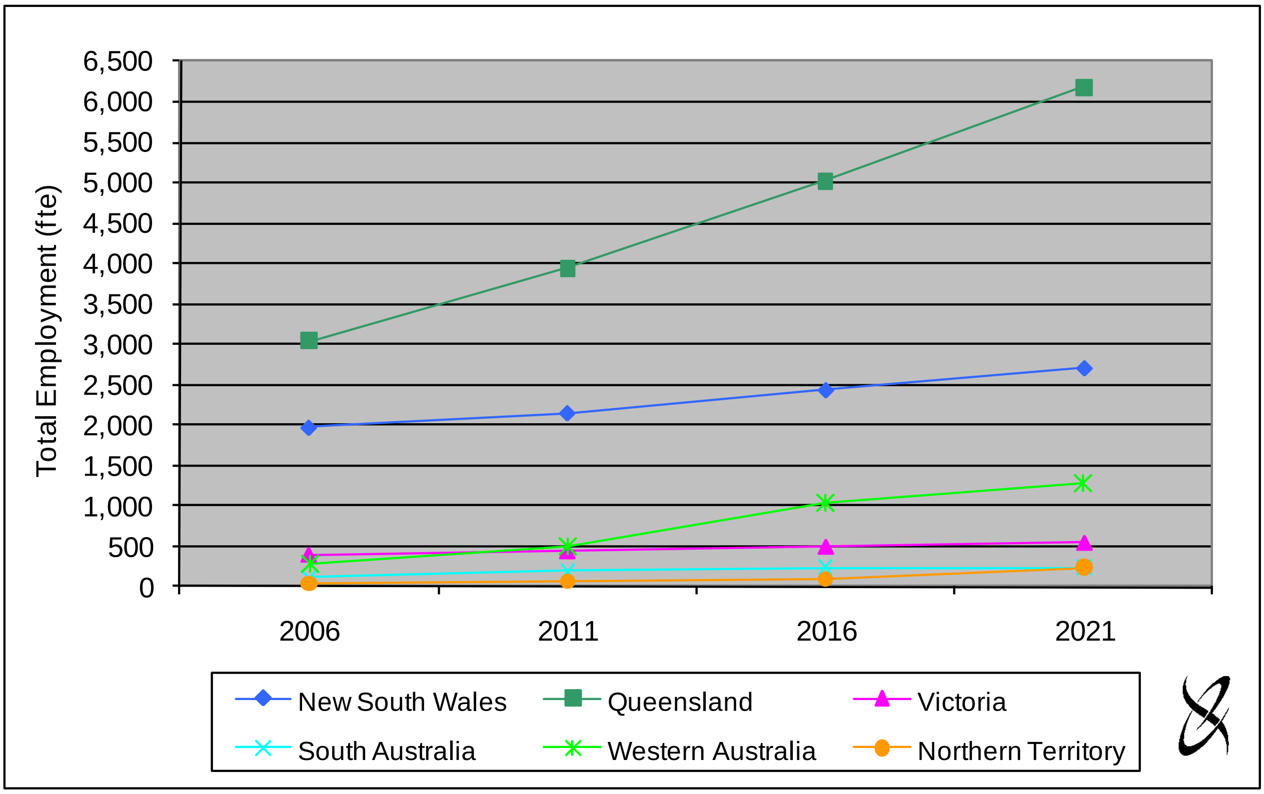

Exhibit 7 - Total employment impact of feedlots at the state level, 2006 to 2021

The estimated economic impacts have been made on the basis of:

- current employment to output ratios in the feedlot industry;
- labour productivity improvements of 1.0% per annum over the forecast period;
- total factor productivity of 1.5% per annum over the forecast period;
- current economic linkages expressed in the state and national input-output models.

Total value added (contribution to GDP) generated by feedlots nationally was forecast to increase from approximately $950M in 2006 to almost $1.8B in 2021. The 2021 forecast impact is comprised of over $500M in direct value added and almost $1.3B in flow-on value added. The major contributors to the total national value added impact in 2021 are expected to be Queensland (55 per cent) and New South Wales (24 per cent).

Employment (direct plus flow-on) is expected to grow from around 6,700 fte to almost 11,400 fte over the period 2006 to 2021.

Based on the assumptions used in this study and provided the feedlot industry can achieve the estimated industry expansion by 2021, the value of the feedlot industry at the feedlot gate will increase from $3.9B in 2006 to $7.4B in 2021 in 2006 dollar terms.

While this represents significant growth for the feedlot industry and for regional economies throughout Australia, it is worth noting that the analysis is an economic impact rather than of investment feasibility. Impact analysis provides information on the distribution of benefits and costs rather than providing an assessment of economic benefits required to justify investment in a particular project.

To realise this level of industry growth the feedlot industry needs to ensure that the appropriate operating environment is developed with the industry effectively working in conjunction with other segments of the lot feeding value chain and the respective State and Federal Government agencies.

Pre-requisites for feedlot industry expansion success

To capitalise on potential industry drivers and overcome identified constraints, the following industry and research recommendations are presented:

- **Water regulation and policy**: There is a need for the feedlot industry to participate in the on-going water regulation changes. Considering the importance and value of this resource, investigation into the capacity of feedlots to pay for water and development of an industry stance regarding water needs may be warranted.
- **Water and energy usage research and extension**: Considering the increasing value of water, on-going research that can lead to real water and energy savings at feedlots will be of value to the industry.
- **Development of an industry plan for GHG research**: It is important to note that based on research to date, actual GHG emissions from feedlots may be significantly different from those calculated by the standard Australian methodology because of potential errors in this methodology. The key research areas to be covered by the plan include:
    - Quantification of methane and nitrous oxide emissions from manure management at all stages through the feedlot system (feedlot pad, manure and effluent storage, manure and effluent reuse).
    - Identification of feasible options to reduce GHG production at feedlots, such as:
        - Production of energy from manure/effluent to offset energy demands and improve waste stream nitrogen management;
        - Improved energy efficiency within the operation;
        - Improved manure management to reduce methane and nitrous oxide emissions;
        - Quantification of soil carbon sequestration capacity of feedlots through manure/effluent usage; and
        - Development of an industry plan for managing GHG regulatory requirements.
- **Quantification of the potential GHG emission benefits to the beef industry from expansion of the feedlot industry:** This research need could be addressed within the scope of a northern beef LCA project.
- **Nutrient management research and extension:** Considering the very high potential value of nutrients excreted by feedlot cattle and the potential this has to alter feedlot economics, research is warranted to investigate:
    - Nutrient recovery options from manure and effluent; and
    - Nutrient reuse from manure and effluent on feedlot farms (which would lead to reduced input costs, increased crop production and improve ongoing regulatory compliance).

- **Regulation:** Regulatory pressures need to be addressed through constant review of changes to policy on a state-by-state basis. Identified research needs include:
  - New options for odour mitigation and review of according separation distances
  - Quantification of pathogen transmission risk via air and water
  - On-going participation in the effluent spillage regulation debate
  - Improved nutrient reuse effectiveness
- **Labour supply:** This may be addressed through recruitment and training of foreign workers under the Section 457 visa immigration ruling and extension of training and incentive programs for young workers and graduates.
- **Improvement of industry data:** This project identified two main data requirements, namely the need for improved livestock occupancy and pen capacity data, and grain consumption data. It would be beneficial to establish a mechanism for keeping up-to-date geo-referenced data on feedlot capacity and this should be explored by the industry.
- **Grain LCA data:** While not a feedlot research need, there is a need for improved LCA data from grain production that contribute to the carbon footprint for feedlot beef production (particularly with respect to GHG emissions, notably nitrous oxide). This research should be promoted to GRDC.

Feedlot industry expansion summary

In summary, the feedlot industry in 2021 will be significantly different from that of 2006. Based on the assumptions used in this study the industry is likely to double in size driven primarily by domestic and export market demand. That growth will result in a significant increase in demand for feedlot inputs.

Projected industry expansion is estimated to increase the feedlot gate value of the feedlot industry from $3.9B to approximately $7.4B in 2006 dollar values.

Exhibit 8 summarises the key impacts and requirements for the projected feedlot industry expansion between 2006 and 2021.

Feedlot Expansion Impact/Requirement	2006	2021
% of slaughter cattle that are grain fed	34%	69%
Estimated number of cattle on feed	906,468	1,812,936
Estimated number of cattle turned off from feedlots annually	2,647,733	6,046,678[(1)]
Estimated pen capacity at 77% utilisation	1,174,181	2,345,000
Estimated Summer feed grain demand (tonnes)	883,647	2,061,470
2006 Summer feed grain production (tonnes)	2,292,933	
Estimated Winter feed grain demand (tonnes)	1,714,035	3,120,126
2006 Winter feed grain production (tonnes)	37,141,634	
Estimated total grain demand (tonnes)	2,597,682	5,181,595
Estimated total feed grain demand as a % of 2006 feed grain supply	6.6%	13.1%
Additional land area required for feedlot expansion & development over 2006 (Ha)	0	5,300
Water required or feedlot use (ML)	28,180	56,280
Estimated full time staff equivalents	1,451	2,897
Value of the feedlot industry at feedlot gate ($B) in 2006 $terms	3.869	7.448

(1) This turnoff number might be constrained by the competition in southern states that feedlots will incur in competitive cost of gain from pasture and crop fed turnoff. Further constraints may occur with drought induced feed grain supply shortages driving up feed grain and feeder steer prices making lot feeding unviable in some regions in these circumstances.

Exhibit 8 - Estimated impacts and requirements for projected feedlot industry expansion between 2006 and 2021

The Australian feedlot industry in delivering reliable supplies of quality beef to domestic and export markets provides an important catalyst for change in the various regional economies and the Australian beef industry. The industry’s importance as a significant value adder of agricultural products and as a regional employer justify both the industry and government working together to provide a suitable operating environment for the industry to achieve the projected expansion targets and consequent economic contributions presented in this report.

Contents

List of Abbreviations

ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
ADG	Average Daily Gain
ALFA	Australian Lot Feeders Association
BSE	Bovine Spongiform Encephalopathy
CRC	Cooperative Research Centre
EPA	Environment Protection Agency
FAO	Food and Agriculture Organisation
FAPRI	Food and Agricultural Policy Research Institute
FMD	Foot and Mouth Disease
IFPRI	International Food Policy Research Institute
GCA	Grains Council of Australia
GDP	Gross Domestic Product
GHG	Green House Gases
GL	Gigalitres
GRDC	Grain Research and Development Corporation
HSCW	Hot Standard Carcase Weight
ML	Mega litre
MLA	Meat and Livestock Australia
MRC	Meat Research Corporation
NFAS	National Feedlot Accreditation Scheme
NWI	National Water Initiative
QDPI&F	Queensland Department of Primary Industry and Fisheries
SCU	Standard Cattle Unit
SMDB	Southern Murray Darling Basin
SWT	Shipped Weight
USDA ERS	United States Department of Agriculture Economic Research Service
VPP	Victoria Planning Provisions

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1 Background

1.1 Project background

1.1.1 Project genesis

A previous MRC project, M.544 "Input requirements for cattle feedlot industry", highlighted the managerial and economic benefits of stratification and differentiation of livestock production activities. Since that time, the Australian beef industry has adopted and benefited from this strategy, turning cattle off breeding areas at an earlier age and transferring them into the feedlot production system. The feedlot sector believes that if the industry wide benefits of these strategies could be demonstrated and quantified, the pace of beef industry structural change would be accelerated, accruing benefits to all sectors of the industry.

1.1.2 Project design overview

FLOT.132 "A 2020 Vision for the Australian Feedlot Industry" has been designed to evaluate and demonstrate the economic, environmental and social benefits of these feedlot industry development strategies going forward to the year 2020.

As a focus for the study, the feedlot industry has set a target scenario where ***'all sale animals that leave the property go directly into the feedlot supply chain, at either weaning or culling'. The target scenario excluded live export cattle and cull breeding stock.***

The initial stages of the study examined global and domestic beef industry drivers and the Australia wide feedlot industry structural, managerial, economic and social effects of moving to this highly differentiated and specialised production system within the northern and southern beef industries.

Using the target scenario set by industry as the focus, the study was principally a desk-top exercise that collected and collated available industry information and, with input from an industry-based Advisory Committee, develop a roadmap for moving the Australian beef industry from its current position to one where all available sale cattle are channelled through the feedlot sector. The study also assessed the trends in meat and beef consumption locally and in key export markets, the potential size and location of the feedlot sector and identified possible constraints that would impact on its ability to respond to this shift in production.

The project also evaluated the economic impacts of the industry development scenarios on a national and state basis, and developed strategies on a state by state basis that the feedlot sector can follow to ensure that the entire beef supply chain can respond appropriately to likely changes. It was hoped that the developed roadmap can provide the platform from which the economic, environmental and social benefits of feedlot industry expansion can be assessed and documented as a basis for planning the future development of the feedlot industry in Australia at both state and regional levels.

1.1.3 Industry advisory committee members

The study team was guided by an industry-based Advisory Committee made up of members of the northern and southern beef industry and feedlot industry members from the various states. The Advisory Committee had Australia wide representation and comprised the following members:

- Mr Malcolm Foster, Rangers Valley Feedlot New South Wales & President of Australian Lotfeeders Association

- Mr Sandy Maconochie. Hopkins River Feedlot Victoria & Immediate Past President of The Australian Lot Feeders Association
- Mr Charles Cay, Warrembool, Corowa, and Chairman of the Southern Australian Beef Research Committee
- Mr Ross Fraser, Managing Director, Frasers Livestock Transport, Warwick Queensland
- Mr John Keaveney, then General Manager, Feedlots, JBS Swift Australia
- Mr Vincent Heeran, National Manager Feedlots Elders, Dubbo , New South Wales
- Mr Don Mackay, previously Managing Director, Australian Agricultural Company, Brisbane
- Mr Des Rinehart, Feedlot Program Manager, Meat and Livestock Australia.

The project team would like to thank the Advisory Committee for their time and wise counsel throughout this project.

1.2 Project objectives

The following are the project objectives as per the terms of reference the consulting team worked to throughout this project:

1. Assess the industry-wide economic, environmental and social benefits of moving the beef industry to a production system where all available sale cattle are channelled through the feedlot supply chain.
2. Identify any constraints that would impact on the industry's ability to move to this production system and develop strategies to ensure that the industry can respond appropriately.

2 Methodology

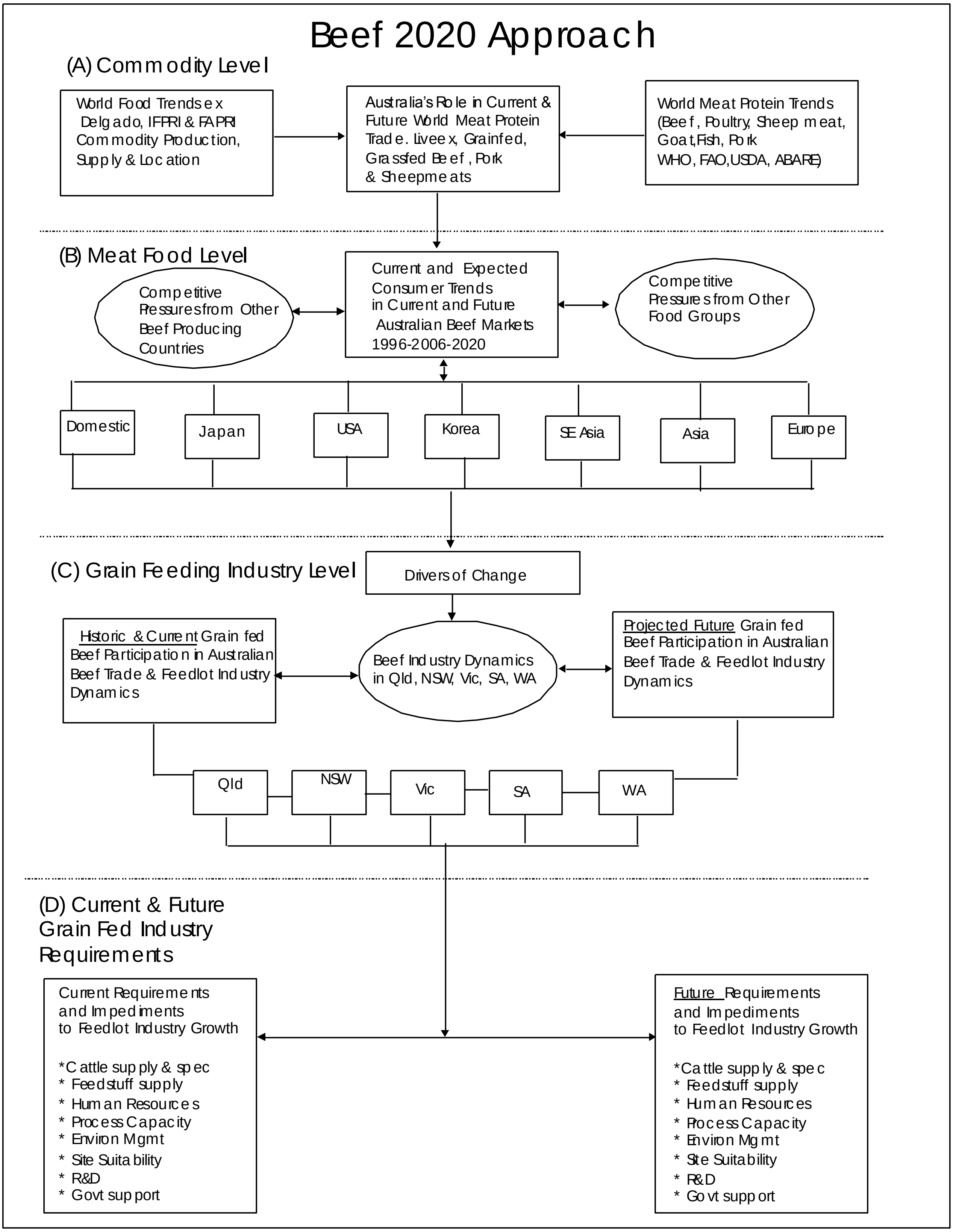
The study was essentially a desk-top study that utilised a significant body of work globally and within Australia. The methodology employed in the study was as follows:

1. Identify and source the full range of information and data that will be required to complete the project, including, but not limited to:
    a. demographics of the livestock herd – current and likely future trends
    b. markets – current and likely future trends
    c. current feedlot resources
    d. current processing resources
    e. current feed and other input resources
    f. potential to expand the existing feedlot sector.
2. Develop a roadmap of the changes required to move the Australian beef industry from its current position to one where all available sale cattle are channelled through the feedlot sector. With input from an industry-based Advisory Committee, this iterative process established the likely future composition of the various industry sectors and the structural changes that will be required to achieve this position.
3. Undertake an assessment of the economic, environmental and social benefits associated with moving the industry to this highly differentiated and specialised production system.
4. Identify any constraints that will impact on the industry's ability to implement the desired production system and develop strategies to ensure that the industry can respond appropriately.

Before an assessment of the future feedlot industry can be put into place there needed to be an assessment of consumer trends in the global protein markets and more specifically in the grain fed beef markets in both developed and developing markets.

Any significant industry changes to be sustainable had to be market pulled rather than production pushed.

The following flow chart puts the study methodology into context and illustrates the logic that enables a rational approach to evaluating the future Australian feedlot industry.


Beef 2020 Approach
(A) Commodity Level
World Food Trends ex Delgado, IFPRI & FAPRI Commodity Production, Supply & Location
Australia's Role in Current & Future World Meat Protein Trade. Livee x, Grainfed, Grassfed Beef, Pork & Sheepmeats
World Meat Protein Trends (Beef, Poultry, Sheep meat, Goat,Fish, Pork WHO, FAO,USDA, ABARE)
(B) Meat Food Level
Competitive Pressures from Other Beef Producing Countries
Current and Expected Consumer Trends in Current and Future Australian Beef Markets 1996-2006-2020
Competitive Pressures from Other Food Groups
Domestic
Japan
USA
Korea
SE Asia
Asia
Europe
(C) Grain Feeding Industry Level
Drivers of Change
Historic & Current Grain fed Beef Participation in Australian Beef Trade & Feedlot Industry Dynamics
Beef Industry Dynamics in Qld, NSW, Vic, SA, WA
Projected Future Grain fed Beef Participation in Australian Beef Trade & Feedlot Industry Dynamics
Qld
NSW
Vic
SA
WA
(D) Current & Future Grain Fed Industry Requirements
Current Requirements and Impediments to Feedlot Industry Growth
*Cattle supply & spec
* Feedstuff supply
* Human Resources
* Process Capacity
* Environ Mgmt
* Site Suitability
* R&D
* Govt support
Future Requirements and Impediments to Feedlot Industry Growth
*Cattle supply & spec
* Feedstuff supply
* Human Resources
* Process Capacity
* Environ Mgmt
* Site Suitability
* R&D
* Govt support

The report has been prepared in four (4) volumes that are reported in this final report as follows:

- **Volume 1** reports the outcomes of preliminary desk research on global food and beef industry trends, Australian beef and food industry trends, trends within the global and Australian beef industry and trends with the Australian feedlot industry. This report was developed by Warwick Yates and Associates Pty Ltd and IQ Agribusiness.
- **Volume 2** examines the feedlot industry dynamic with the current production and projected expansion scenario for the feedlot industry in Australia with particular focus on the drivers and constraints for future feedlot expansion within these regions. This report was developed by FSA Consulting.
- **Volume 3** examines the regional and national economic and social impacts of the projected feedlot expansion scenario developed in Volume 2. This report was developed by EconSearch Pty Ltd.
- **Volume 4** is the final report for the project that integrates the previous three reports into a standalone document.

This project had significant challenges and a protracted time frame caused by unprecedented matters facing the current feedlot industry that made any consideration of future feedlot expansion difficult. Some of those significant matters were:

- Arguably, the worst drought that Australia had seen in 100 years making access to livestock and feed grain at economic prices for normal feedlot operation extremely difficult;
- Constrained access to water supplies for existing feedlots and moratoriums on additional water supply;
- Severe limitations on access to feedlot staff by very high employment rates and competitive demand for staff from a booming mining industry;
- Significant increases in world oil prices increasing costs of production for livestock transport; feedlot operations and farming operations; and
- Reduced export market demand for grain fed beef resulting as a knock on effect from consumer concerns about food safety in the aftermath of BSE outbreaks in North America and Asia.

The result of recent developments has been a significant reduction in feedlot capacity utilisation across Australia, shutdown of uneconomic feedlot capacity, rationalisation and consolidation of existing feedlot capacity, reductions in the time cattle were fed on grain, higher feedlot entry weights and moves to effect higher levels of supply chain integration.

The occurrence of these events shows that the feedlot industry, while resilient, operates in a volatile operating environment, is affected by national and world events but has the capacity to change rapidly to adjust to these changing circumstances. While the last few years has placed extreme pressure on the Australian feedlot industry, it is likely that the pace and rate of change will continue with the industry implementing commercially realistic contingency development plans for the future.

3 Drivers of change in the Australian lot feeding industry

3.1 The current lot feeding industry strategic direction

Australian Lot Feeders Association (ALFA) Strategic Plan sees the following industry development scenario:

"The Australian feedlot industry is currently growing at approximately 7% per annum, with an expectation that it will continue at this rate into the foreseeable future, reaching a capacity of 1.5 million head in the next five years and 2.0 million head in 10-15 years.

Looking to the future, the industry sees lot feeding as enhancing its position to the point where it becomes the principal form of beef production. This will be underpinned by the following:

- *Market driven demand for feedlot product, both domestically and internationally;*
- *The pivotal position that the industry holds in the beef supply chain where it provides a conduit for the transfer of market and performance information and supply and price signals from processors to producers; and*
- *Improved public perception of the environmental and animal welfare performance of the feedlot sector, e.g. the feedlot sector will be seen as a mitigating mechanism for land degradation and animal welfare issues associated with grass-fed production during periods of drought.*

Likely areas, for at least part of this expanded production, include Western Australia and northern Australia, particularly as the genetic composition of the northern herd improves.

Ultimately, feedlots will have the market power to drive improvements in genetics and feedstuffs and changes in infrastructure and service industries to service the industry's requirements.

While there are currently several new feedlot facilities either being constructed or proposed, along with current and planned expansions of existing facilities, the location and extent of future industry development will be governed by:

- *Availability and access to water;*
- *Grain and cattle supply constraints;*
- *Labour supply constraints;*
- *Urban encroachment, although this is not seen as a problem in the short-term;*
- *Environmental considerations, particularly related to obtaining regulatory approvals; and*
- *Impact of fuel prices.*

Pressure on resources and inputs may constrain the expansion of large operations and there may be an increase in the number of smaller operations that are self-sufficient in terms of inputs and family labour requirements if competitive operational cost structures can be achieved.

Producers wanting to retain ownership of cattle through the supply chain will encourage the development of more custom feedlots and increased vertical integration, with breeders investing in both backgrounding and feedlot operations, as mechanisms for achieving this outcome.

Likewise, there is likely to be the development of a specialist weaner-background-feedlot supply chain and a specialist backgrounding industry that collects an assortment of cattle and tailors *them to lines that meet the requirements of the various feedlots they supply. Processors, and to a lesser extent feedlots, may become more of a service provider.*

Cattle supply pressure and market demand for reduced slaughter age will see the industry feeding younger cattle. This will necessitate an increased emphasis on managing stress, pre-conditioning, backgrounding and improved disease diagnostics to overcome the health problems associated with feeding these younger cattle. It will also change the dynamics of the industry, with more cattle being bred as a result of the earlier turnoff and more cattle numbers going through feedlots."

So the key questions are:

- What is likely to drive this change scenario?
- Is the suggested change scenario valid?
- And what will be the likely impediments to feedlot industry expansion?

The current drought across Australia, increasing grain prices, decreased water availability, declining beef herd numbers and feedlot capacity utilisations, increased difficulty in attracting skilled staff are already challenging the current strategic direction of the industry.

These challenges have often made it difficult for feedlot industry stakeholders to focus on future industry development in these times of severe economic hardship. Despite these hardships most industry players continue to see a robust future for the industry because of global demand drivers for quality beef by consumers in developed and developing countries.

3.2 Global population dynamics favour future beef export growth to developing countries particularly Asia

The future of the Australian feedlot industry in Australia is intrinsically tied to the trends in world population growth and accompanying beef consumption trends over the next 20 years.

The following section provides an overview of those population dynamic and beef consumption trends. The importance of these trends is not only population growth but estimates of improvements in each developing countries gross domestic product (GDP). As GDP increases there is an established trend to increased protein consumption particularly that sourced from animals.

The last 20-30 years has seen an explosion in world population and subsequent growth in meat demand as economic conditions have improved in developing countries.

Over the next 15 years, the major population growth centres will be Africa and Asia (United Nations, 2006), which are forecast to grow by around 300 – 400 million people by 2020 (Figure 1).

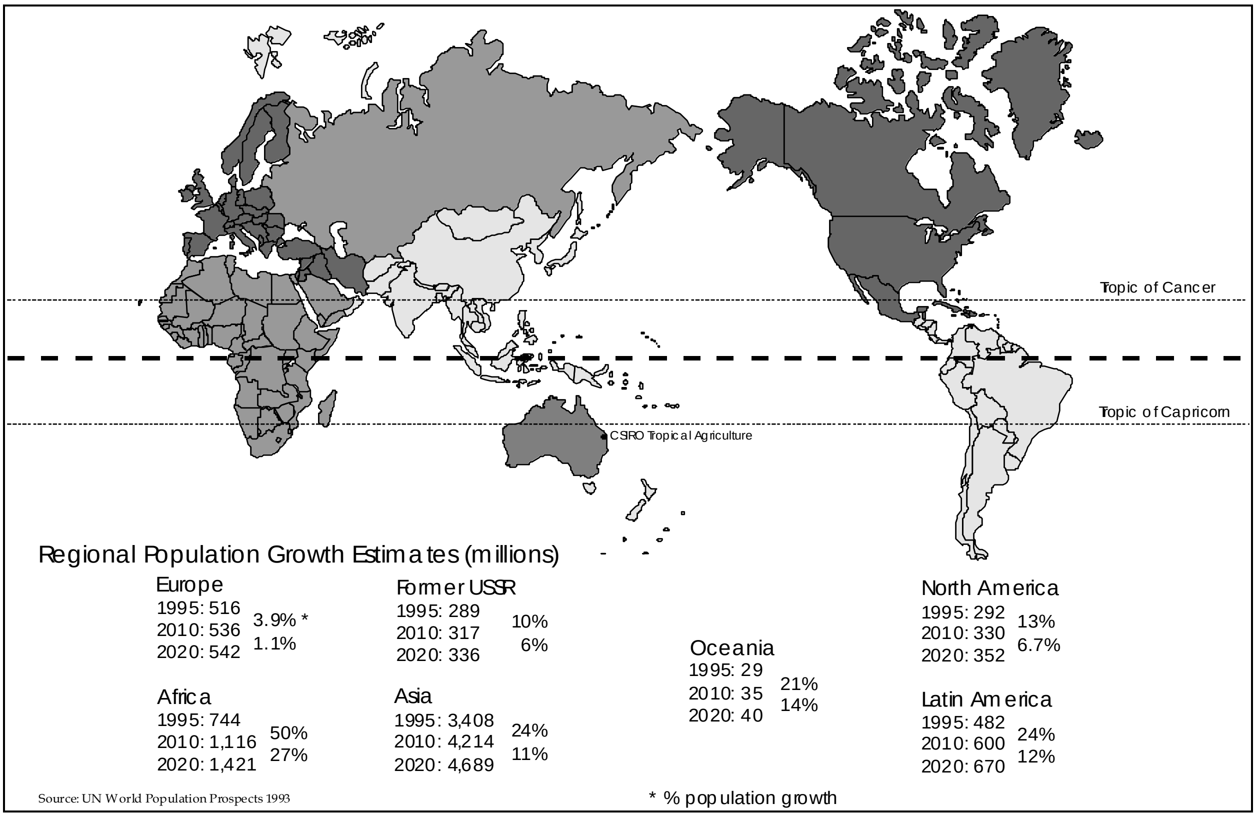


Figure 1 - Regional population growth estimates

In the Asian region, nine (9) cities across seven (7) countries are forecast to grow to more than 20 million people by 2020. There will be a further ten (10) cities with more than 10 million people, spread across these countries, with India accounting for six (6) of the nineteen (19) megacities by 2020 (Figure 2). The growth of megacities and population shifts from rural to urban areas along with increasing GDP will all drive increased demand for food particularly animal protein. Where the current level of self sufficiency in countries is low then these countries will import that food to satisfy demand. Australia has the capacity to satisfy a significant portion of that growth in animal protein demand in the future.

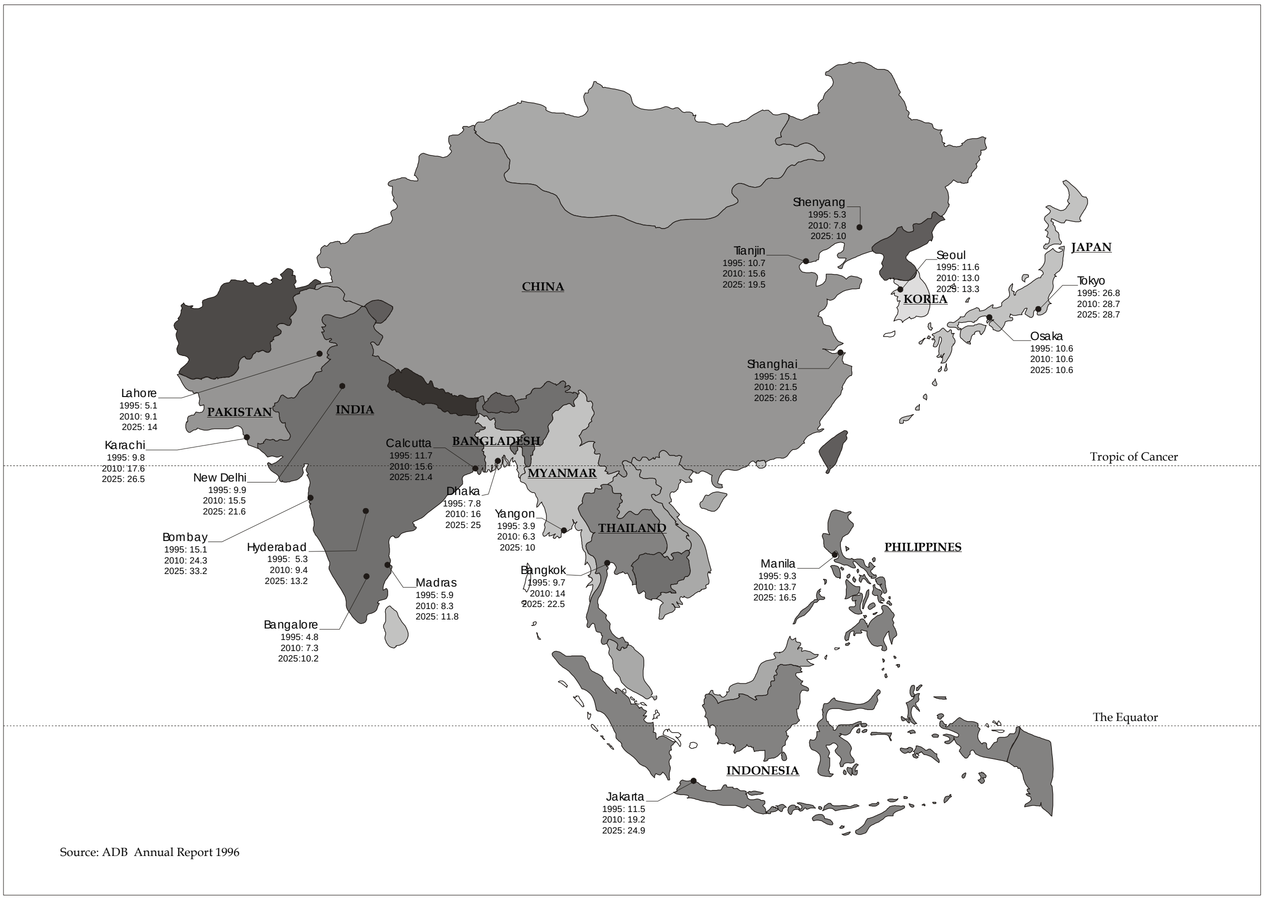


Figure 2 - Population of existing and future mega-cities 1995-2025 (million)

3.3 Increasing global demand for beef

Unlike the supply-led Green Revolution, the so-called "Livestock Revolution" is being driven by demand predominantly from developing countries. From the early 1970's to the mid-1990's, the quantity of meat consumed in developing countries grew almost three times as much as it did in the developed countries. Developing-world consumption grew at an even faster rate in the second half of this period, with Asia in the lead (Table 1)[1].

Table 1 - Actual and projected meat consumption by region

	Annual growth in total meat consumption		Total meat consumption		
Region	**1982–94**	**1993–2020**	**1983**	**1993**	**2020**
	(percent)		(million metric tons)		
China	8.6	3.0	16	38	85
Other East Asia	5.8	2.4	1	3	8
India	3.6	2.9	3	4	8
Other South Asia	4.8	3.2	1	2	5
Southeast Asia	5.6	3.0	4	7	16
Latin America	3.3	2.3	15	21	39
West Asia/North Africa	2.4	2.8	5	6	15
Sub-Saharan Africa	2.2	3.5	4	5	12
Developing world	5.4	2.8	50	88	188
Developed world	1.0	0.6	88	97	115
World	2.9	1.8	139	184	303

Source: FAO annual data. Total meat consumption for 1983 and 1993 are three-year moving averages. 2020 projections come from IFPRI's global model, IMPACT.

Notes: Meat includes beef, pork, mutton, goat, and poultry. Suspected overestimation of meat production in China in the early 1990s suggests that actual 1993 consumption was 30 million metric tons (a 6.3 percent annual growth rate since 1983). If so, the level of world meat consumption for 1993 is overestimated here by at most 4.3 percent and by even less than that for 2020 because IMPACT incorporates pessimistic assumptions that are compatible with the conservative view for 1993.

[1] Delgado C, et al, 1999, "Livestock to 2020: The Next Food Revolution", IFPRI, Washington, http://www.ifpri.org/2020/briefs/number61.htm

People in developed countries obtain an average of 27 percent of their calories and 56 percent of their protein from animal food products. The averages for developing countries are 11 and 26 percent, respectively. The difference in consumption levels gives an indication of the dramatic changes in store for global food production (Delgado, 1999). As GDP increases, there is generally a transition from cereal based diets to those with higher animal based protein levels (Figure 3).

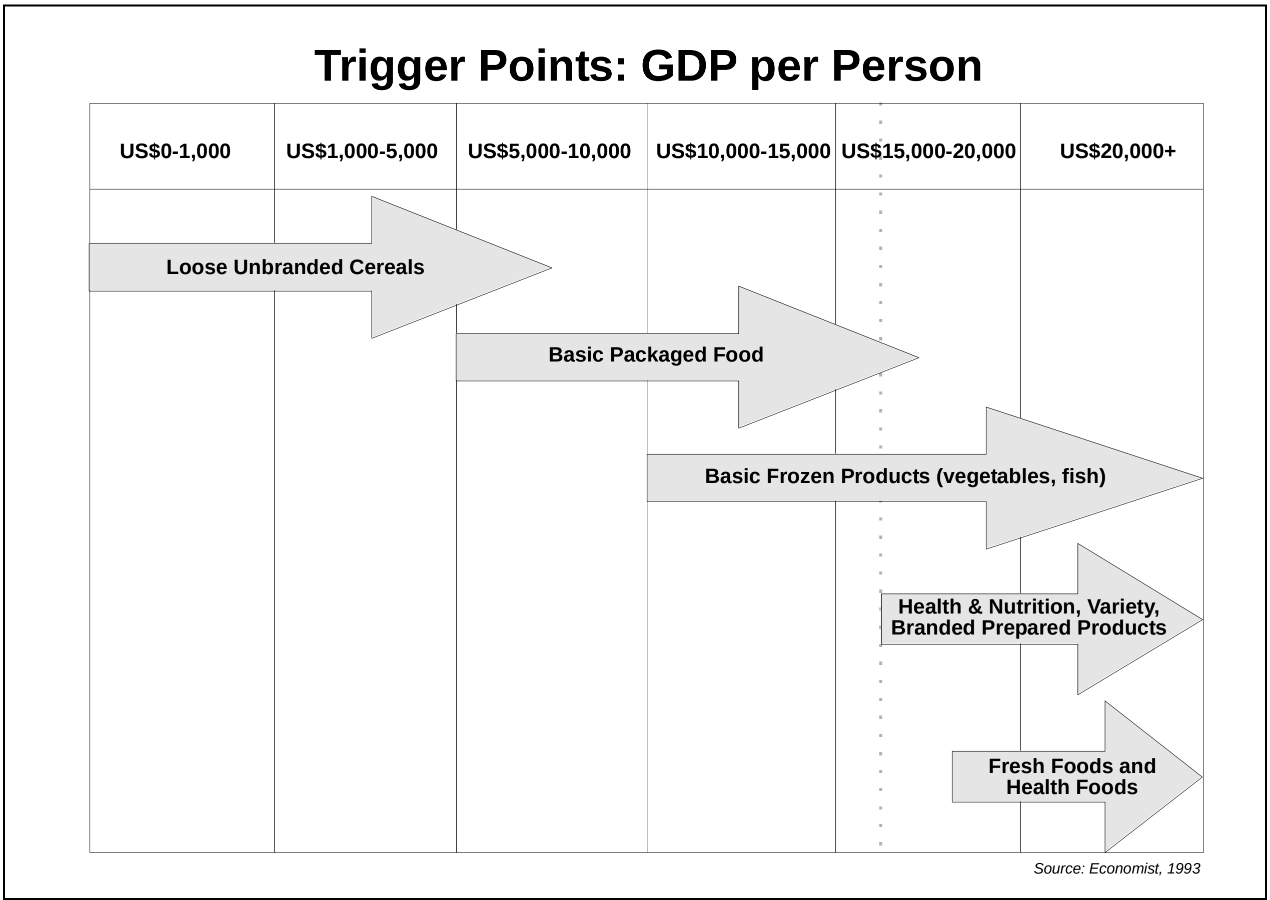
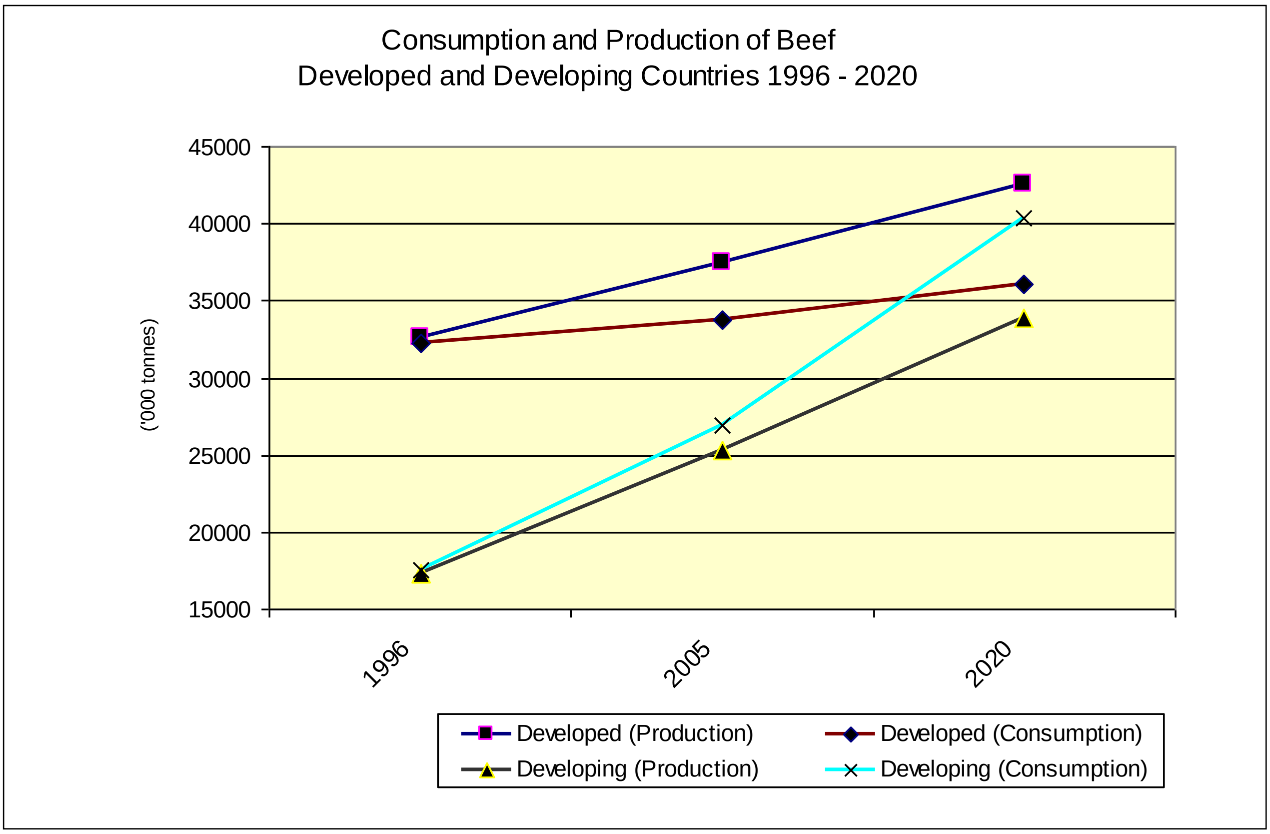


Figure 3 - GDP driven demand for foodstuffs – average GDP per capita

Until the mid-1990's, production of animal food products grew most rapidly in the same countries where consumption increased. Total meat production in developing countries grew by 5.4 percent per year between the early 1980s and mid-1990s, more than five times the developed-world rate (Figure 4).



Source: IFPRI, 2006

Figure 4 - Beef consumption v production

By 2020 developing countries will consume 100 million metric tons more meat and 223 million metric tons more milk than they did in 1993, dwarfing developed-country increases of 18 million metric tons for both meat and milk.

By 2020 developing countries will produce 60 percent of the world's meat and 52 percent of the world's milk. China will lead meat production and India milk production (IFPRI, 1999).

3.4 A meat scene without significant future population growth

Given the slowdown in population growth rates, particularly in the developed world, global meat production may be approaching a time when it can no longer rely on population growth alone to drive demand, according to the FAO, the food/agriculture agency of the United Nations.

FAO analysis shows that the total meat economy will remain huge - approximately 228 million tons of all meats were consumed globally in 1999/2001. Some 465 million tons will have to be produced annually by 2050.

On a per capita basis, pork and poultry consumption is forecast to continue to grow in the medium term, while per capita beef consumption is relatively static (Figure 5).

Source: FAPRI Projections, 2006

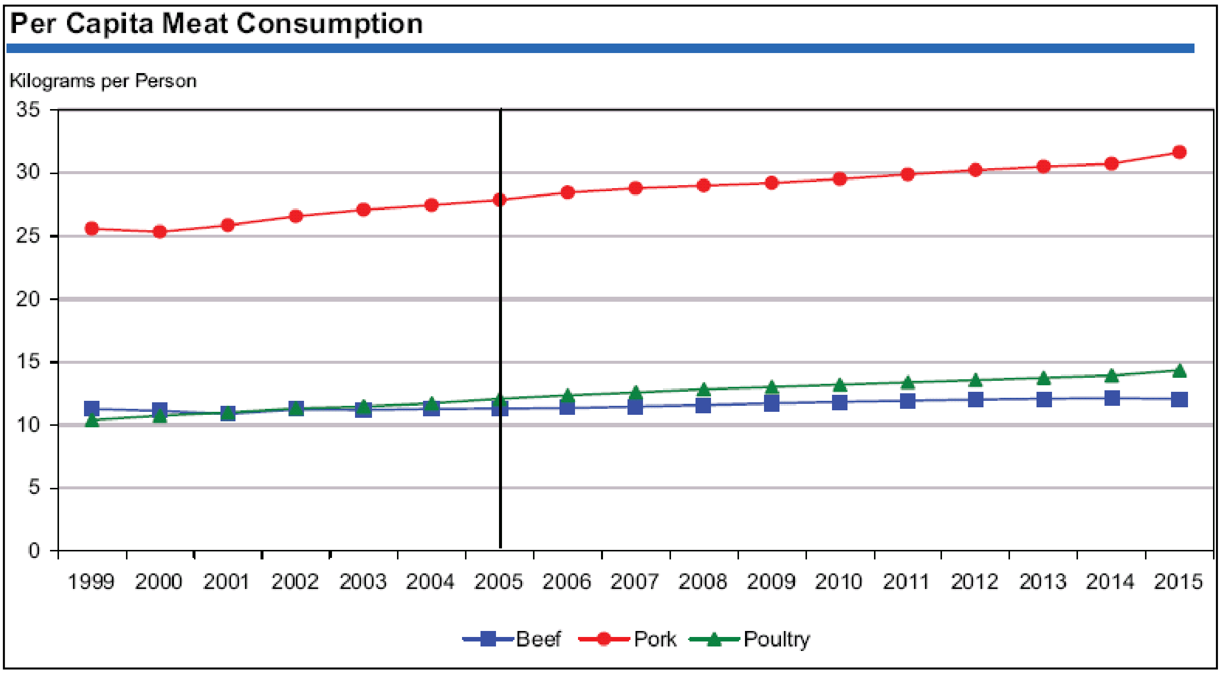
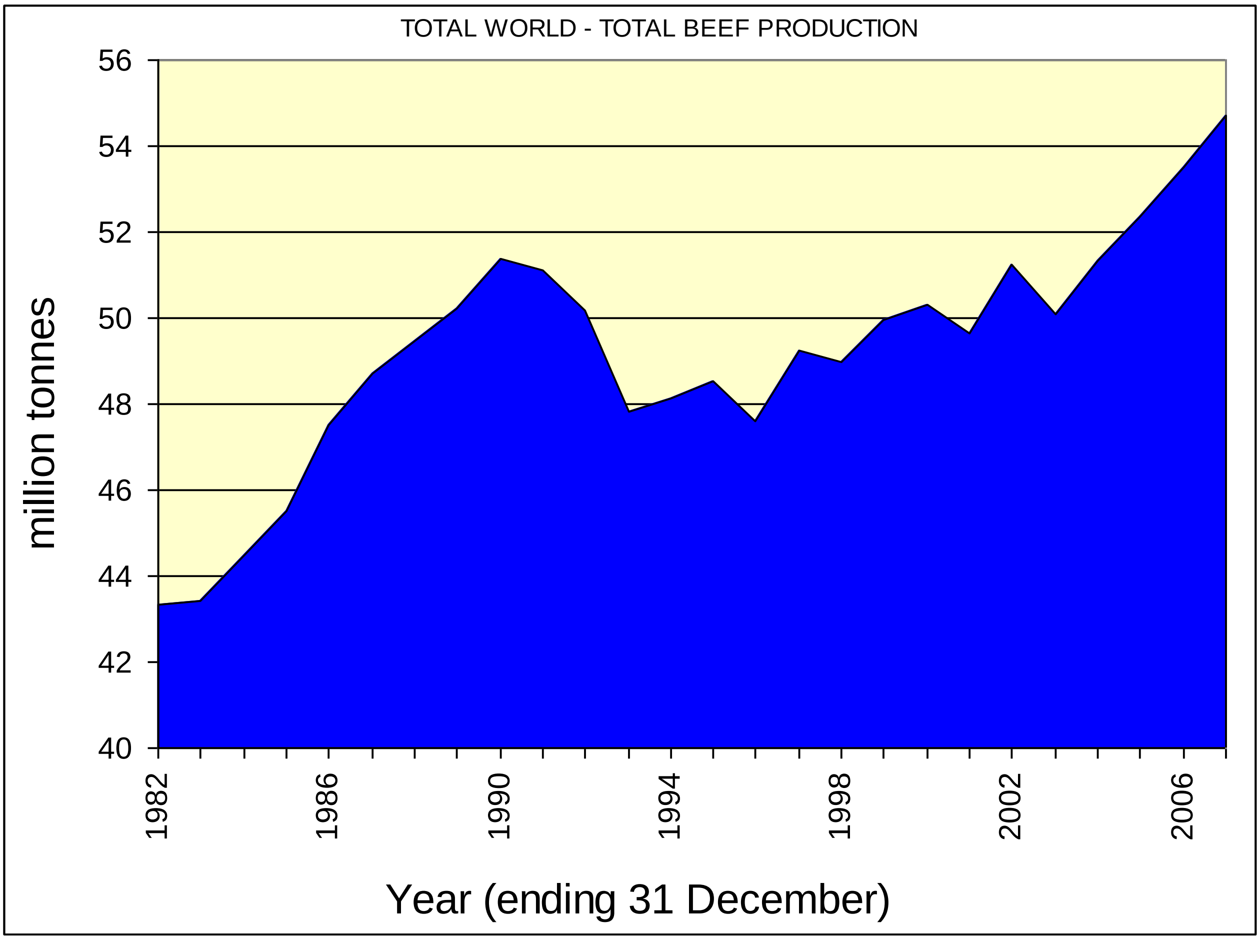


Figure 5 - Per capita meat consumption

3.5 Changes in the world beef industry

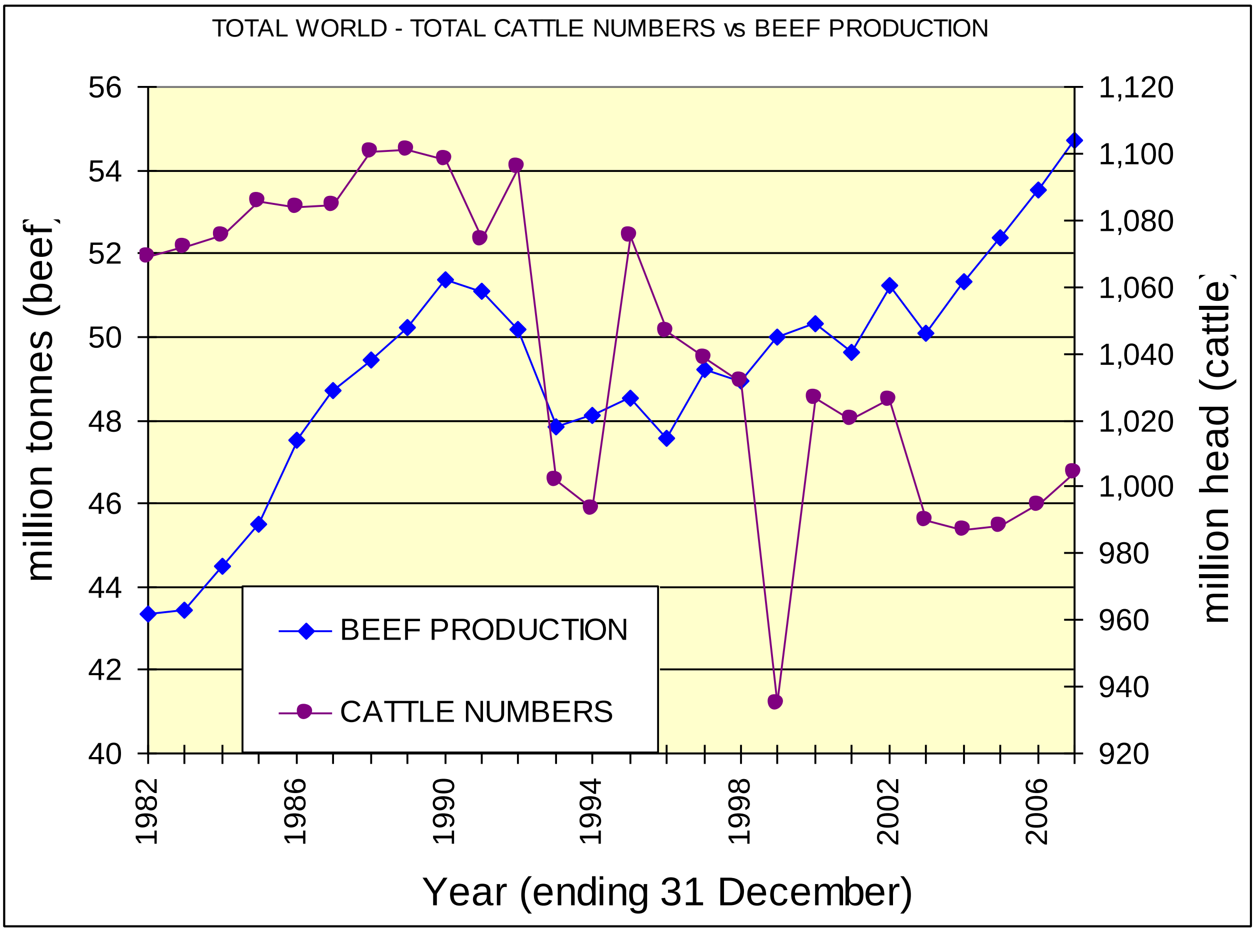
Total beef production continues to grow steadily, with no major shocks occurring in the last five years (Figure 6).



Source: USDA ERS Statistics, 2007

Figure 6 - World beef production

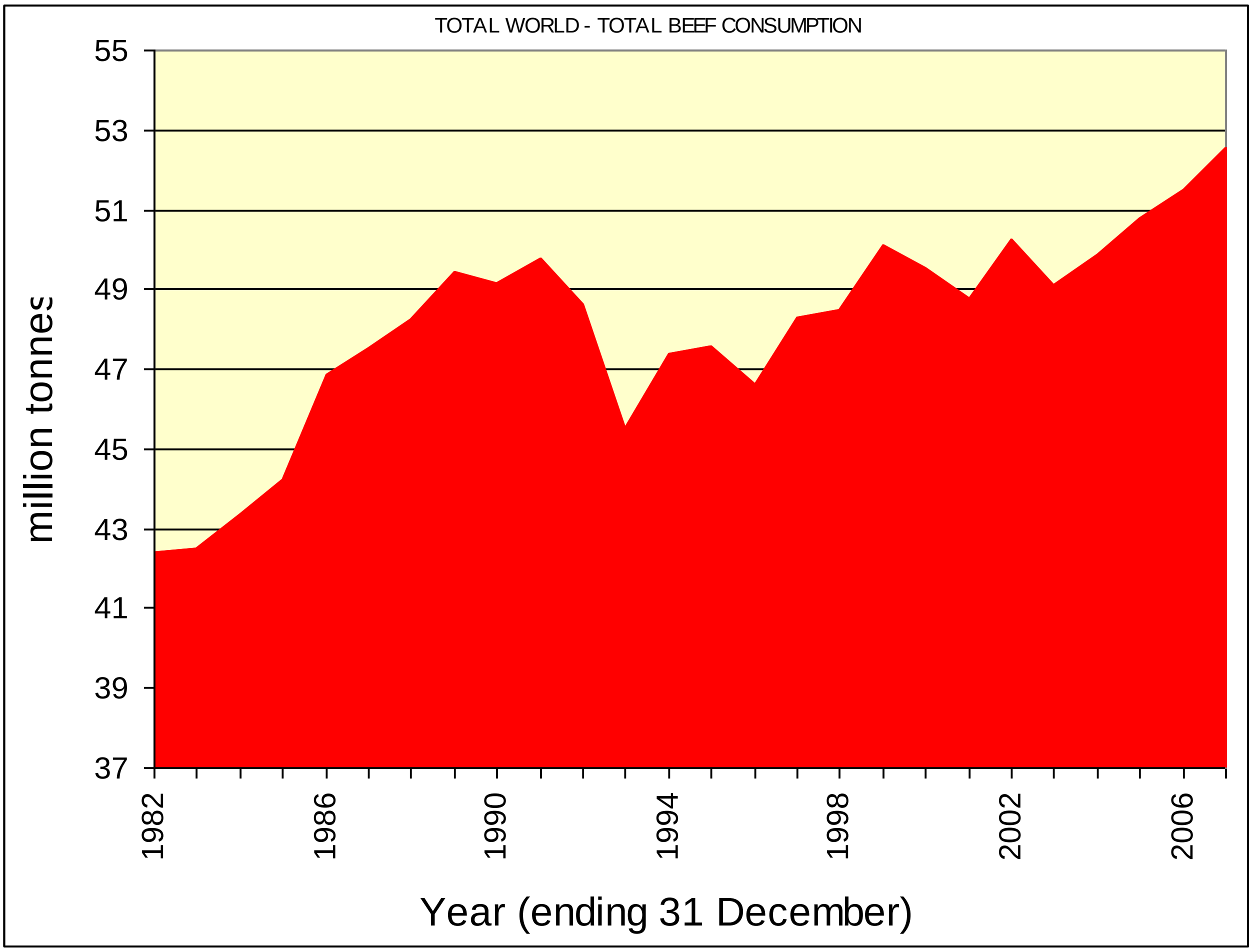
Figure 7 shows that world cattle numbers rose after a period of sharp decline in the early 2000's. The continued increase in beef production suggests a higher level of production efficiency attributable in part to improved genetics and nutrition management.



Source: USDA, 2007

Figure 7 - World cattle numbers and beef production

Figure 8 illustrates the steady growth in consumption, approximating the growth in production. If these trends continue into the future the market prospects for the export beef industry appear to be good, notwithstanding possible future demand shocks from food safety, animal health events and economic conditions that could dampen demand.



Source: USDA, 2007

Figure 8 - World beef consumption

The reality is that countries such as Australia and Brazil will be major sources of beef export supply needed to satisfy the projected demand increases as many countries have contracting beef industries due in part to competitive pressures from alternative land use.

Table 2 (FAPRI, 2007) shows the expected changes in world beef imports and exports to 2016. The major point to note is the relative change in 'market share' for the US, Australia, Brazil and Argentina in export terms.

Table 2 - World beef trade predictions ('000 tonnes)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Net Exporters											
Argentina	496	607	622	597	577	582	595	618	647	687	726
Australia	**1,408**	**1,540**	**1,567**	**1,585**	**1,602**	**1,622**	**1,640**	**1,658**	**1,678**	**1,702**	**1,727**
Brazil	1,915	2,086	2,276	2,387	2,480	2,578	2,650	2,709	2,762	2,815	2,849
Canada	305	273	267	267	269	284	308	337	368	405	450
China - Mainland	87	63	46	27	7	-13	-38	-67	-104	-153	-225
European Union-25	-340	-407	-451	-499	-484	-460	-441	-429	-424	-420	-422
India	750	749	755	764	754	740	744	763	789	808	829
New Zealand	530	587	596	620	626	646	651	661	671	678	679
Thailand	-1	-5	-8	-10	-11	-11	-12	-11	-11	-10	-10
Ukraine	-40	-91	-108	-117	-110	-105	-104	-101	-95	-95	-97
United States	-872	-854	-746	-624	-538	-557	-583	-632	-684	-733	-722
Total Net Exports *	**5,496**	**5,908**	**6,129**	**6,247**	**6,316**	**6,452**	**6,587**	**6,747**	**6,914**	**7,095**	**7,259**
Net Importers											
Bulgaria	53	56	55	55	55	57	59	61	63	64	65
Hong Kong	92	95	99	103	108	111	113	114	117	119	122
Egypt	225	252	270	289	312	328	350	360	369	378	389
Indonesia	16	27	19	16	12	4	0	-1	0	1	7
Japan	**693**	**770**	**830**	**869**	**919**	**962**	**998**	**1,030**	**1,064**	**1,099**	**1,133**
Mexico	330	324	373	435	488	529	539	542	561	582	601
Other CIS †	-5	-4	8	14	16	14	12	9	6	3	1
Other Eastern Europe‡	27	32	35	36	35	31	27	23	20	17	14
Philippines	142	160	171	184	196	204	216	226	235	243	253
Romania	32	6	0	-2	20	38	54	66	75	81	86
Russia	**825**	**966**	**1,022**	**1,026**	**1,007**	**976**	**954**	**935**	**919**	**900**	**887**
South Africa	23	48	65	73	80	85	85	85	84	80	76
South Korea	**193**	**208**	**253**	**268**	**285**	**308**	**333**	**355**	**367**	**386**	**404**
Taiwan	98	103	107	111	116	120	122	124	127	130	133
Rest of World	1,493	1,505	1,512	1,518	1,525	1,537	1,549	1,576	1,589	1,601	1,613
Total Net Imports	**5,496**	**5,908**	**6,129**	**6,247**	**6,316**	**6,452**	**6,587**	**6,747**	**6,914**	**7,095**	**7,259**

* Total net exports are the sum of all positive net exports and negative net imports.
† Includes: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova Republic, Tajikistan, Turkmenistan, Uzbekistan.
‡ Includes: Albania, Bosnia and Herzegovina, Croatia, Macedonia, Yugoslavia.

Higher income countries such as Japan and Korea are forecast to increase imports reflecting domestic cattle sectors that are constrained by land availability. These imports are primarily grain-fed beef. US exports to these countries are forecast to re-build over the next 10 years, but will not completely recover to levels attained prior to the first US BSE case in 2003. Australia and New Zealand are forecast to increase their presence in these East-Asian markets as well.

US beef imports, primarily of grass-fed lean beef from Australia and New Zealand for use in ground beef and processed products, will rise slightly through the period to 2016. Asian demand for Australian and New Zealand product will remain strong.

The growth in Russia's beef imports resumes as rising consumer demand outpaces gains in domestic production. Russia remains a large market for EU and Brazilian beef exports. In recent years Russia has become a significant market for Australian beef.

3.6 South East Asia as an emerging market for Australian beef

While beef demand growth in the developing countries and Australia's traditional export markets of the USA, Japan are slowing there is expected to be growth in the Korea and SE Asian markets where Australia has some competitive advantages albeit with competitive complexities.

South-East Asian economies grew at healthy rates during 2006, and are expected to continue this trend through 2007. Local currencies within the region have strengthened over the past year; nonetheless, they remain weak compared with the pre- Asian crisis levels in 1997.

The strengthening of the A$ against South-East Asian currencies, together with increased supply of low price beef from South America and Indian carabeef (meat derived from buffalo) is expected to continue to pressure Australia's competitiveness in these markets.

Australian beef exports to the region comprise a large proportion of frozen manufacturing beef, which is used to produce hamburger, meat balls, canned food and other processed beef products.

Falling local supplies and changing diets in most South-East Asian markets is expected to grow demand for protein products over the next five years. However, increased beef imports are expected to be mainly sourced from South America, India, and local beef derived from imported Australian feeder cattle.

Prospects for increased imports of Australian chilled beef is forecast to lie in the more limited, but higher priced and expanding, quality foodservice and modern retail segments.

Consumers in the South-East Asia region are generally not major beef eaters. After the Asian crisis hit the region in 1997, the level of beef consumption in these countries declined. Beef demand in these markets is very price sensitive, which means consumers and foodservice outlets often substitute beef with other cheaper meat types when there is a rise in the price of beef. Consumption of beef by channel varies within individual South-East Asian countries, with the only similarity being strong demand in November through to January (Table 3).

Table 3 - Beef consumption trend by sector

<table>
<tr><th>Markets</th><th>Sectors</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td rowspan="2">Malaysia</td><td>Retail</td><td colspan="2">Low</td><td colspan="6">Average</td><td colspan="4">High</td></tr>
<tr><td>Foodservice</td><td>Low</td><td colspan="5">High</td><td colspan="5">Average</td><td>High</td></tr>
<tr><td rowspan="2">Singapore</td><td>Retail</td><td colspan="2">High</td><td colspan="4">Average</td><td colspan="4">Low</td><td colspan="2">High</td></tr>
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<tr><td rowspan="3">Philippines</td><td>Retail</td><td colspan="2">Average High</td><td colspan="2">Low</td><td colspan="8">High</td></tr>
<tr><td>Foodservice</td><td>Average</td><td>High</td><td colspan="2">Low</td><td colspan="2">High</td><td>Low</td><td colspan="5">High</td></tr>
<tr><td>Manufacturing</td><td>Average High</td><td colspan="5">Low</td><td colspan="6">High</td></tr>
<tr><td rowspan="3">Thailand</td><td>Retail</td><td colspan="2">Average High</td><td colspan="6">Low</td><td colspan="4">High</td></tr>
<tr><td>Foodservice</td><td></td><td colspan="7">Low</td><td colspan="4">High</td></tr>
<tr><td>Manufacturing</td><td colspan="7">Average High</td><td colspan="5">High</td></tr>
</table>

Source: Trade

Australian beef has faced fierce competition in the SE Asian region from New Zealand, North America, South America, India and China. Compared with the low cost suppliers, total imports of Australian beef into South-East Asia were relatively small, with market share ranging from 3% (Malaysia) to 40% (Indonesia) during 2006. Nonetheless, Australia has been the dominant supplier of chilled beef to the region over the past decade, with share in these markets, ranging from 58% (Singapore) to 93% (Indonesia) in 2006 (Table 4).

Table 4 - Beef market share

Chilled fresh beef market shares

	Australia				US				NZ				India				South America				Other			
	2003	2004	2005	2006	2003	2004	2005	2006	2003	2004	2005	2006	2003	2004	2005	2006	2003	2004	2005	2006	2003	2004	2005	2006
Malaysia*	72%	58%	69%	87%	0%	0%	0%	3%	16%	34%	27%	0%	11%	8%	0%	12%	-	-	-	-	0%	0%	5%	4%
Singapore	58%	57%	60%	58%	9%	1%	0%	7%	33%	42%	40%	34%	-	-	-	-	0%	0%	0%	1%	0%	0%	0%	0%
Indonesia*	80%	96%	88%	93%	13%	1%	1%	0%	6%	2%	3%	7%	-	-	-	-	-	-	-	-	0%	0%	8%	0%

*2006 Data are up to November for Indonesia

Total beef market shares

	Australia				US				NZ				India				South America				Other			
	2003	2004	2005	2006	2003	2004	2005	2006	2003	2004	2005	2006	2003	2004	2005	2006	2003	2004	2005	2006	2003	2004	2005	2006
Malaysia*	10%	7%	4%	3%	0%	0%	0%	0%	8%	9%	9%	0%	80%	82%	82%	89%	-	-	-	-	2%	1%	5%	8%
Singapore	17%	13%	11%	15%	4%	0%	0%	1%	12%	13%	11%	11%	-	-	-	-	66%	74%	77%	71%	0%	0%	1%	2%
Philippines	13%	9%	11%	8%	3%	1%	2%	2%	5%	6%	4%	6%	55%	52%	51%	58%	22%	30%	22%	26%	0%	0%	0%	1%
Indonesia*	68%	33%	41%	42%	6%	3%	2%	0%	26%	64%	57%	58%	-	-	-	-	0%	0%	0%	0%	1%	0%	1%	0%

*2006 Data are up to November for Indonesia

Prior to the ban on US beef in December 2003, the US accounted for only small shares of the imported beef market in South-East Asia – averaging between 1% to 5%, due to its relatively high prices.

On the other hand, imports of US beef into the rest of South-East Asia remained limited as a result of local authorities' restrictions for boneless beef derived from cattle less than 30 months of age. Australia has to be continually aware of price competitiveness in these markets (Table 5).

Table 5 - Competitor 2006 average wholesale prices in South Asia (A$/kg)

	Indonesia			Malaysia			Philippines			Singapore		
	Frozen Striploin	Frozen Ribeye	Frozen Topside	Frozen Striploin	Frozen Ribeye	Frozen Topside	Frozen Striploin	Frozen Ribeye	Frozen Topside	Frozen Striploin	Frozen Ribeye	Frozen Topside
Australia	-	18.34	6.58	12.00	15.47	5.96	22.04	23.39	2.24	16.14	20.97	12.57
NZ	-	-	-	11.28	14.68	6.12	11.98	12.02	-	13.72	19.26	-
US	-	-	-	-	-	-	29.67	29.45	-	-	-	-
Canada	-	-	-	-	-	-	33.42	-	-	-	-	-
Brazil	-	-	-	-	-	-	6.68	6.50	2.00	9.96	14.24	9.39
Argentina	-	-	-	8.45	8.45	5.09	-	-	-	-	-	-
Uruguay	-	-	-	7.34	-	-	-	-	-	-	-	-
India	-	-	-	2.52	-2.15	2.52	-	-	1.81	-	-	-
China	-	-	-	7.16	-7.52	4.66	-	-	-	-	-	-

Source: Trade

Competitor 2006 average retail prices in South Asia (A$/kg)

	Indonesia			Malaysia			Philippines			Singapore		
	Chilled Tenderloin	Chilled Ribeye	Chilled Striploin	Chilled Tenderloin	Chilled Ribeye	Chilled Striploin	Chilled Tenderloin	Chilled Ribeye	Chilled Striploin	Chilled Tenderloin	Chilled Ribeye	Chilled Striploin
Australia	53.20	31.50	28.54	39.39	24.45	20.39	40.45	33.48	29.42	41.11	30.78	29.42
NZ	60.96	33.42	26.96	-	-	-	-	-	-	32.69	28.79	23.90
US	65.46	43.16	36.27	-	64.28	66.83	76.11	48.94	-	38.26	37.78	-
Argentina	-	-	-	36.86	30.78	28.63	-	-	-	-	-	-
Local	31.08	15.12-	16.96	31.47	21.92	13.13	18.12	11.05	10.15	-	-	-

Source: Trade

Total Australian beef exports to South-East Asia during 2006 increased by 22% compared with 2005, to 20,717 tonnes swt, including a boost in both the chilled and frozen segments, as well as grain fed and grass fed volumes (Table 6).

Table 6 - Australian chilled beef exports to South East Asia

	Thai	% ch	Sing	% ch	Malay	% ch	Indo		Phil	% ch	Total	% ch
2002	217	-11%	1230	10%	867	11%	1173	27%	118	37%	3606	14%
2003	237	9%	1143	-7%	987	14%	952	-19%	84	-29%	3403	-6%
2004	313	32%	1148	0%	718	-27%	934	-2%	58	-31%	3171	-7%
2005	306	-2%	1238	8%	763	6%	788	-16%	34	-41%	3129	-1%
2006	500	63%	1344	9%	663	-13%	822	4%	28	-18%	3357	7%

Source: Department of Agriculture, Fisheries and Forestry

Total chilled beef exports to South-East Asia increased by 7% to reach 3,357 tonnes swt in 2006 (Figure 9). Interestingly, grain fed beef exports to the region also jumped by 92% on 2005, to 3,131 tonnes swt, as a result of the expansion in the Australian feedlot sector and growing demand from South-East Asia's foodservice sectors for high quality beef (Figure 10).

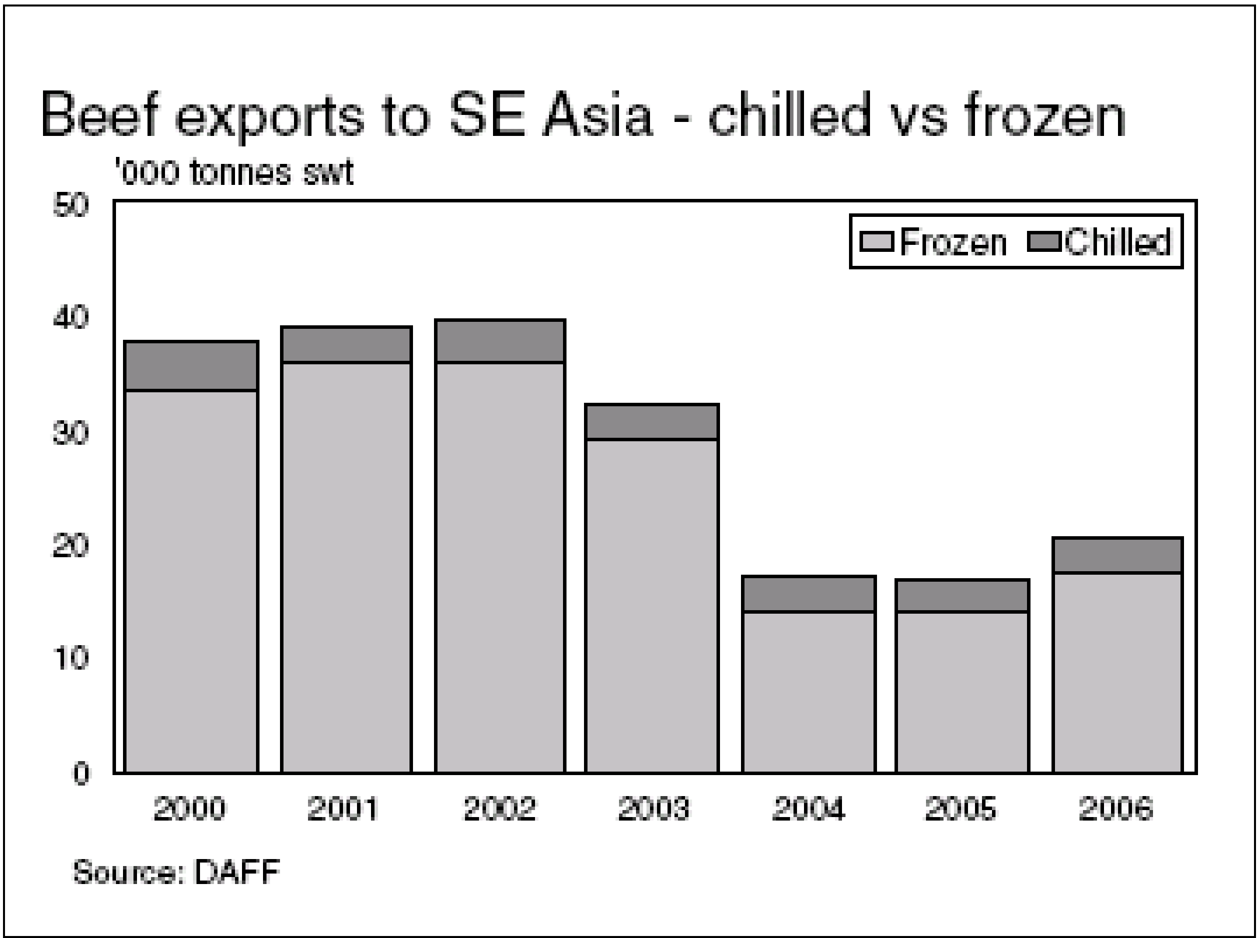


Figure 9 - Beef exports to SE Asia – chilled and frozen 2000-2006

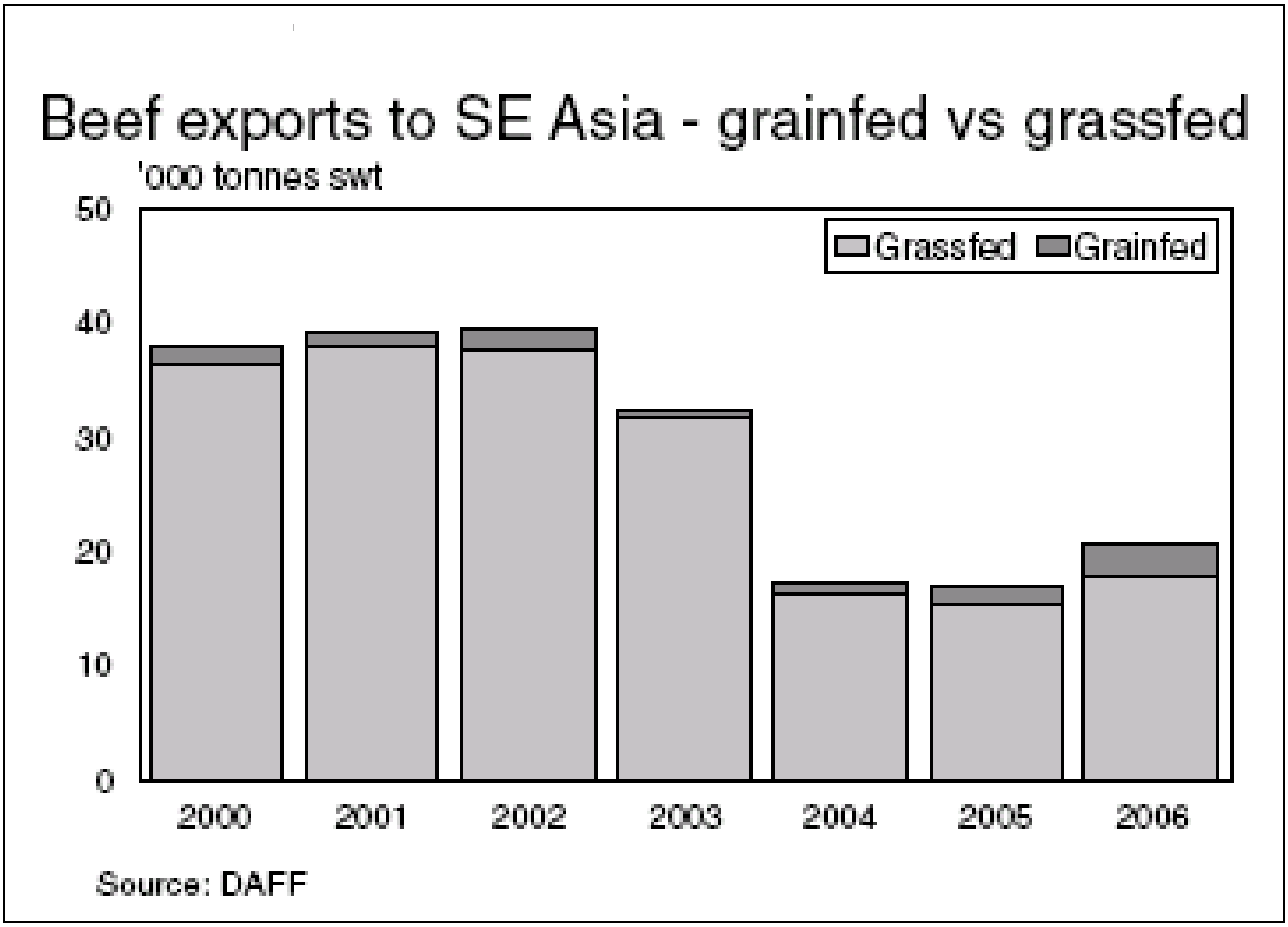


Figure 10 - Beef exports to SE Asia 2000-2006– grain fed v grass fed

With economic growth forecast to remain strong in the South-East Asia region, overall demand for red meat is expected to increase. However, Australia does and needs to continue to monitor and negotiate market access conditions for Australian beef. Figure 11 summarises the market access position in a range of South-East Asian countries.

Market access barriers

Market	Tariff rates	Non-tariff restrictions	Restrictions on other competitors
Thailand	40% MFN but for Australia 34.67% reducing to zero by 2020 under FTA		Additional business tax and VAT applied at point of import.
Philippines	10%	Right reserved to use special safeguard measures.	
Indonesia	5% + 2.5 % income tax VAT 10% exempted started Jan 2007		Importing countries restricted to those free of FMD. Import licensing requirements are used to regulate trade and can be a barrier to entry.
Malaysia	0%		
Singapore	There is no tariff for meat coming into Singapore except for importers need to pay 5% good services tax to the custom dept and $4.60 per 100 kg to AVA (Agrifood & Veterinary Authority of Singapore).		

Figure 11 - SE Asian market access parameters

3.7 Australia's expected future role in the world meat trade

Based on the available information from USDA it appears that Australia will continue to be one of the dominant world beef exporters (Table 7).

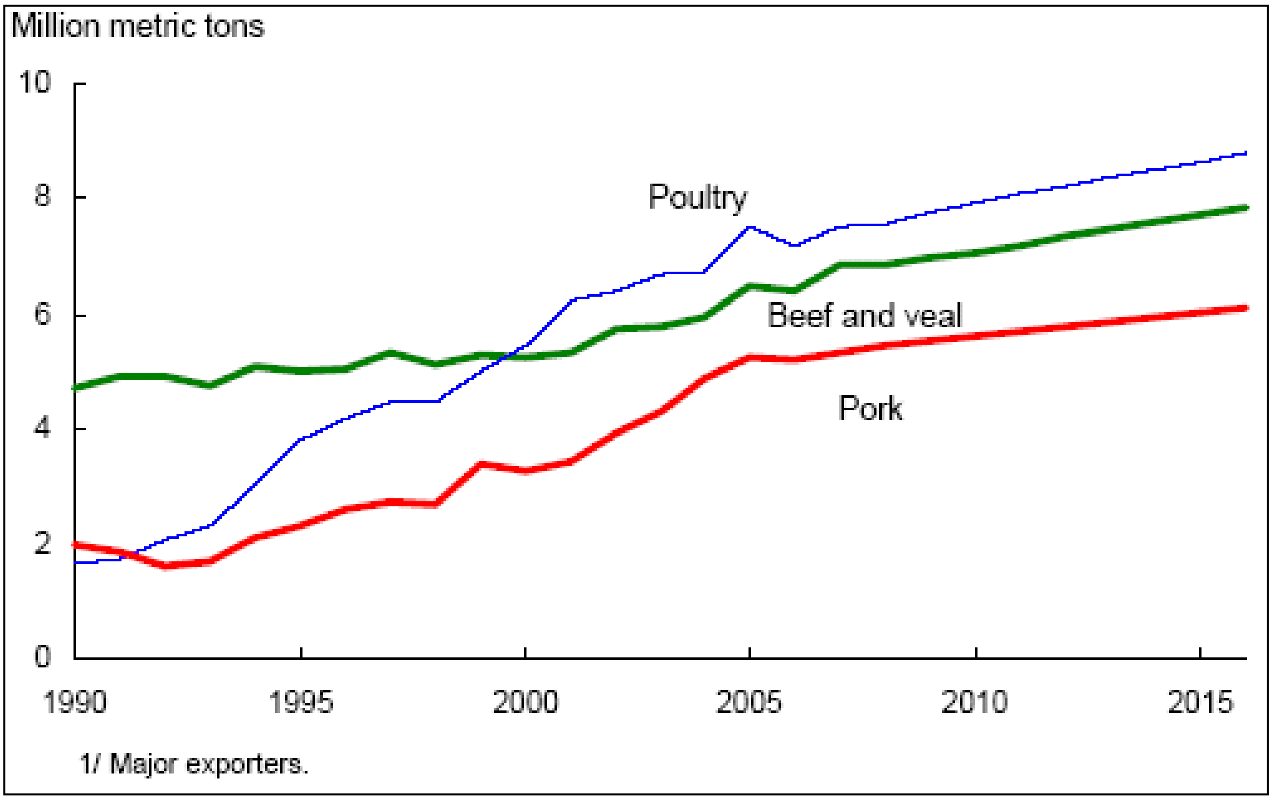
Table 7 - World beef trade long term projections

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Importers						*Imports thousand metric tons, carcass weight*						
Japan	700	693	765	785	801	813	825	836	846	856	866	876
South Korea	243	193	230	263	280	293	309	329	348	363	384	400
Taiwan	92	98	100	101	102	106	108	110	113	116	119	121
Philippines	140	142	148	168	180	189	201	208	215	222	229	237
European Union	599	540	560	650	650	650	651	651	651	650	650	650
Russia	993	840	905	989	1,005	1,014	1,023	1,039	1,046	1,059	1,070	1,074
Other Europe	137	119	115	178	187	193	197	204	209	214	218	221
Egypt	214	225	240	273	284	291	303	308	314	320	326	332
Mexico	326	365	375	450	506	546	588	623	666	699	734	787
Canada	133	150	160	179	190	195	200	210	216	224	229	233
United States	1,632	1,439	1,524	1,527	1,537	1,548	1,559	1,570	1,581	1,593	1,605	1,617
Major importers	5,208	4,804	5,122	5,563	5,721	5,837	5,963	6,087	6,204	6,316	6,429	6,527
Exporters						*Exports thousand metric tons, carcass weight*						
Australia	1,413	1,420	1,495	1,477	1,459	1,410	1,385	1,376	1,379	1,386	1,410	1,414
New Zealand	589	540	570	568	561	557	556	553	552	550	547	545
Other Asia	719	840	885	899	927	945	974	1,006	1,038	1,059	1,077	1,099
European Union	255	200	200	215	252	273	285	297	309	327	346	365
Argentina	762	500	600	554	543	527	523	516	509	498	491	474
Brazil	1,867	1,945	1,985	1,992	2,049	2,127	2,190	2,243	2,283	2,311	2,338	2,355
Canada	551	455	440	433	4338	462	484	504	524	541	556	568
United States	317	523	880	706	741	776	811	846	881	925	963	1,024
Major Exporters	6,473	6,423	6,855	6,844	6,968	7,076	7,209	7,342	7,475	7,596	7,729	7,844

1/Covers EU -25, excludes intra EU trade.

The projections were completed in November 2006

International trade in animal products, however, remains heavily dependent on demand from developed countries and from market access achieved under existing and future trade agreements. Nevertheless projections from a number of agencies are consistent in projecting future growth in world beef exports of which Australia is a major player (Figure12).



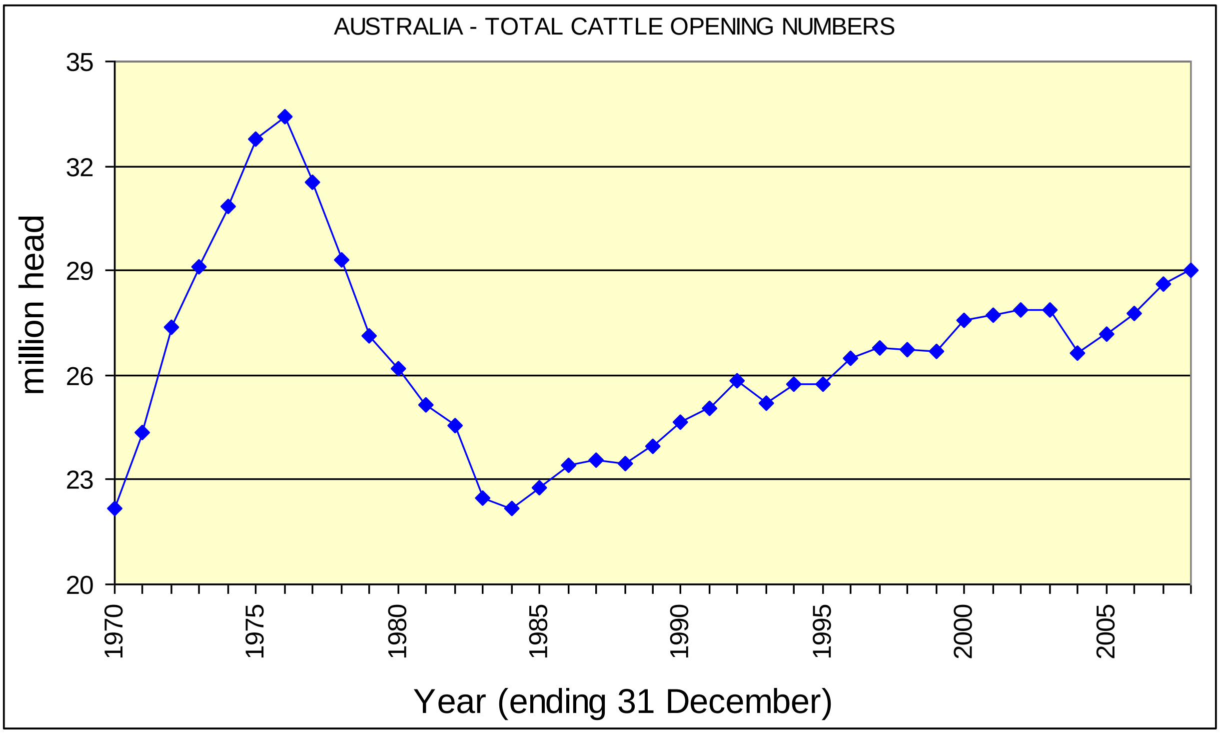
Source: FAPRI, 2006

Figure 12 - Projected world beef trade

The continued positive outlook for world beef continues to create and opportunity for the Australian beef industry. Australia recognises that its relatively small scale but large export volumes enhance the country's capacity as an effective niche marketer of quality beef to world markets. The emergence of increased demand for quality chilled beef is creating opportunities for the Australian feedlot industry to supply this increased demand. As such the industry is an integral part of the Australian beef industry's current and future landscape and market mix.

3.8 Changes in the Australian beef industry

Except for one or two drought induced impacts, Australia's cattle population has been rising steadily over the last two decades, but still has not reached the highs of the mid-1970's (Figure 13). Most of this growth has been in northern Australia. The current drought is likely to have significantly slowed the rate of beef herd expansion.



Source: USDA 2007

Figure 13 - Australian cattle opening numbers

Total slaughter numbers have remained relatively constant at approximately 9 million head per year (Figure 14).

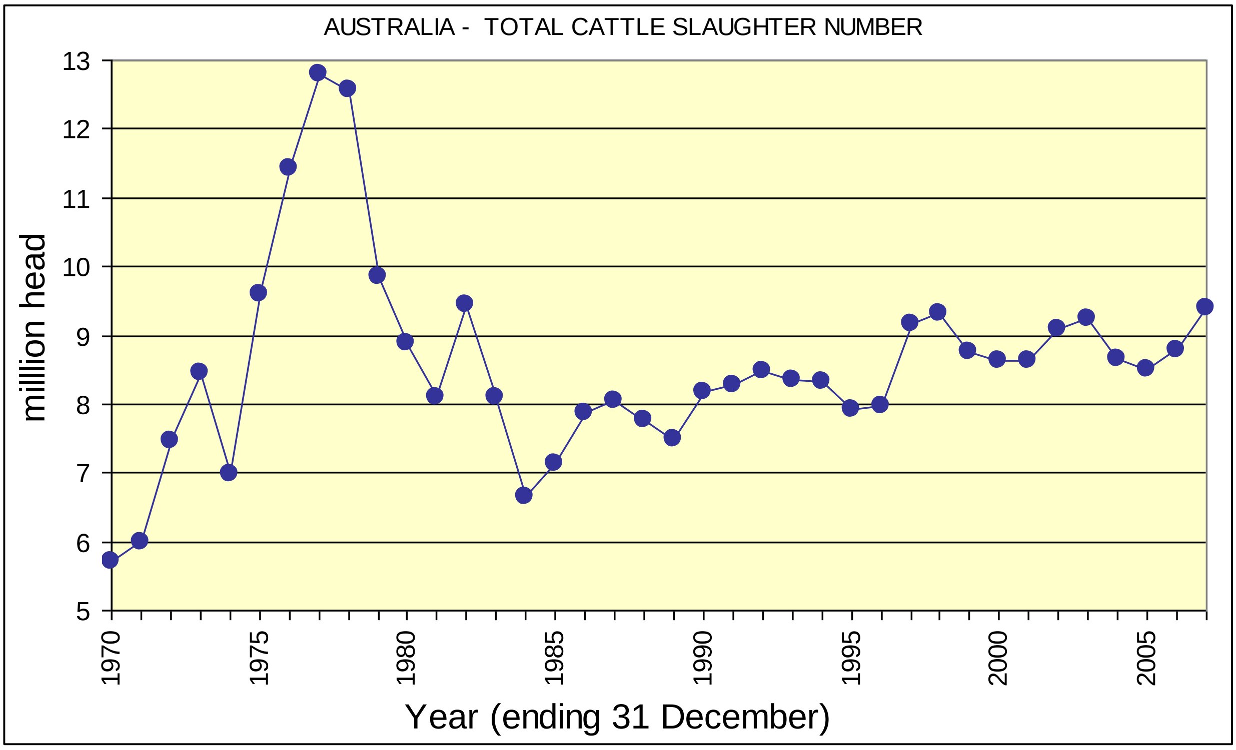


Figure 14 - Total cattle slaughter Australia

Total beef production has been increasing steadily more or less in line with cattle numbers albeit also driven by increasing carcase weights as processors seek to obtain processing economic advantages from increased carcase weights and improved compliance with market specifications (Figure 15).

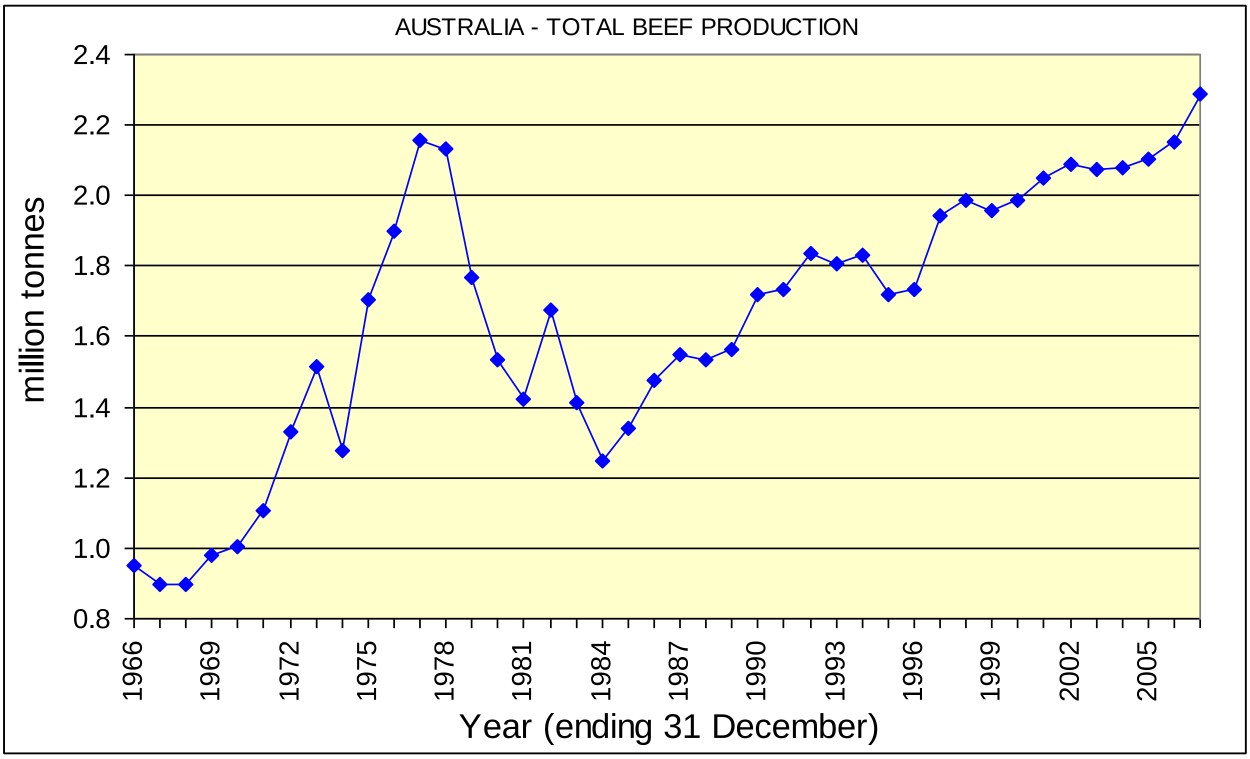


Figure 15 - Beef production, Australia 1966-2006

Exports have risen in line with production while domestic consumption is relatively flat (Figure 16).

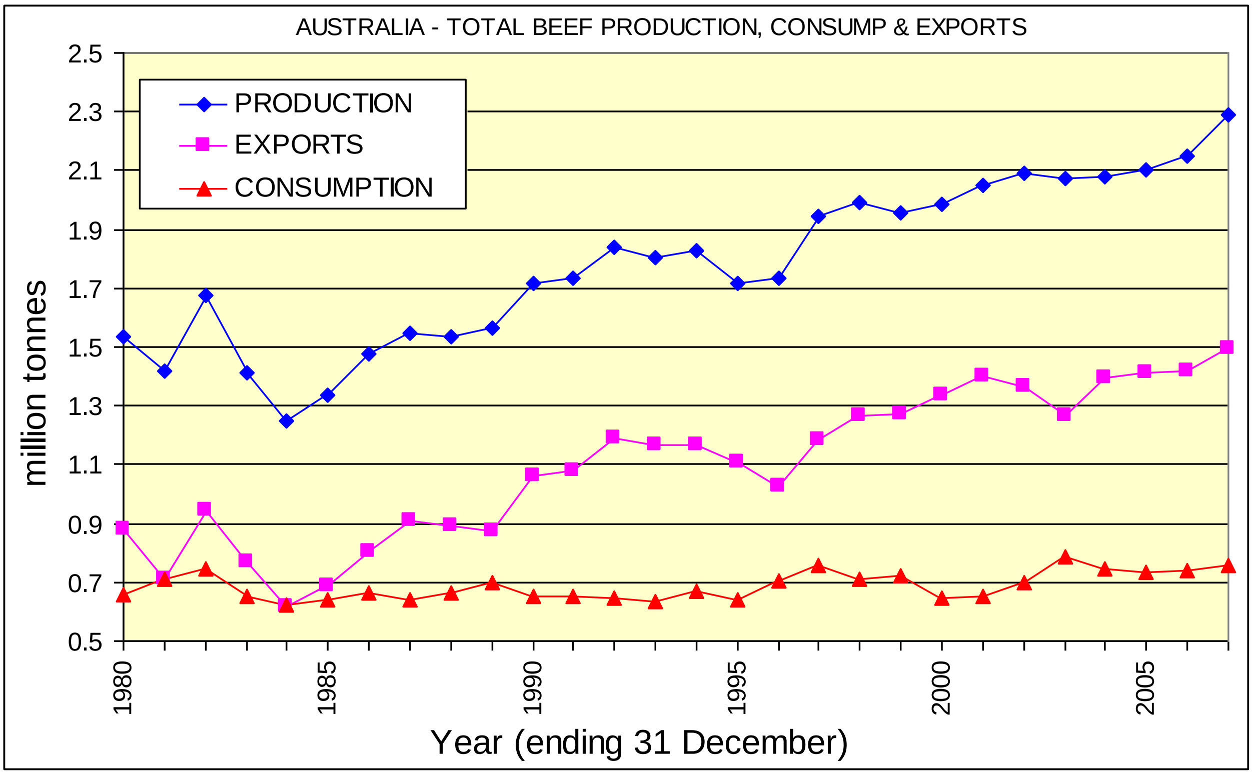


Figure 16 - Beef production and use, Australia

Average slaughter weight has been increasing almost continuously since 1976, indicating productivity improvements from genetics and improved nutrition including the growing importance of grain-fed cattle in the slaughter mix (Figure 17).

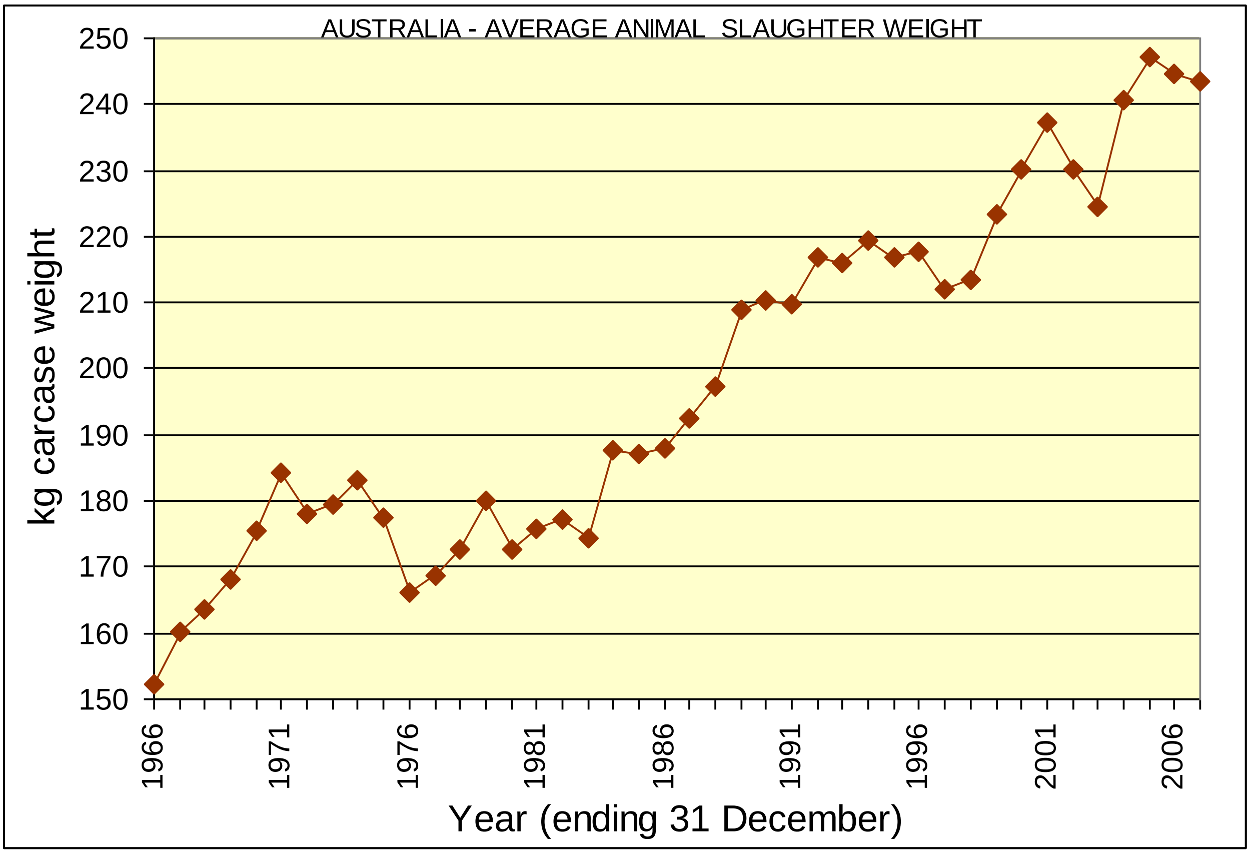


Figure 17 - Average cattle slaughter weight, Australia

Per capita beef consumption has been trending downwards since 1977 consistent with trends in other developed countries (Figure 18).

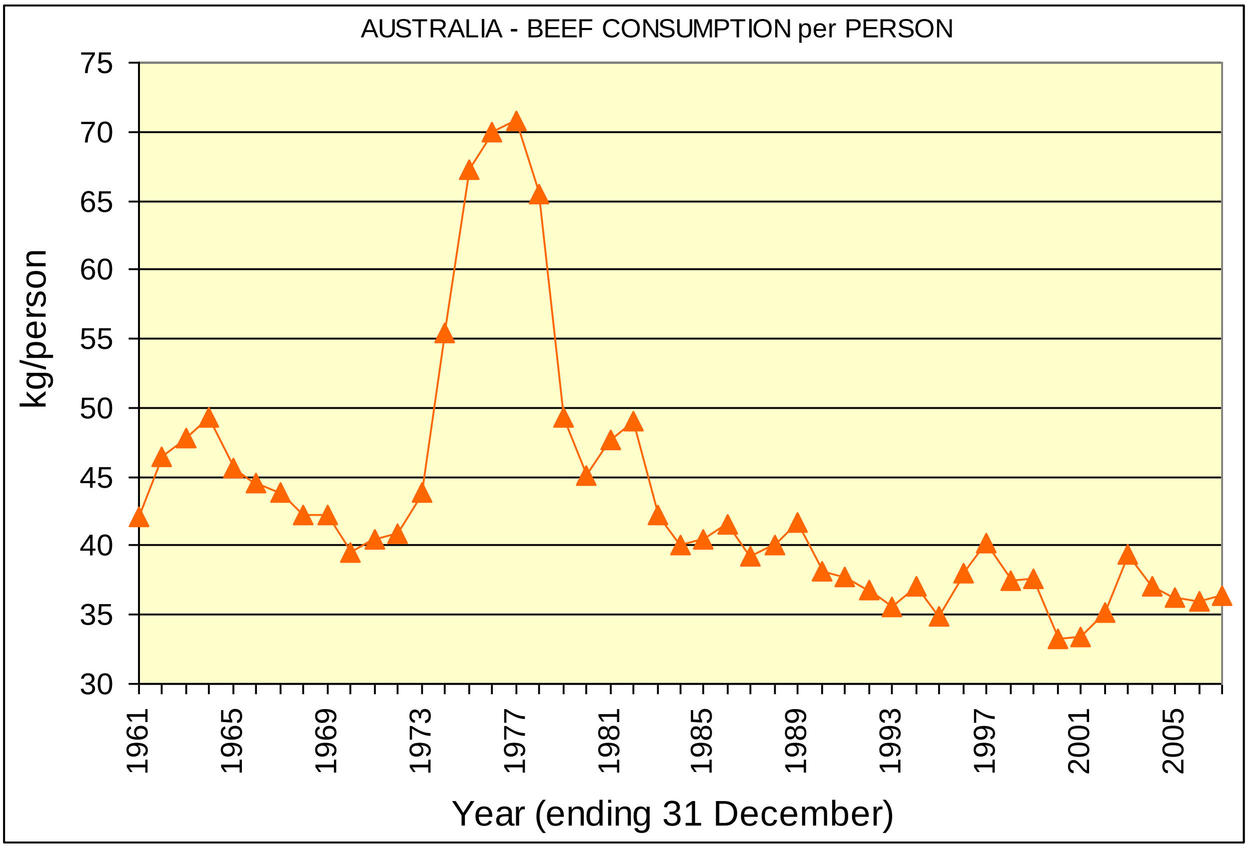


Figure 18 – Per capita beef consumption, Australia

Exports have risen significantly since 1984, countering the impact of declining per capita domestic consumption (Figure 19).

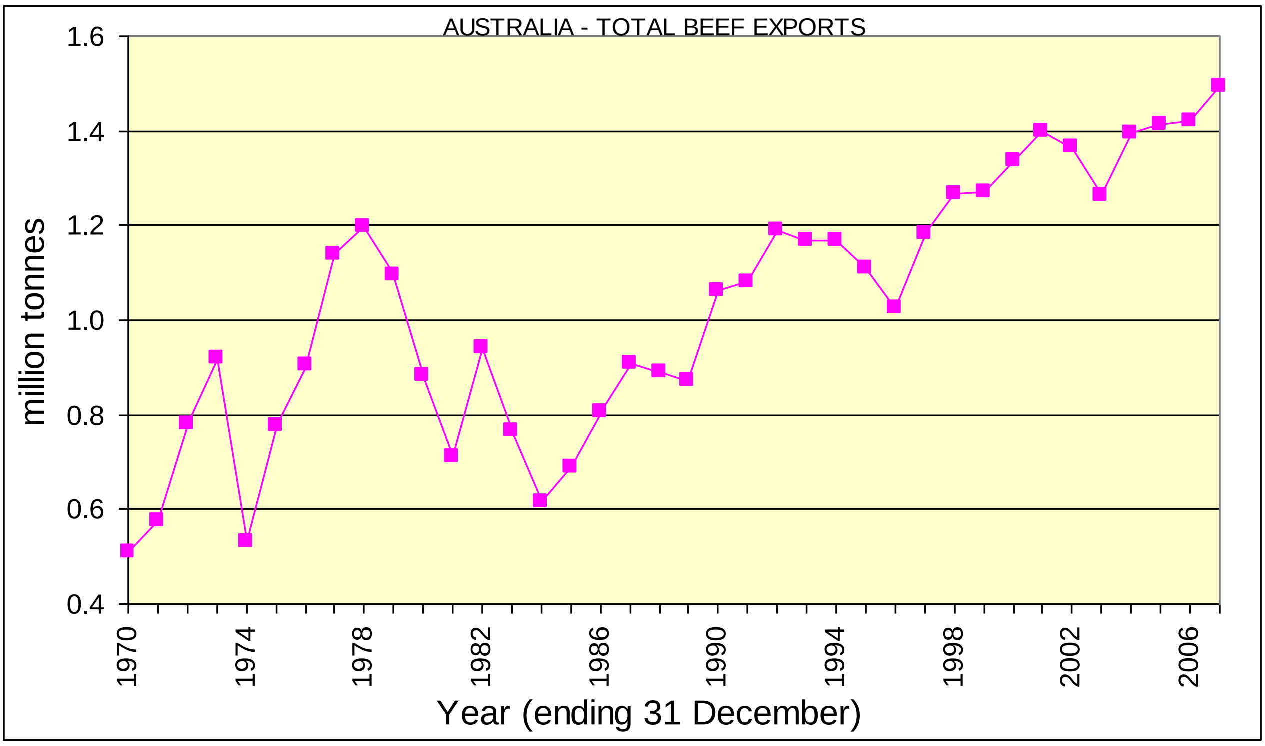


Figure 19 - Total beef exports, Australia

Queensland clearly dominates the Australian beef industry production and slaughter capacity and also is the home of the largest feedlot capacity (Table 8).

Table 8 - Livestock slaughtering and production by State

	Aust 2003	2004	2005	2005 NSW	Vic	Qld	SA	WA	Tas.	NT	ACT
Livestock Slaughtering (a)(b)											
Cattle ('000)	8,083	7,753	7,986	1,700	1,516	3,690	359	511	204	-	-
Calves ('000)	1,146	1,026	868	201	539	73	5	4	44	-	-
Sheep ('000)	11,886	10,421	11,443	3,548	3,465	919	979	2,205	326	-	-
Lambs ('000)	16,870	16,562	17,331	4,110	6,787	287	3,236	2,467	443	-	-
Pigs ('000)	5,742	5,591	5,342	1,615	847	1,285	895	647	46	-	-
Chickens ('000)(c)(d)	419,181	423,742	444,742	147,973	124,726	84,086	np	np	np	np	np
Livestock products											
Meat (a)(e)											
Beef ('000t)	2,035	1,998	2,133	441	363	1,046	93	131	57	-	-
Veal ('000t)	38	35	29	13	11	3	-	-	1	-	-
Mutton ('000t)	268	220	237	78	68	19	23	44	6	-	-
Lamb ('000t)	329	341	354	83	136	6	72	49	9	-	-
Pig meat ('000t)	420	406	389	119	63	96	64	44	3	-	-
Chicken meat ('000t)(d)(f)	690	694	760	226	220	129	np	np	np	np	np

3.9 Productivity improvements in the beef industry due to the feedlot industry

The development of the feedlot industry has conferred productivity benefits to the Australian beef industry. Feedlots have significantly contributed to changes in the Australian beef supply chain enabling the breeding industry to turn off weaners at an earlier age, grow them through a specialist weaner-background-feedlot supply and specialist backgrounding industry that collects an assortment of cattle and tailors them to suitable lines to meet the requirements of the various feedlots they supply.

These supply chain changes have enabled beef production to be better tailored to regional operating environments. Importantly more cows can be run on lower priced breeding country and cattle growth rates can be maintained through backgrounding and feedlot operations leading to better quality beef and heavier carcase weights at various age groups.

In times of drought, feedlots provide an effective drought mitigation and cattle disposal system compared to previous times when drought would see the demise of cattle herds. This approach guarantees a supply line for meat processors and consistency of abattoir utilisation provided feedlot economics are positive.

The improvement in beef industry economics in Northern beef herds and additional benefits from grain feeding can be illustrated from work undertaken by the Beef CRC.

The Beef CRC, in examining the economic benefit of crossbreeding in Northern Australia estimated the improvements that could accrue from the development of crossbreeding and composite development in Northern beef herds with cattle being finished in grass fed or 120 day grain fed supply channels compared to returns from a conventional Brahman herd.

The results of that analysis indicate that crossbreeding and composite development improved gross margins by $7 and $24 per Adult Equivalent which equated to an improvement in profitability of 4 and 14 per cent from crossbred and composite herds respectively.

When a similar analysis was conducted examining crossbred and composite animals targeted at the 120 day grain finished export market gross margins increased to $38 per Adult Equivalent above a conventional Brahman herd which was an improvement in profitability of 22 per cent.

The gross margin increased by another $5 per AE if just 15 per cent of steers achieve a higher marbling score (worth 10c/kg) and by another $9 per AE if there were to be a 5c/kg premium for tenderness on an assumed 60 per cent of steers based on the assumptions used by the researchers.

That is, grain feeding offers a potential improvement in gross margin of approximately $30-45 per Animal Equivalent for crossbred and composite cattle respectively over conventional Brahman cattle on grass fed systems.

4 The current status of the Australian feedlot industry

4.1 The Australian feedlot industry dynamic

The increase in the Australian beef herd has also seen the increase in the development of feedlot capacity in the eastern states of Australia particularly Queensland. Figure 20 shows the proximity of current feedlot development to the large cattle populations in Queensland and regional clusters in northern and southern New South Wales, South Australia and Western Australia to a lesser extent.

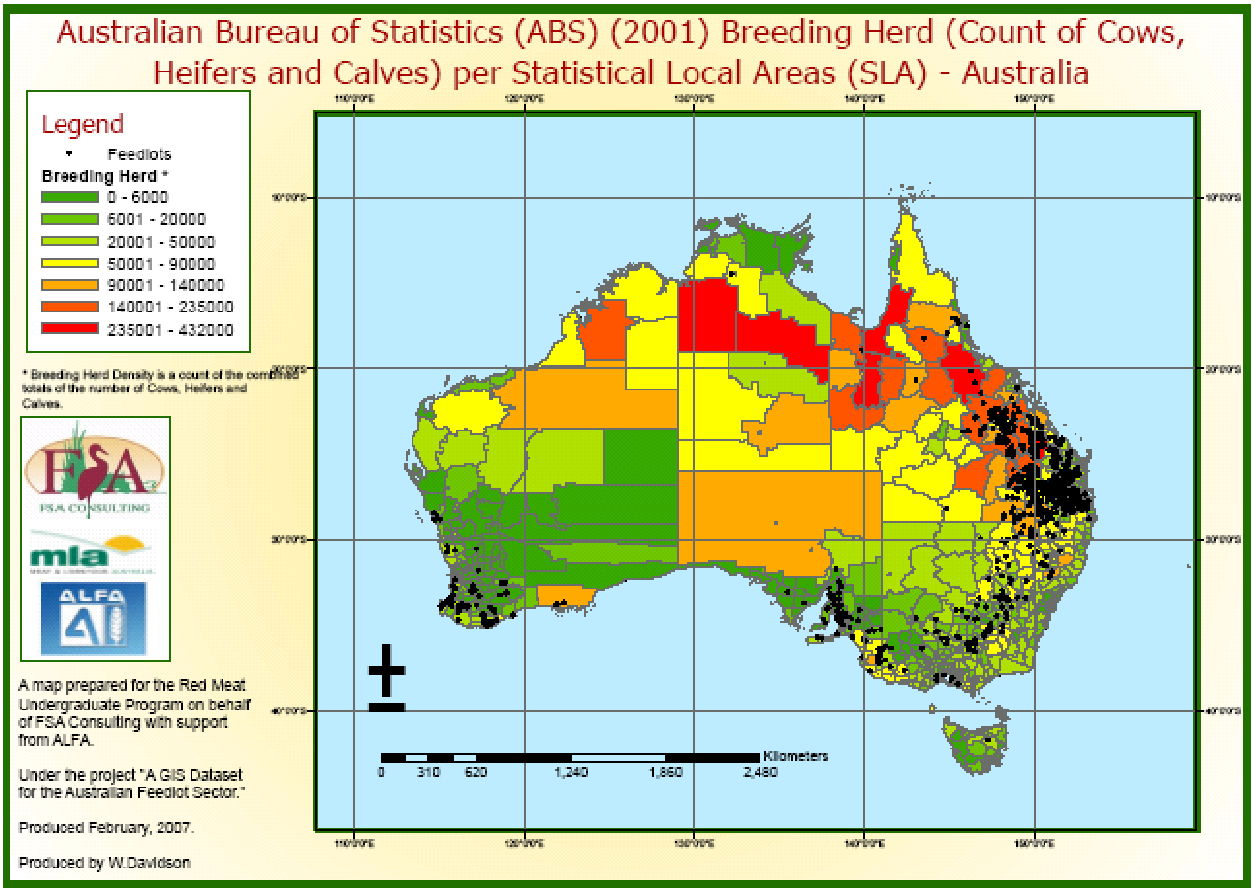


Figure 20 - Cattle population relative to feedlot location

The influence of the grain-fed sector in the Australian beef industry continues to expand, with feedlot beef production now accounting for 34 percent of total cattle slaughter in Australia[2].In 2005-06, 2.59 million head were sold ex-feedlot - a 5 percent increase on the previous year.

At the end of June 2006, 940,000 head were on feed - 5 per cent higher than the March quarter and 7 percent above the corresponding period in 2005.

2 ALFA , August , 2006

Since 2003 there has been a 25 per cent increase in feedlot capacity driven primarily by a rapid expansion in Australia's market share in Japan and Korea and increased domestic demand for feedlot beef from major domestic supermarkets. The ongoing drought has also encouraged feedlot development as a drought mitigation strategy.

This expansion occurred primarily in larger feedlots in larger lots while the number of smaller operations decreased (Figure 21). Current feedlot capacity is 1.13 million head.

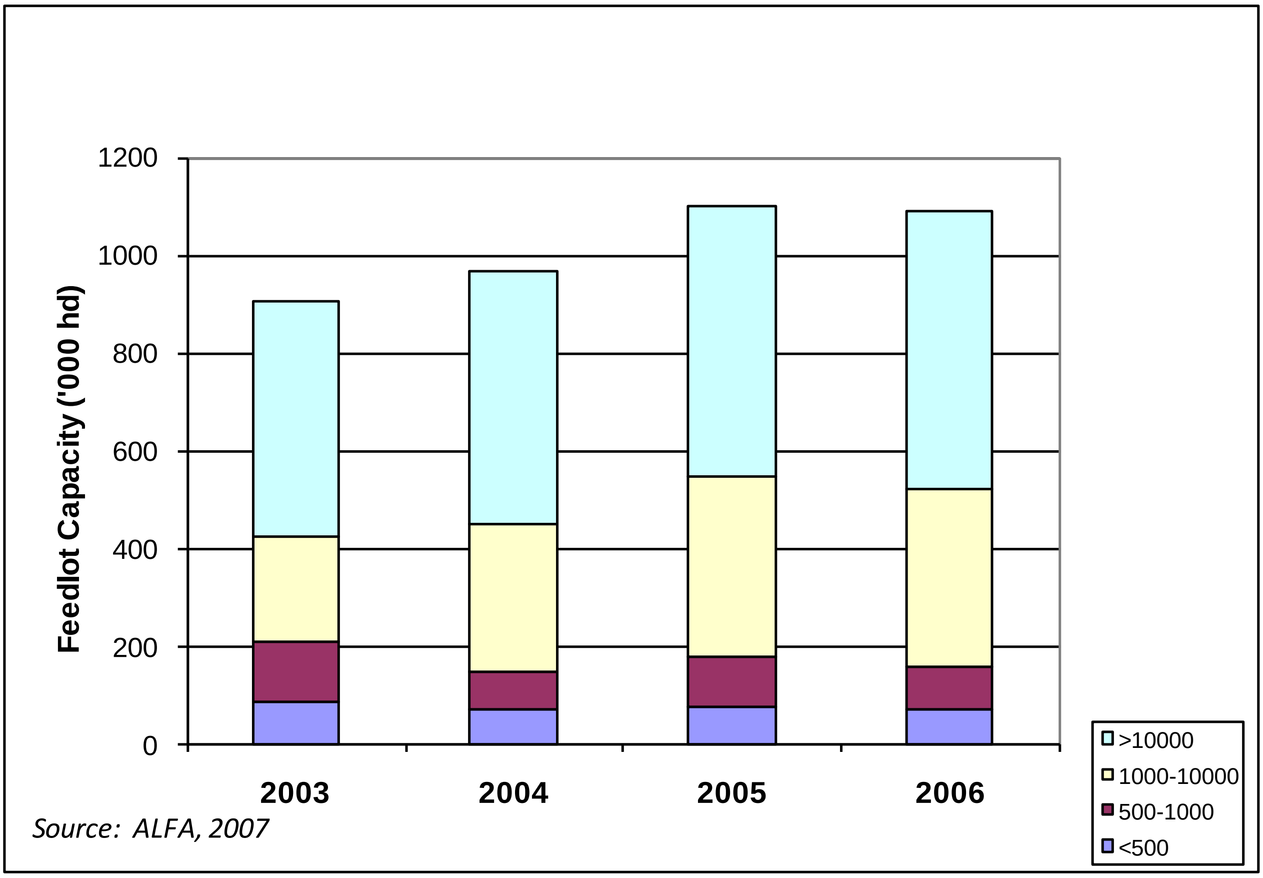


Figure 21 - Feedlot capacity at December by feedlot size

The number of cattle on feed has increased substantially in the year to December 2006, reflecting the impact of the drought and the inability to finish cattle on grass (Figure 22).

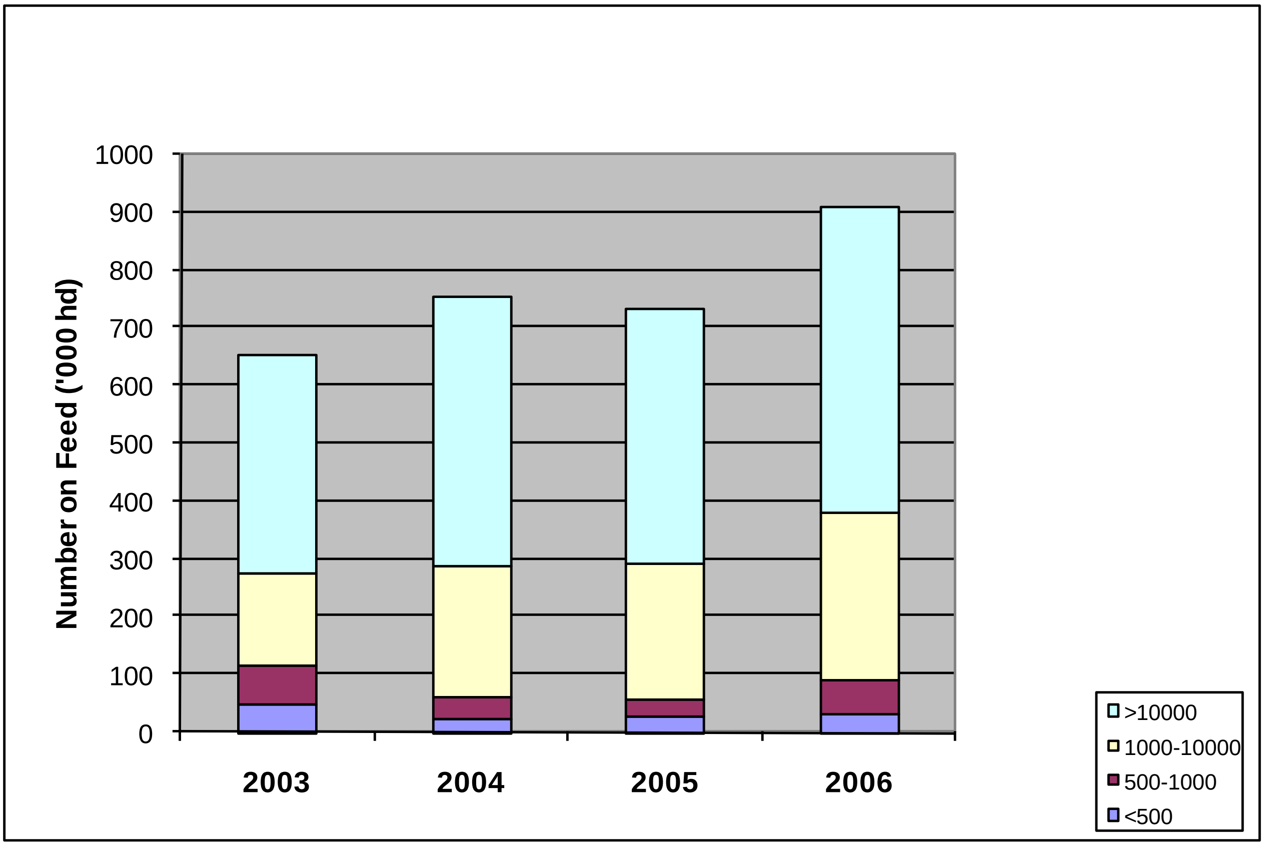


Figure 22 - Number on feed at December by feedlot size

Capacity utilisation has also been increasing, particularly for the larger feedlots but smaller and mid-sized feedlots have variable capacity utilisation (Figure 23 & Table 9).

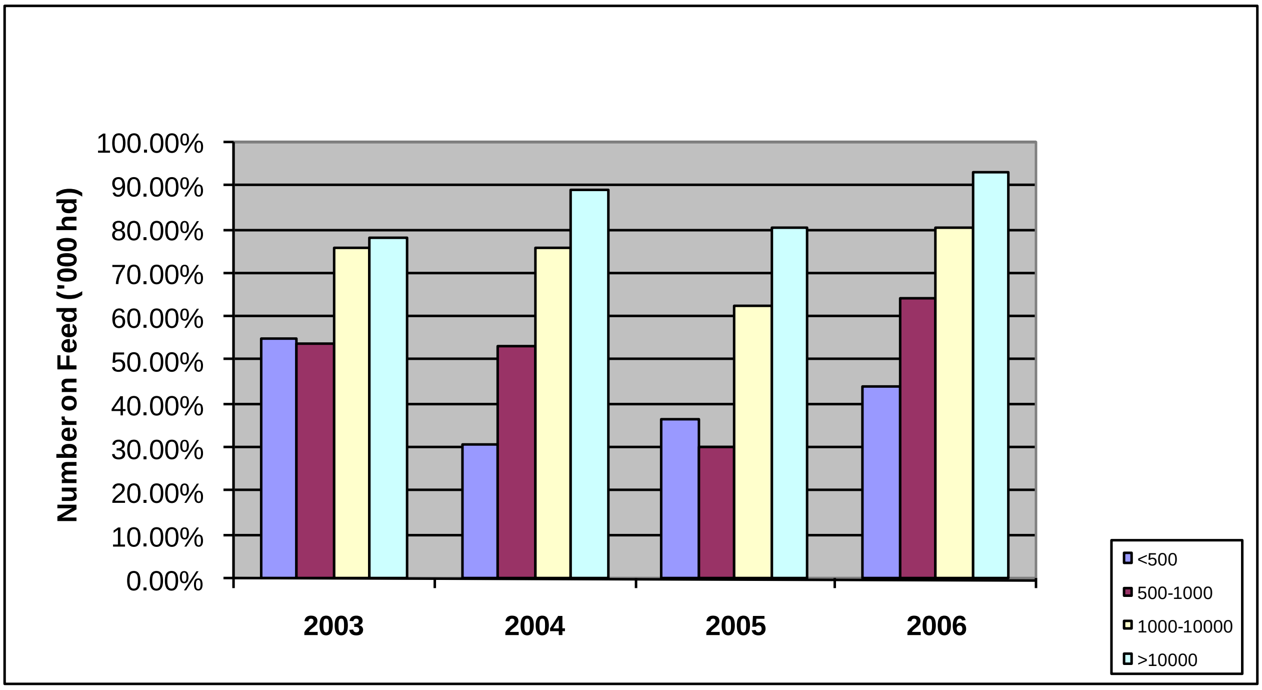


Figure 23 - Capacity utilisation at December by feedlot size

Japan has become increasingly important as a destination for grain fed cattle, as has the domestic market (Figure 24).

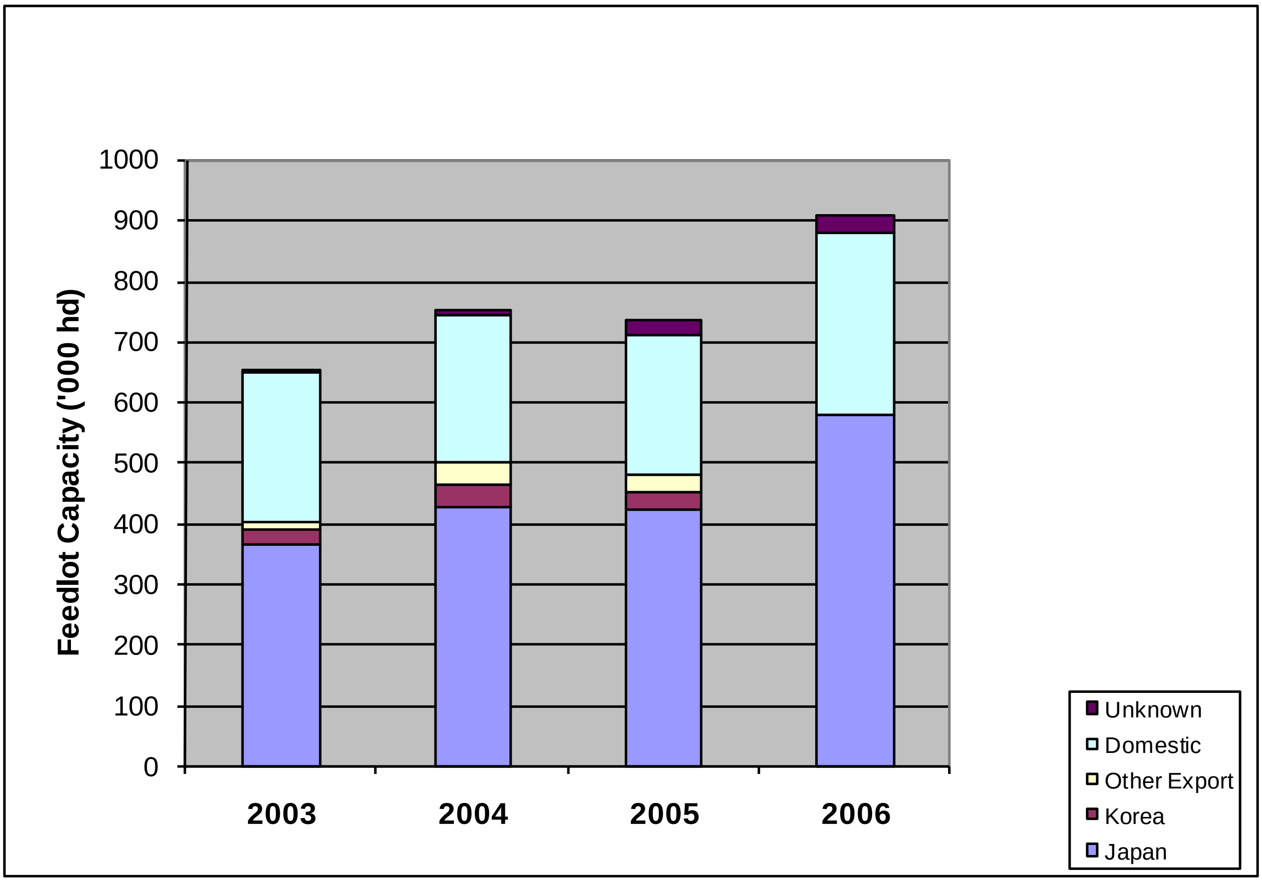


Figure 24 - Cattle on feed by destination

Table 9 - State feedlot capacity breakdown by feedlot size

	Capacity			Number on Feed			Capacity Utilisation	
	Dec-06	Sep-06	Dec-05	Dec-06	Sep-06	Dec-05	Dec 06	Dec 05
New South Wales	369,521	368,238	353,544	319,067	299,937	274,824	86.3%	77.7%
<500 head	8,478	11,249	11,029	6,509	4,008	6,079	76.8%	55.1%
500-1000 head	20,610	19,653	19,674	15,590	9,294	5,639	75.6%	28.7%
1000-10000 head	99,100	96,503	80,508	61,428	74,077	60,096	62.0%	74.6%
>10000 head	241,333	240,833	242,333	235,540	212,558	203,010	97.6%	83.8%
Queensland	528,675	550,130	543,531	440,704	466,466	346,257	83.4%	63.7%
<500 head	44,480	51,055	46,963	17,130	30,627	14,015	38.5%	29.8%
500-1000 head	40,970	40,856	51,307	21,250	30,135	16,097	51.9%	31.4%
1000-10000 head	167,935	192,403	185,675	158,811	165,323	123,374	94.6%	66.4%
>10000 head	275,290	265,816	259,586	243,513	240,381	192,771	88.5%	74.3%
Victoria	72,097	73,292	72,655	67,468	60,220	61,150	93.6%	84.2%
<500 head	1,497	1,305	1,060	1,170	284	265	78.2%	25.0%
500-1000 head	4,600	4,237	4,595	3,463	3,474	3,070	75.3%	66.8%
1000-10000 head	14,000	15,750	15,000	12,617	11,149	10,069	90.1%	67.1%
>10000 head	52,000	52,000	52,000	50,218	45,313	47,746	96.6%	91.8%
South Australia	34,539	38,610	25,209	27,161	27,033	16,654	78.6%	66.1%
<500 head	4,527	4,913	4,117	2,835	2,282	1,263	62.6%	30.7%
500-1000 head	8,982	11,230	6,647	7,834	5,819	5,339	87.2%	80.3%
1000-10000 head	21,030	22,467	14,445	16,492	18,932	10,052	78.4%	69.6%
>10000 head	0	0	0	0	0	0	0.0%	0.0%
Western Australia	86,890	101,937	106,669	54,420	27,625	35,473	62.6%	33.3%
<500 head	12,215	11,112	14,198	3,720	763	3,547	30.5%	25.0%
500-1000 head	13,475	16,355	16,594	8,977	2,569	2,437	66.6%	14.7%
1000-10000 head	61,200	74,470	75,877	41,723	24,293	29,489	68.2%	38.9%
>10000 head	0	0	0	0	0	0	0.0%	0.0%
Australia	1,091,722	1,132,207	1,101,608	908,820	881,281	734,358	83.2%	66.7%
<500 head	71,197	79,634	77367	31,364	37,964	25,169	44.1%	32.5%
500-1000 head	88,637	92,331	98817	57,114	51,291	32,582	64.4%	33.0%
1000-10000 head	363,265	401,593	371505	291,071	293,774	233,080	80.1%	62.7%
>10000 head	568,623	558,649	553919	529,271	498,252	443,527	93.1%	80.1%

4.2 Factors influencing feedlot location and current capacity expansion

4.2.1 Geographic spread

Feedlots have developed across the Australian grain belt particularly in Queensland, New South Wales and Victoria. Location is prompted primarily by access to cattle supplies, meat processing capacity and feed grain and water supplies. Despite significant grain production in Western Australia and South Australia that grain supply capacity has not been matched by comparable feedlot development (Figure 25).

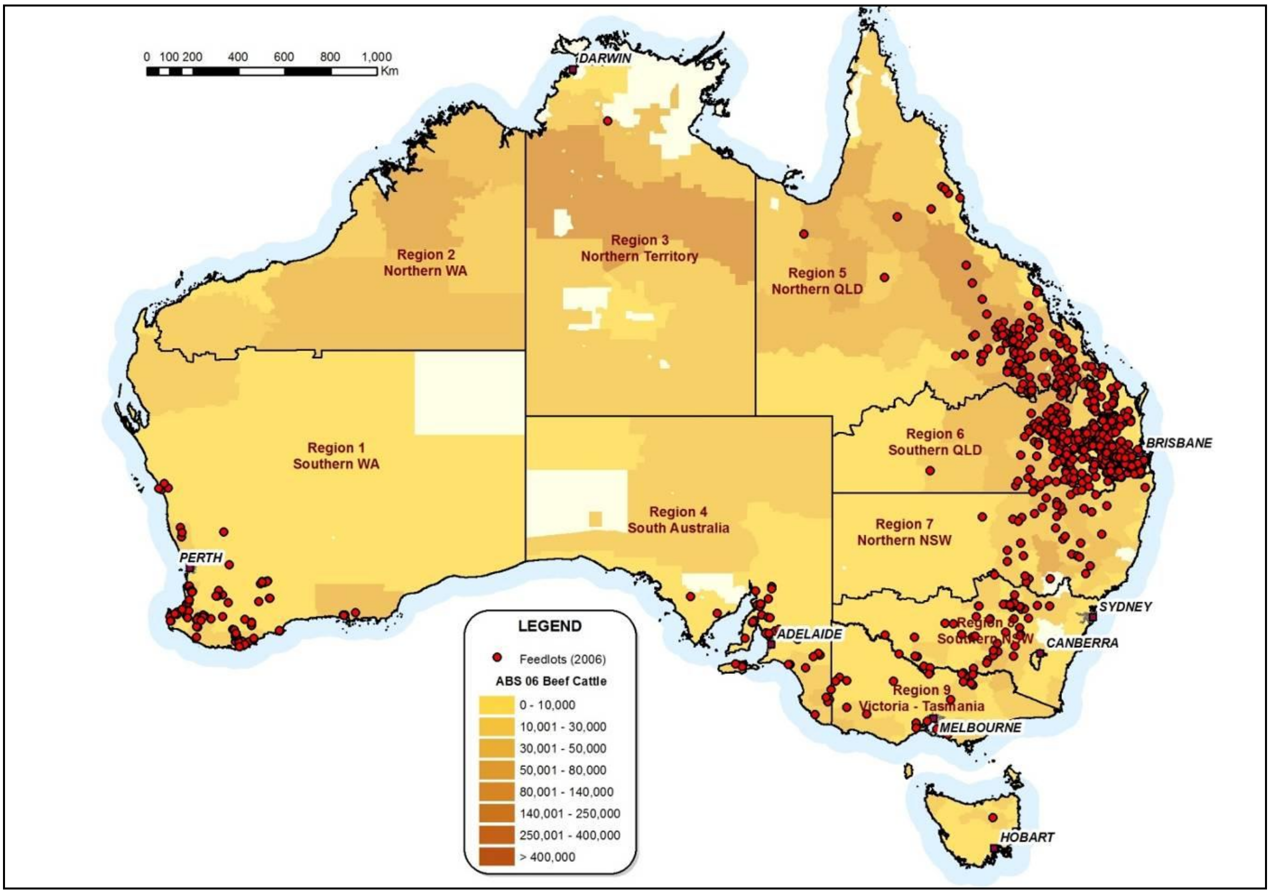


Figure 25 - Location of the Australian beef herd in relation to existing feedlot capacity

4.2.2 Heat stress location considerations

Potential heat stress has been another key determinant in feedlot location as shown in the following chart. Despite increasing feedlot development in Indonesia this has not been accompanied by comparable feedlot development in northern Western Australia and the Northern Territory (Figure 26). Instead live cattle are exported out of northern ports to SE Asian feedlots .The demise of the meat processing sector in Northern Australia has further constrained any significant feedlot development activity.

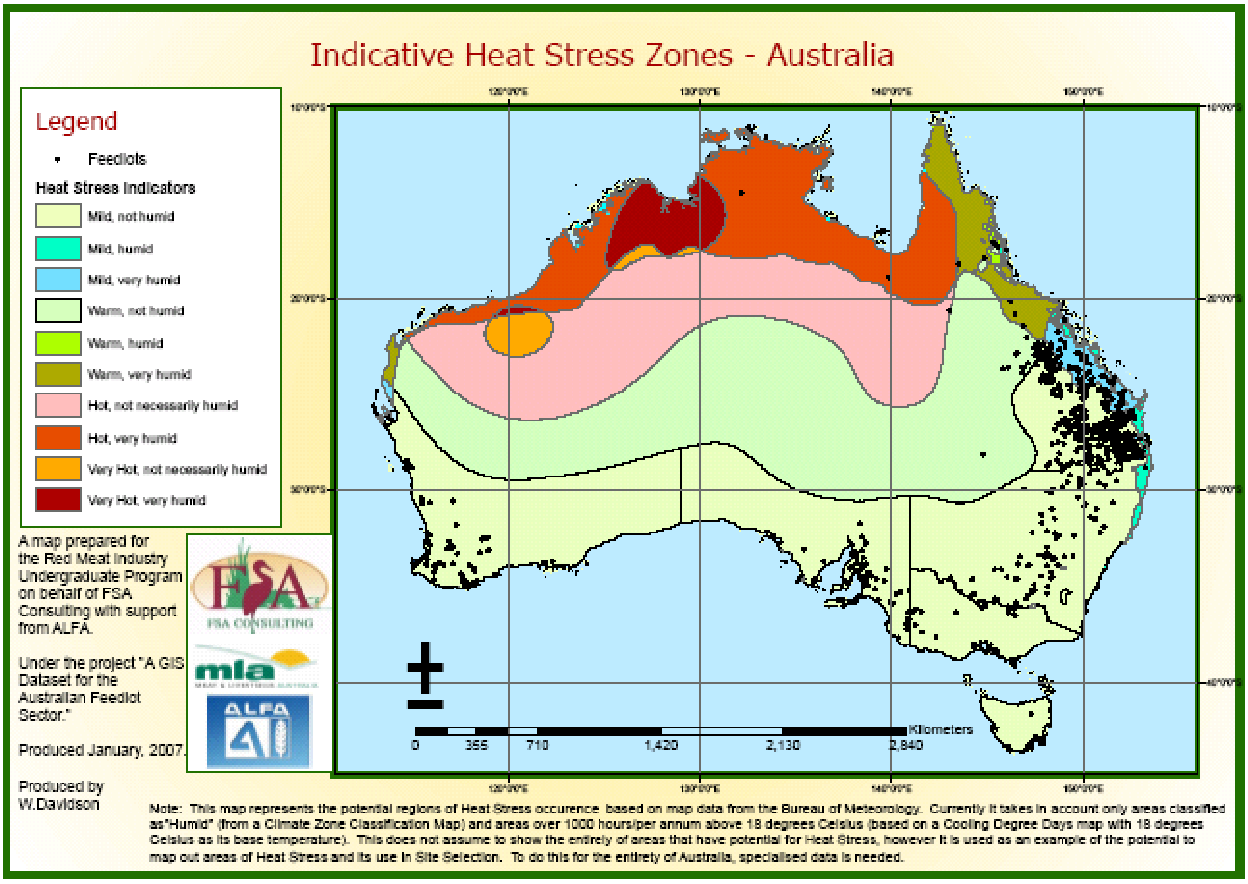


Figure 26 - Indicative heat stress zones, Australia

4.2.3 Abattoir proximity

The lot feeding sector has undergone significant change in recent years with a decrease in the number of opportunity feedlots and an increase in the number of full time commercial lots particularly in Queensland.

Proximity to major abattoirs is a key consideration in feedlot location. The following charts examine existing feedlot location relative to large abattoir draw areas. Clearly abattoir proximity is a key consideration in feedlot location (Figures 27-30).

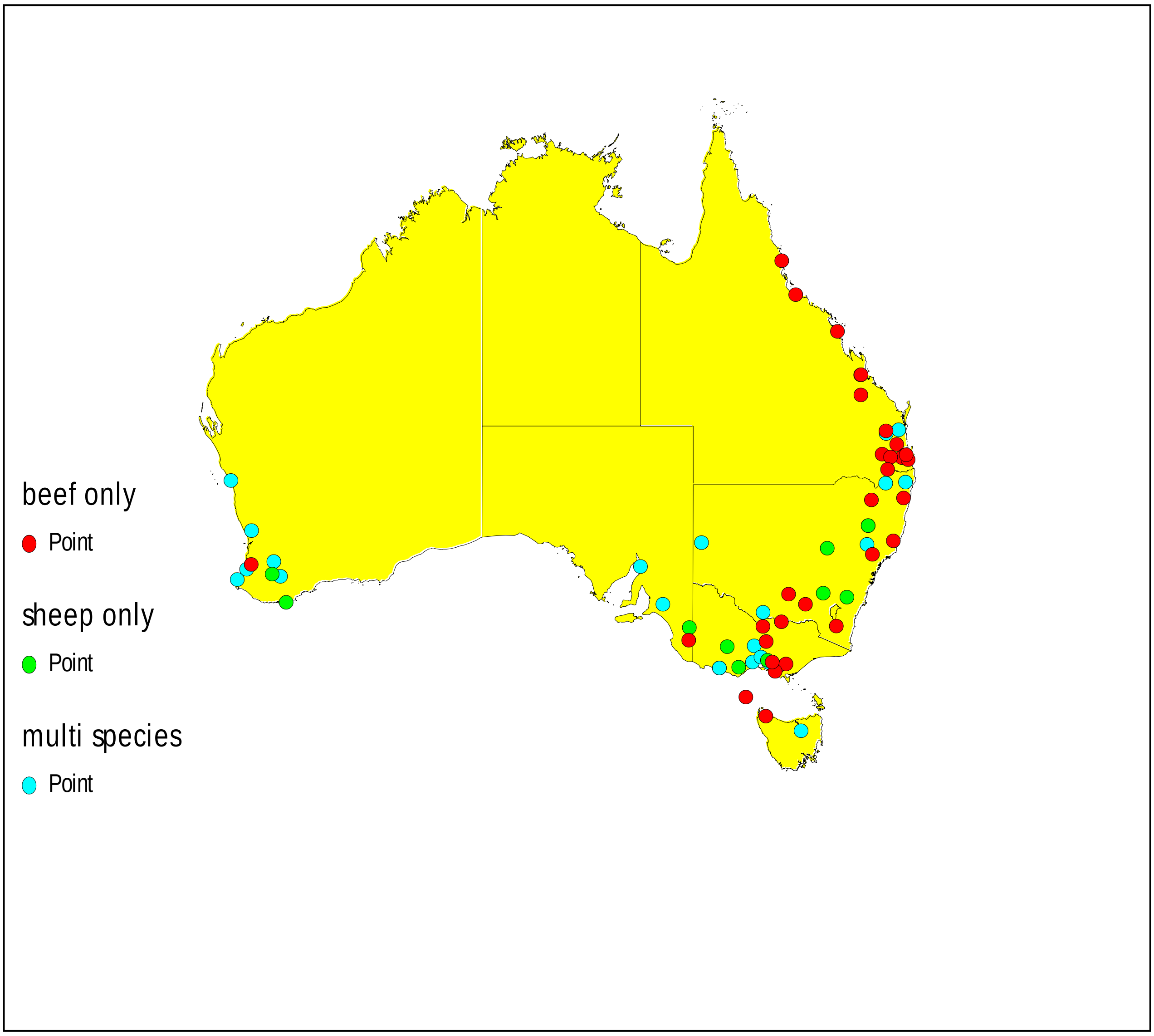


Figure 27 - Australian export abattoirs, May 2006

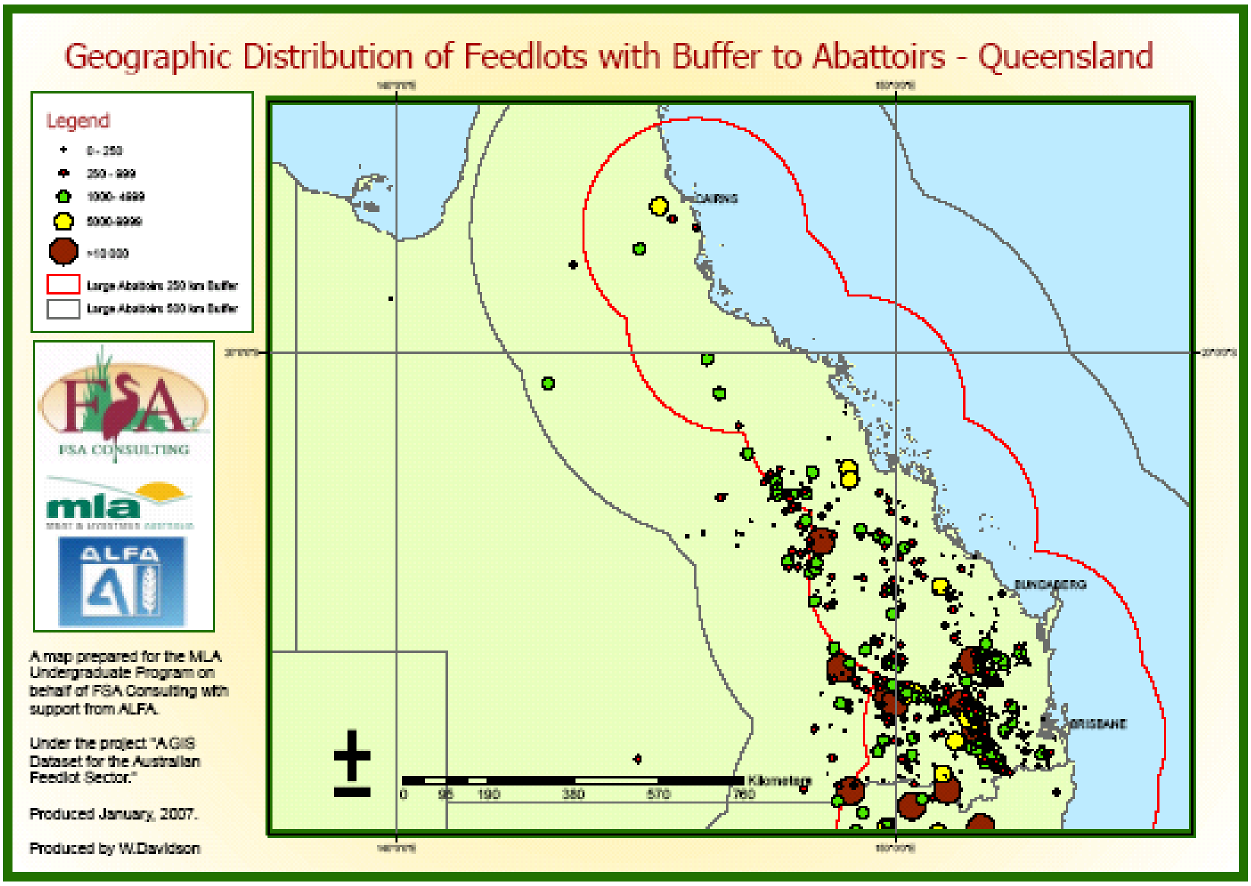


Figure 28 - Feedlot and abattoir distribution, Queensland

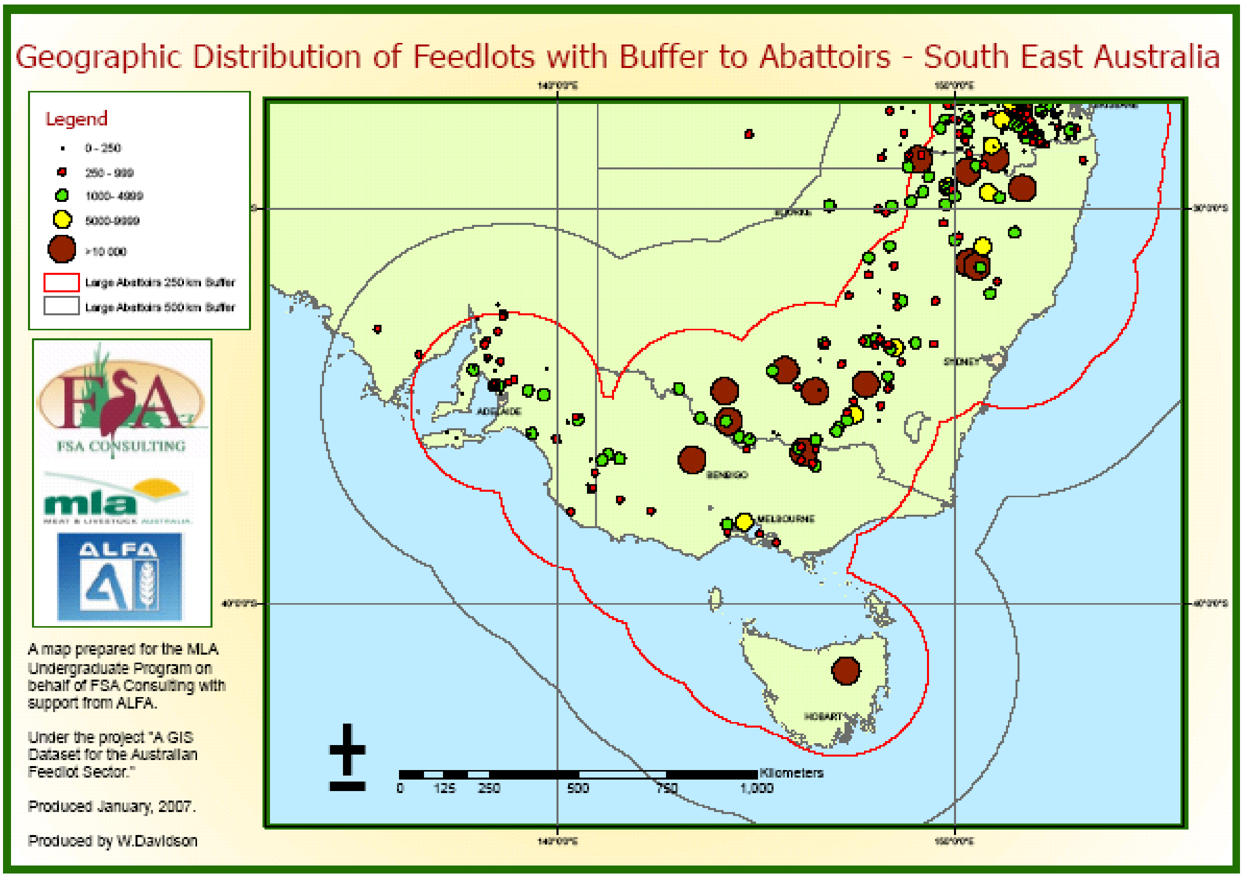


Figure 29 - Feedlots and abattoir distribution, southern Australia

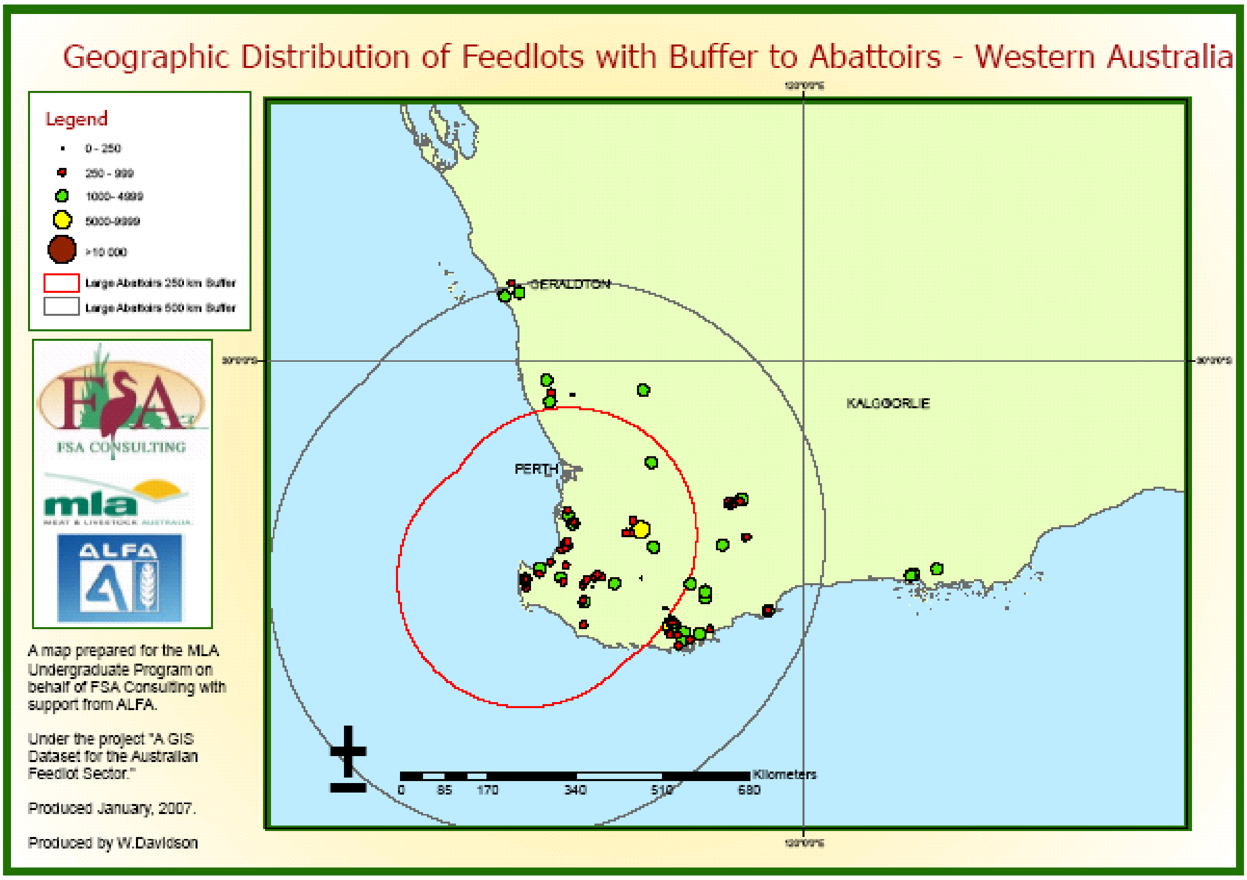


Figure 30 - Feedlots and abattoir distribution, Western Australia

Central Queensland has seen the greatest expansion in the number of feedlots (Figure 31).

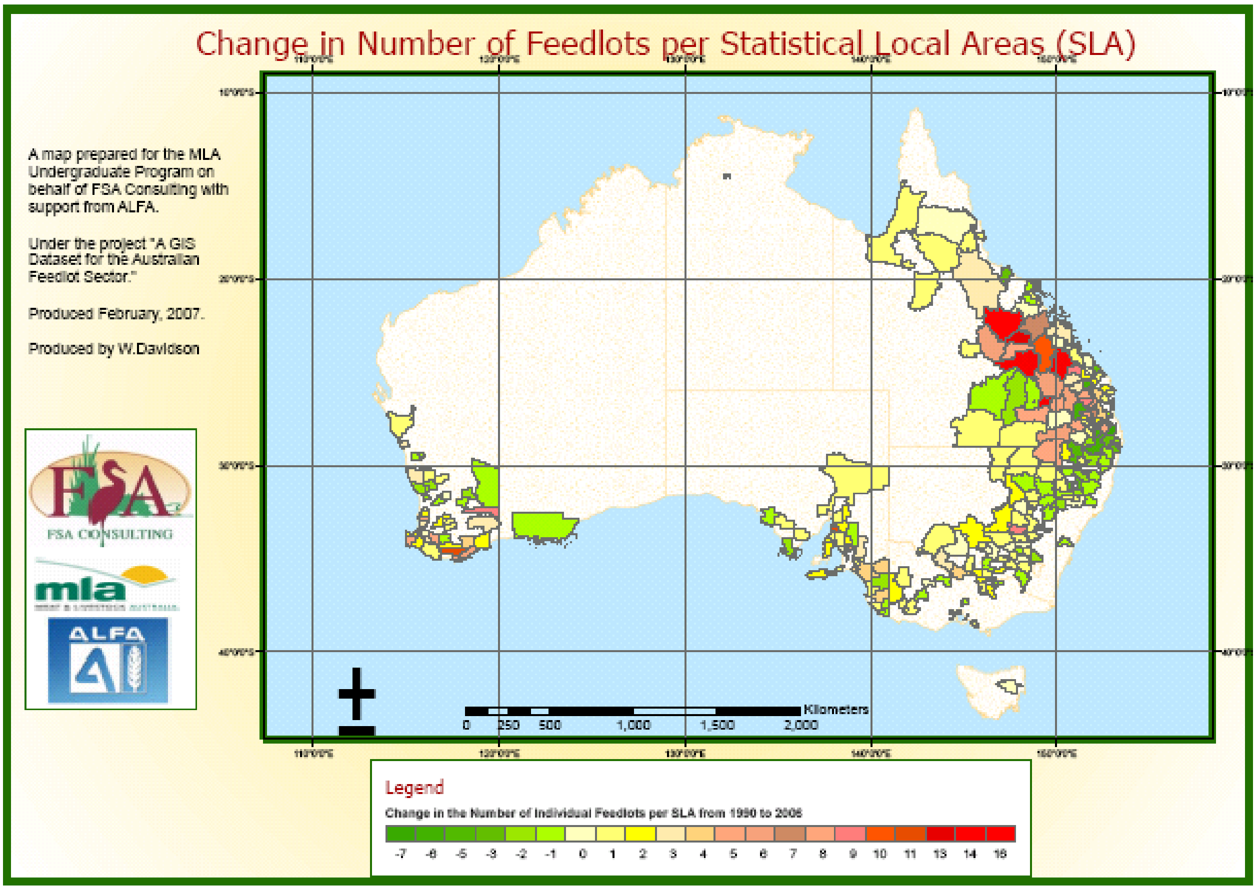


Figure 31 - Change in feedlot number by SLA

4.2.4 Feedlot grain supply security

Feedlots require access to reliable year round supplies of feed grains. One of the reasons feedlots are located in the grain belt is that it is easier to transport cattle to grain. Feedlots have to compete for feed grain supply against other users of grain including the dairy, pork and poultry industries and more recently grain based ethanol plants. In northern New South Wales and southern Queensland grain demand often exceeds supply with additional supplies being imported from other states (Figure 32).

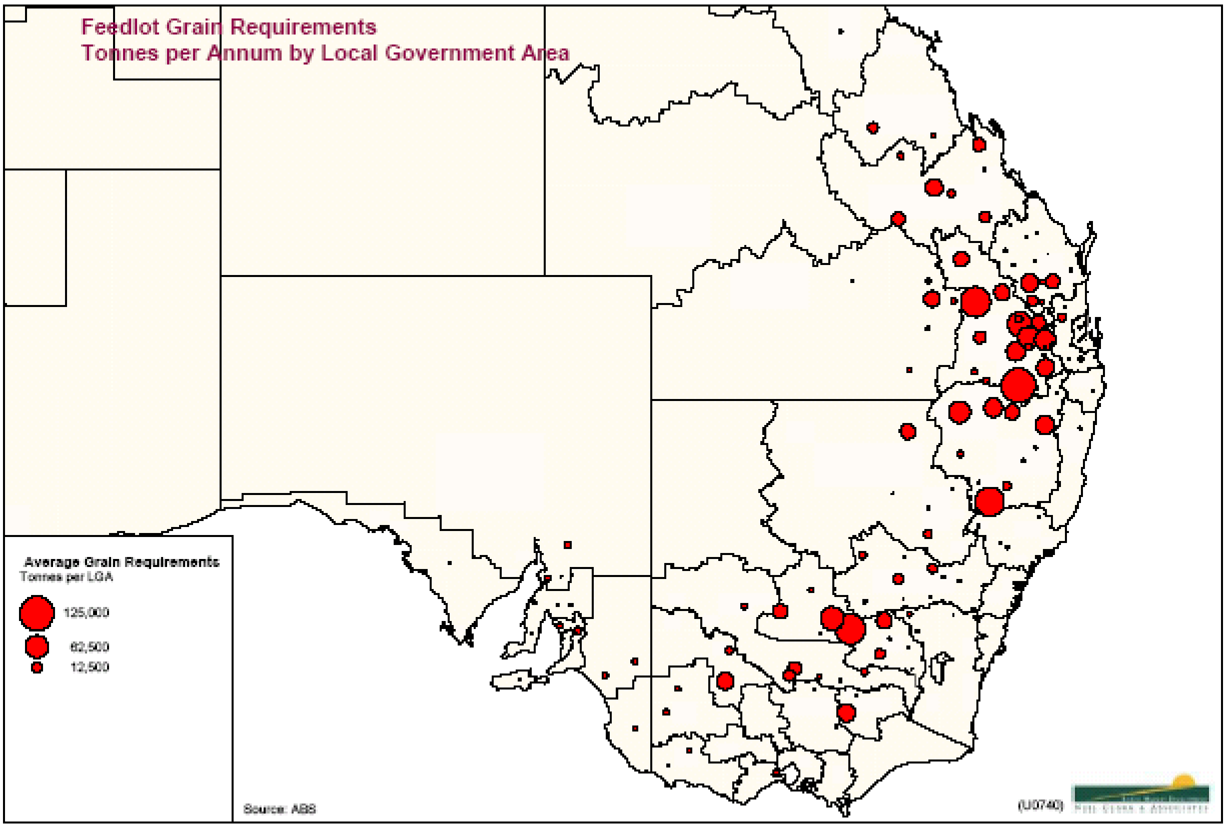


Figure 32 - Feedlot grain requirements by SLA

It is interesting to note the relativity of feedlot grain supply/demand relationships in an average, high and low production year. Clearly in low production years there is deficit of grain to satisfy existing demand, limiting further feedlot capacity growth. This position becomes increasingly exacerbated when the competition for feed grain increases from either competitor intensive livestock industries or new grain users such as the prospective grain based ethanol plants (Figures 33-35).

Because Australia's quarantine regulations prohibit the import of grain and transport of untreated grain up country Australian lot feeders cannot rely on supplies of imported grain as do feed grain competitors such as the poultry industry. Where there are regional supply/demand shortages feed grain is often "imported" from interstate particularly in northern New South Wales and Queensland. Any further industry expansion will have to accommodate the need for further feed grain supply to match that future feedlot growth particularly in poor grain production years.

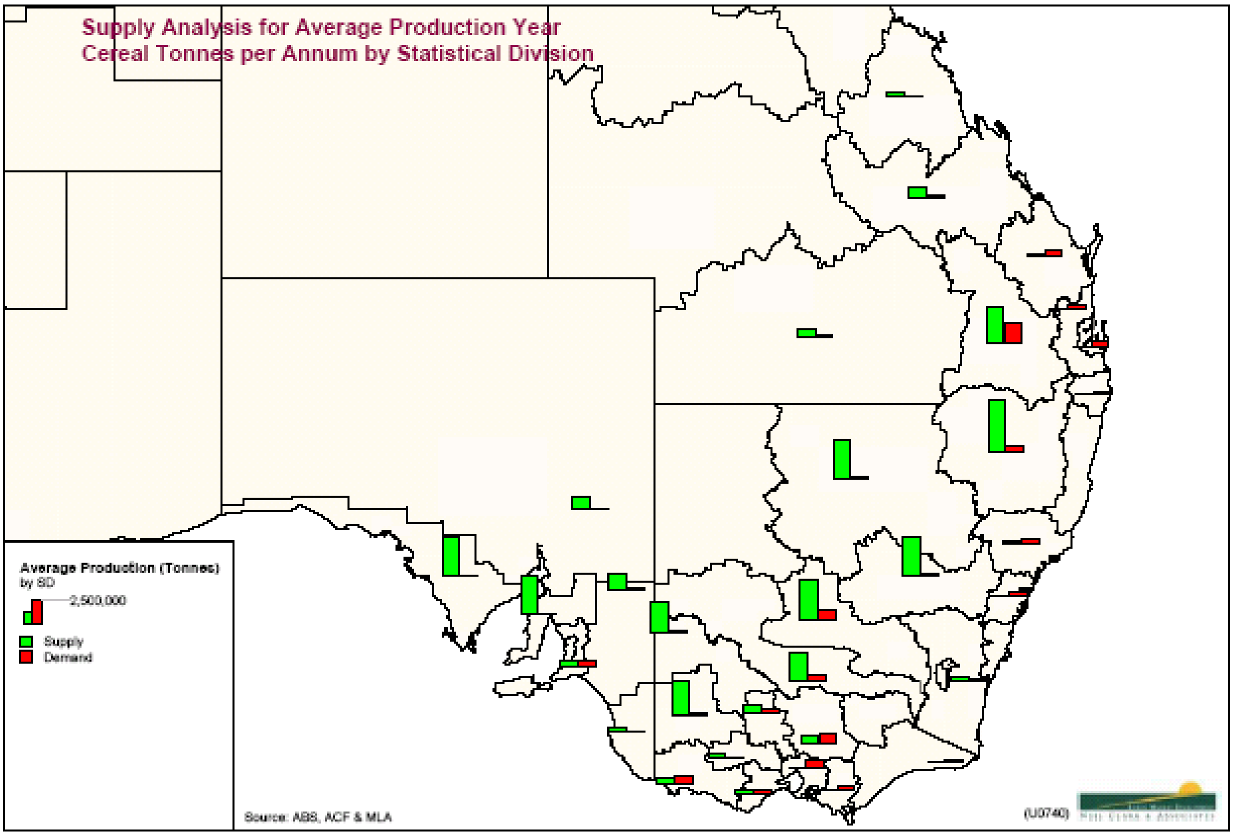


Figure 33 - Grain supply by statistical division – average year

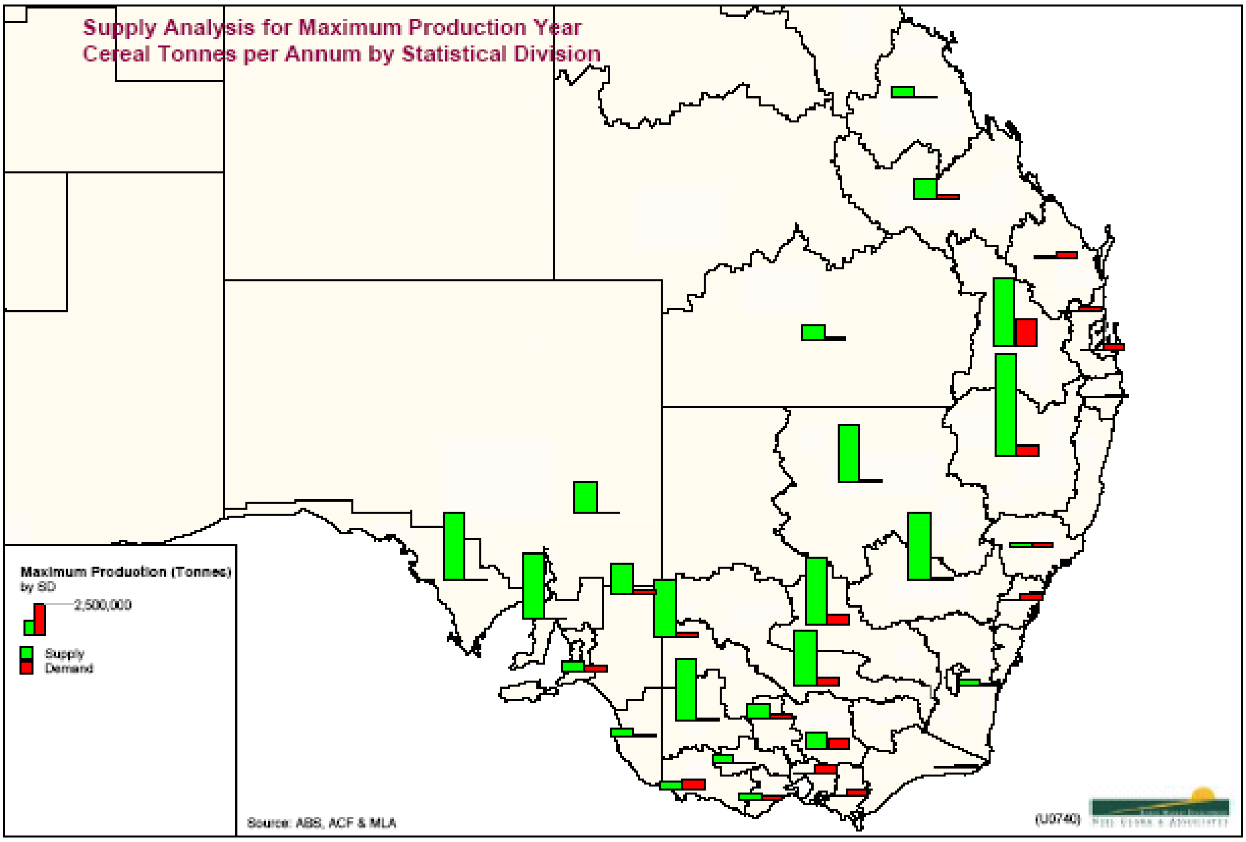


Figure 34 - Grain supply by statistical division – maximum year

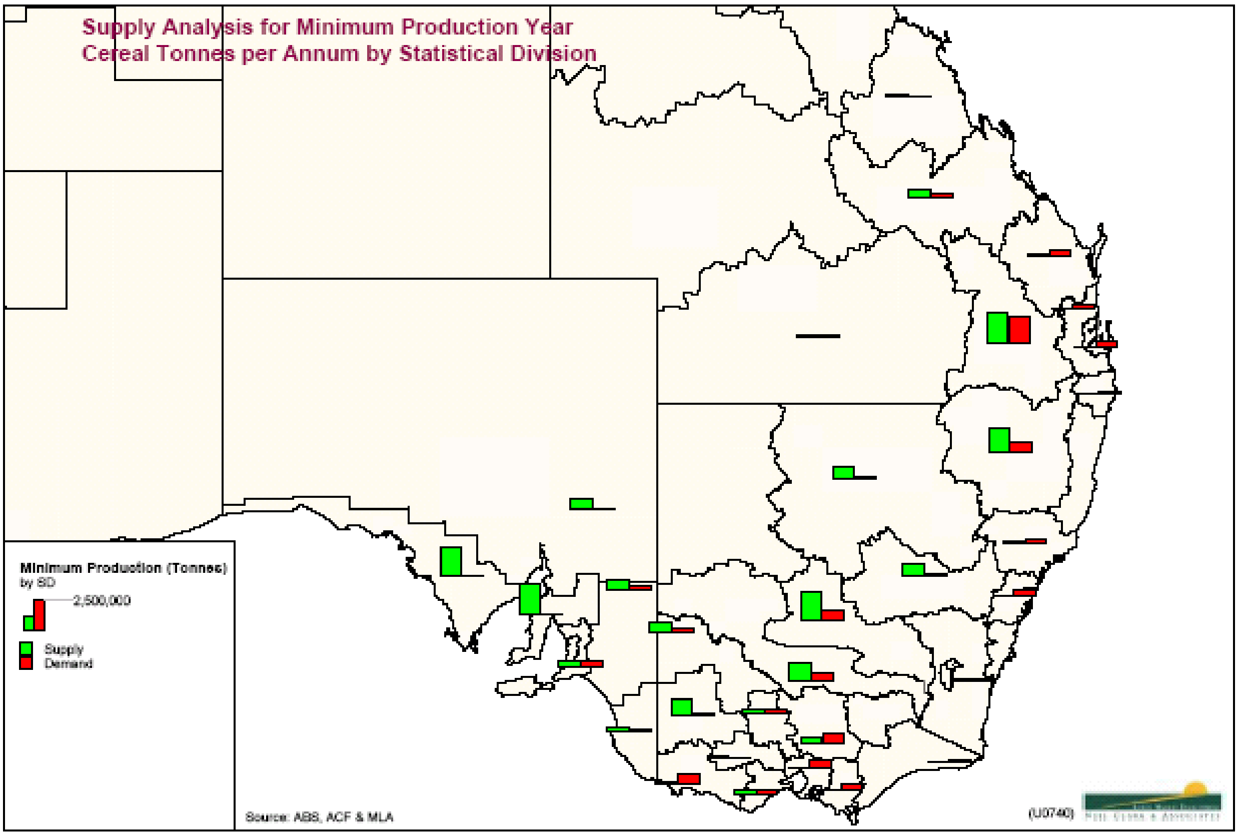


Figure 35 - Grain supply by statistical division – minimum year

4.3 Challenges for the Australian lot feeding industry

4.3.1 Drought mitigation

Drought presents challenges for the feedlot sector principally in terms of water availability for normal feedlot use and associated livestock and farming activities. The biggest drought challenge is the increased price of grain and competition for supply especially if the drought is state wide or more extensive. While drought conditions usually improve feeder steer buy/sell margins, feedlots need to ensure appropriate close-out price lock-ins to ensure viability. The issue of available grain supply is paramount and is addressed in the next section. As the feedlot and feed grain industry matures the possibilities of forward supply contracts with preferred feed grain suppliers becomes essential. Even these forward contracts need to be carefully managed to ensure there is physical grain supply at the right price to enable lot feeders to mitigate drought effects.

4.3.2 Grain supply

Reliability of supply of feed grain has become a high priority issue for industry in the northern region. Expansion by major intensive livestock and industrial users of grain, combined with high inter-annual variability in seasonal conditions, has generated concern in the industry about reliability of supply. Hammer, et al (2002)[3] report on a modelling study undertaken to analyse the reliability of supply of feed grain in the northern region. Feed grain demand was calculated for major industries (cattle feedlots, pigs, poultry and dairy) based on their current size and rate of grain usage. Current demand was estimated to be 2.8Mt. With the development of new industrial

3 Hammer G, Potgieter A, Strahan R, (2002) "The reliability of supply of feed grains in the northern region", QDPI

users (ethanol) and by projecting the current growth rate of the various intensive livestock industries, it was estimated that demand would grow to 3.6Mt.

Data for Queensland and northern New South Wales were combined to obtain total estimates for the northern cropping region. Estimates for northern New South Wales were taken as one-third of the values reported for the state by the Australian Bureau of Statistics (ABS) (Table 10).

Table 10 - Current and projected feed grain demand in the northern cropping region

Industry	Current Demand ('000 t)	Growth Rate (annual %)	Demand in 3 years ('000 t)
Feedlots (Qld)	1,150	7.4	1,424
Pigs (Qld)	367	10.0	488
Poultry – Meat (Qld)	239	2.5	257
Poultry – Layers (Qld)	96	2.5	104
Dairy (Qld)	184	0	184
Ethanol (Qld)			200
All industries (Qld)	2,036		2,657
All industries (N NSW)	770		947
Total	**2,806**		**3,604**

The study concluded that should demand for feed grain in this region grow as projected in the demand analysis, current supply capability will become increasingly inadequate. Even in good planting years, close to half (48%) of the time, demand would not be met by local feed grain production.

In most years Australian feed grain production has enjoyed a surplus over and above domestic market requirements (43%) although this surplus can be reduced significantly during drought. Growth in the intensive livestock sector fuelled by growth in response to domestic and export market demands for product consistency and supply reliability is putting increasing pressure on the traditional feed grain supply surplus particularly in the eastern states.

The fundamentals of short-term grain demand are unlikely to alter substantially in the short-term. That is not to say that supply will not change, but rather that the fundamental drivers of it are unlikely to, as the major alternative demands for grain are unlikely to have any major production increase impact over that time.

However, many issues need to be considered when looking at potential demand going forward. Potential demand pressures could outstrip especially supply in potential increased export market demand and emerging new grain uses such as bio fuels.

One of the problems with the demand assumptions made by many is the assumption that if X amount of grain is available (in Australia, for example) that entire amount is available for a particular use. This assumes, for instance, that the entire grain production of Australia theoretically could be available for stockfeed or grain-based ethanol production. However, users of feed grain have to compete for supply and the various users often have different capacities to pay for that feed grain and remain price competitive. When that feed grain price is beyond the capacity of a lot feeder to payfeedlot capacity utilisations generally decrease unless the price increase is mitigated by favourable feeder steer pricing.

Looking to 2020, it is generally believed that the specifics of the feed grain crop grown could be adjusted according to demand, within the parameters of agronomics and sustainability (GRDC, 2004).

There is a difference between required demand (i.e. for food) and potential demand that includes emerging uses of grain and grain substitution. Most theorists predict the amount of grain required for food will not increase substantially because there seems to be three demand factors at a basic food level:

- population growth is slowing
- more of the world's population already has fairly high levels of per capita grain consumption, beyond which the scope for further increases is fairly limited, and
- the assumption that people who do not have enough food to eat are unable to afford more (and so increase demand) or do not have the resources and other means to produce it themselves.

Within the context of a population growth of around 1.1 percent per annum to 2025, the cumulative effects of these factors is an assumed stagnant per capita demand for grain for direct food use (not including its input into meat). The fundamental strategic issue for the Australian grains industry is not only to identify the particular quantities of demand for each grain, but also the transformations from the existing food and feed value chains to the emerging alternate value chains for new uses of grain and grain-based specialised ingredients.

Before 2020, Australian grain producers are likely to make only minor adaptations to the production processes of the grain industry in the face of increasing demand. The larger challenge will be to identify and supply the maximum potential for international demand for Australian grain production and grain technologies.

Considerable opportunities will exist for the development of increasingly specialised demand chains, with some 40–50 primary uses of wheat and wheat fractions, hundreds of uses of pulses and oilseeds and unspecified emerging opportunities in bio-pharmaceutical, nutraceuticals, and functional grain use.

Apart from demand for pharmaceuticals, nutraceuticals and beneficial foods, the broader volume demand increases will be for lower base cost grain supply than currently applies in the primary human food areas. The big concern is that while world grain supplies are likely to be adequate to meet food needs to 2020, the export opportunities and other pulls on the grain pool towards fuel production, agriceuticals, bio-products and industrial ingredients can lead to a potential demand for Australian grain in the range of 5–6 times the current supply by 2025 (GRDC, 2004).

Previous studies by ABARE and GCA have also identified a number of other key issues facing the feed grains industry including:

- Grain handling and storage infrastructure: - most grain storage and handling infrastructure has been designed and located to facilitate grain exports. This current infrastructure is not designed to handle frequent intra and inter regional transfers of feed grains because of the wide diversity of ingredients and quality characteristics;
- Transport: high cost of internal transport in Australia is an impediment to grain transfers between surplus and deficit regions;
- Lack of coordination between marketing organisations:- the key decision is to decide whether to service traditional overseas markets (contractual obligations)or domestic user markets that may have temporary feed grain deficits;

- Quarantine and biosecurity regulations limiting the availability of feed grain imports: - drought and increased feed demand from growing intensive livestock feeding industries have focused debate on feed grain imports. However there are significant barriers to large scale grain imports although some feed grain is imported for use by the poultry and feed manufacturing industries for use within close proximity of receival ports or for stockfeed milling;
- The need to increase the total supply of feed grains based on projected growth in the intensive livestock feeding industries;
- Improving internal grain flows to minimise supply/demand shortfalls and meet domestic demand for feed grains;
- GRDC's Premium Grains for Livestock Program is aimed at improving the management and pricing system for feed grains enabling grain marketers and end users to develop pricing alternatives and risk management facilities for feed grain producers and users. One possible tool is the development of a rapid and accurate tool to determine the nutritional value of grain to livestock as basis for improved feed grain pricing.

4.3.3 Water supply

While, environmental conditions play a significant role, feedlot cattle require approximately 24 ML per 1,000 head of throughput as a general rule of thumb,[4]. Water supply access at these volumes must be 'high security' water to ensure the viability of a feedlot operation at peak summer demand as well as at all times during the year.

The current water debate in Australia is tending to ignore the needs of the intensive livestock industry players who, unlike broadacre agricultural enterprises, are locked into a production sequence requiring constant access to livestock water supplies with little ability to shut down the feeding program until closeout. The various moratoriums on the taking of further water from river and groundwater supplies has significant potential to curtail further feedlot expansion in both new greenfield sites and expansion to existing feedlot capacity.

4.3.4 Availability of suitable sites

Proximity to grain, cattle supply, abattoirs and water supply have the potential to limit the number of available feedlot sites in any expansion scenario. Separation distance between feedlots and residences is a significant problem in closer settled states in southern Australia. Given the high cost of developing feedlot capacity careful attention needs to be given to suitable site selection to ensure the investment proposition for full feedlot capacity development is realised.

4.3.5 Proximate location of feedlots and abattoirs in feedlot expansion areas in northern Australia

Northern Western Australia, the Northern Territory and Gulf Region of Queensland do not have ready access to abattoirs apart from the Katherine Meatworks which is mothballed. This situation allied with the strength of the live export trade to Indonesia presents problems in the immediate term for the development of feedlot capacity in these regions. The other constraining factor is the quantity of available farming land and the crop science knowledge in these regions that would enable a feedlot to source sufficient feed grain supplies for year round operations.

[4] QDPI&F (2004) *Reference manual for the establishment and operation of beef cattle feedlots in Queensland*

4.3.6 Transport

The cost of fuel and increased livestock transport charges caused by regulatory compliance with driver fatigue laws has caused the pastoral industry to consider alternatives to the current triple bottom road train transport of cattle from the Northern Territory and north Queensland to feedlots in central and southern Queensland. The same dilemma faces operators wanting to truck cattle from northern Western Australia to feedlots in that State's south west. Rail infrastructure is lacking in these regions so livestock transport is the only option apart from walking cattle long distances between breeding properties and grow out and feedlots even in integrated supply chains.

A major concern for the feedlot industry is problems with grain and livestock transport infrastructure policy which is characterised as:

- being short term in focus;
- having insufficient cooperation between governments and the private sector;
- failing to account for greenhouse gas emissions when allocating funds to roads;
- suffering rail investment that is ad hoc and not performing well;
- having existing infrastructure that is not efficiently used;
- where new technology is slow to be adopted; and
- having no overall national transport infrastructure plan or strategy and thus nothing to guide priorities.

4.3.7 NSW transport & OH&S regulations

The feedlot industry supply chains extend across State boundaries with cattle and feedstuffs being sourced from interstate .However there is a significant variation in transport loading regulations and OH&S regulations between the states. For example, there is no recognition of the inherent differences between state authorities, which in turn creates inequities between state jurisdictions. For example, livestock loading volume schemes exist in Victoria and Queensland however an equivalent scheme does not exist in New South Wales where legal loads are calculated on a mass balance basis. If a Queensland feedlot were to transport cattle from the feedlot to a New South Wales abattoir and cattle were loaded to Queensland volumetric standards that same truck would be deemed illegal in New South Wales as the truck would exceed legal mass limits.

The same applies for trucks carting grain from New South Wales to Queensland feedlots. Those trucks would have to carry a lighter load to comply with New South Wales laws but would be considered underweight in Queensland. The lack of uniformity between states creates transport inefficiency and increases unit costs.

4.3.8 Labour availability

The recent drought and decrease in feedlot capacity utilisation has created a dilemma for lot feeders in staffing feedlots. Feedlots were averse to putting off highly trained staff in the short term only to have to recruit raw staff and retrain them as feedlot capacities increase in the future. The competition for staff in regional areas from such industries as mining has created a longer term issue of labour supply security that needs to be addressed. Industry players are now exploring employment of overseas staff using a range of instruments such as 457 Visas. The problem with these instruments are that they are not long term only lasting two years perpetuating the hire, lose staff, rehire and retrain cycle which adds unnecessary cost to operations. Like agriculture generally, the feedlot industry needs to sell the attractions of the feedlot industry as a starting point to long term careers to attract and retain young staff wanting to make a career in the food industry.

5 Opportunities for expansion and limitations to growth in the Australian lot feeding industry

5.1 Introduction

This section examines the expansion potential of the feedlot industry in Australia based on the key drivers for beef industry and consequent feedlot growth identified previously in this report. The section provides detailed assumptions that were used in modelling the projected feedlot industry expansion scenario. Fundamental to the efficacy of the assumptions used in this study was the identification of the current size of the Australian feedlot industry.

The baseline year is 2006 for these forward projections with industry expansion assumptions for the years 2011, 2016 and 2021. The industry development scenario identify on a state by state and regional basis the expansion opportunities but also the limitations to further industry expansion. Feedlot industry development expansion scenarios used in this analysis were developed in consultation with the feedlot industry through a feedlot industry participant workshop and a project advisory committee comprising members from the feedlot and beef industry. These scenarios were developed in respect to the terms of reference for the project and the premise that moving the beef industry to a production system where all available sale cattle are channelled through the feedlot supply chain.

5.2 Spatial distribution of feedlots and size of the current feedlot industry in Australia

The feedlot sector is a vital part of both the export and domestic beef markets in Australia, producing a specialised product in an intensive and specialised operation involving the investment of millions of dollars. However, there is currently no complete register of feedlots in Australia and no precise data available to accurately quantify the size of the industry. For any meaningful future projection of industry development potential the current baseline industry size needs to be accurate .That being said, there are a number of datasets that contain valuable information, but the quality and completeness of these sets vary.

Datasets include:

1. **The National Feedlot Accreditation Scheme (NFAS).** This is a voluntary industry quality assurance program for feedlots throughout Australia, and is mandatory for feedlots wishing to sell beef to export markets. However, being voluntary, the NFAS database is not complete.
2. **State based environmental licensing registers**. As cattle feedlots have a potential environmental impact, most are licensed under environmental protection legislation. Furthermore, local authorities require land use consent for feedlots. It must be noted that there are differences in regulations and licensing thresholds between states. Therefore, there is no standard regulatory database for feedlots in Australia.

The main industry sector not covered in the state environmental licensing registers are the small feedlots (< 1000 hd). There is one exception to this. In Queensland, all feedlots exceeding 49 standard cattle units (SCU) require licensing. For this reason, Queensland has a comprehensive dataset of feedlots, though this is not the case for other states.

Considering this fragmentation and known deficiency in the industry data, a sub-project was initiated to collate all available data and develop methods to fill known data gaps.

5.2.1 Feedlot database development

The sub-project (Davidson 2007) developed a comprehensive feedlot database from various sources to give a geographical representation of the industry. This was done by compiling available data from the NFAS database and state regulatory feedlot registers. Further feedlot information was added by searching industry journals and talking with industry stakeholders including MLA and industry consultants.

The recorded feedlot data included licensed capacity and actual pen capacity. **Licensed capacity** is the capacity of the feedlot (in either SCU or head depending on the regulatory system) approved for that site. **Actual capacity** is the constructed pen capacity. This may be less than licensed capacity if the feedlot is still under development. Davidson (2007) confirmed actual feedlot capacity via a check with the major feedlots. A brief telephone survey to the major feedlots was performed to check the current data. This survey covered 80% of the known capacity, ensuring that "actual capacity" data were current for 80% of known feedlot capacity.

The result of this process was the development of the FSA feedlot database (FSAFLdB) which is a comprehensive, nation-wide feedlot register as of 2006.

5.2.2 Geo-referencing feedlot database

GIS requires spatial information for its analysis and map building functions. The data collection phase, due to the nature of information, is an ongoing operation. Geo-referencing takes a real world location and gives it spatial attributes (i.e. co-ordinates). The software Google Earth, a 3D satellite imagery program, allowed photos from satellites and aircraft to be used to locate feedlots. These images are pictures taken throughout the last three years.

This gives a combination of low resolution (15 m pixel size) and high-resolution images (one-metre pixel size) (Google Earth, 2006). Using Google Earth in combination with known areas of localities in the FSAFLdB, the actual position of feedlots were located and recorded. The FSAFLdB then records the latitude and longitude coordinates of these positions in decimal degrees.

Feedlot sites were located in a ranked order. In order of priority, feedlots were searched on the basis of:

- Size (large feedlots located first);
- Feedlots located in areas of higher resolution imagery;
- Feedlots located in areas of low resolution imagery; and
- Smaller feedlots.

Street addresses provided additional aid in locating feedlots on both high and low resolution imagery. Not every feedlot was successfully located. However, given the scale of this project, an Australian industry snapshot, geo-referencing with the locality of the feedlot was sufficient. Hence, the higher priority of establishing a total industry picture overruled the need for absolute accuracy.

A simple ranking system was used to distinguish between the feedlots that have been geo-referenced accurately and those that have not. This helps also to distinguish between known feedlot sites and other sites that need further information to establish a more precise location. Therefore, the two categories are as follows:

- Good - the point position is accurate on a known location of a known feedlot. The feedlot can be clearly identified on Google Earth. This category does not to need to be updated.
- Poor – the Poor category does need to be updated and is made up by any of the following scenarios:
  - The feedlot is too small and cannot be found so the point position is located on the town of its postal address and can be assumed to be within a 30 km radius of the actual point;
  - The resolution is too large to see it clearly so again the point position is located on the town of its postal address and can be assumed to be within a 30 km radius of the actual point; and
  - When a feedlot is found in an area of many feedlots, an estimate is made regarding which feedlot it is, generally based on feedlot size.

The “Poor” category does leave inaccuracies within the map, but these are not considered a significant source of error on a nation-wide scale. This is summarised in Table 11.

Table 11 - A comparison of "Good" versus "Poor" geo-referenced feedlot locations

Capacity	"Good" Count	%	"Good" Capacity	%	"Poor" Count	%	"Poor" Capacity	%	Total Count	Total Capacity
Less than 400	61	12.8%	7,006	11.5%	416	87.2%	54,070	88.5%	477	61,076
400 to 999	37	17.6%	26,430	20.3%	173	82.4%	103,566	79.7%	210	129,996
1000 to 4999	56	39.7%	130,552	48.7%	85	60.3%	137,817	51.4%	141	268,369
5000 to 9999	21	77.8%	148,155	81.3%	6	22.2%	34,000	18.7%	27	182,155
over 10000	26	96.3%	523,623	97.5%	1	3.7%	13,500	2.5%	27	537,123
Total	**201**	**22.8%**	**835,766**	**70.9%**	**681**	**77.2%**	**342,953**	**29.1%**	**882**	**1,178,719**

Source: Davidson 2007

Currently the geo-referenced feedlots within the FSAFLdB represent around 99.8% of known current feedlot capacity. The FSAFLdB references the locations of 882 feedlots.

The FSAFLdB was used as a baseline dataset (2006) for all predictions of feedlot density, pen capacity and location in the subsequent industry projections. The baseline for currently known feedlot pen capacity is 1,178,719 head.

5.3 Feedlot industry survey and workshop expansion assumptions

A survey and workshop were conducted in 2007 to develop feedlot expansion projections on a state by state basis. The proposed herd expansion and feedlot pen capacity on a state by state basis are presented to form key input assumptions to the industry expansion modelling.

The workshop was attended by key members of the feedlot industry, predominantly feedlot operators. Working on the hypothesis that all young cattle in Australia were to be fed through feedlots, the workshop participants developed state by state feedlot expansion projections to achieve this goal. Originally the project scope was for industry expansion through to the year 2020, however in order to align the expansion scenario with baseline data supplied from the ABS census of 2006, this was moved forward one year to 2021.

The workshop participants also proposed herd expansion rates for the Australian beef herd. These projections are based on changes in herd dynamics that can occur when all cattle are sent to feedlots by approximately 2 years of age. Removing these animals from grazing properties should allow a larger proportion of the carrying capacity to constitute breeding cows and calves, leading to higher overall production from the whole industry. The cattle herd projected expansion numbers are presented in Table 12.

Table 12 - Proposed cattle herd expansion projections

Region	2006	2011	2016	2021
Qld	baseline	5%	10%	10%
NSW	baseline	0%	0%	0%
Victoria/Tasmania	baseline	0%	0%	0%
South Australia	baseline	0%	0%	0%
Northern Territory	baseline	10%	10%	10%
WA	baseline	10%	10%	10%
AUSTRALIA	baseline	3.8%	2.1%	0.0%

It was assumed that northern regions had a larger capacity to expand the beef herd compared to the southern states. Following this scenario, the national beef herd of 25,485,877 (ABS 2006a) would expand to 27,028,600 head. This in turn would allow for a greater supply of young cattle into the feedlot industry.

The workshop participants developed expansion projections for feedlot pen capacity by state. The expansion scenario was staged in five year intervals to approximately double pen capacity by 2021.

Table 13 shows the estimated feedlot pen capacity expansion projections. As with the beef herd projections, the greatest areas of feedlot capacity growth were expected to be in Queensland and Western Australia.

Table 13 - Estimated feedlot pen capacity expansion projections by State – 2006 to 2021

Region	2006	2011	2016	2021
Qld	592,624	780,000	975,000	1,200,000
NSW	365,486	405,000	450,000	500,000
Victoria/Tasmania	79,825	90,000	100,000	110,000
South Australia	29,535	40,000	60,000	60,000
Northern Territory	8,000	15,000	20,000	50,000
WA	98,711	170,000	350,000	425,000
AUSTRALIA	**1,174,181**	**1,500,000**	**1,955,000**	**2,345,000**

5.4 Industry expansion impacts methodology

To accurately determine the environmental and infrastructure impacts and constraints following the expansion scenario determined at the workshop, a model of the feedlot production system was developed. While pen capacity determines the physical capacity of the feedlot industry, a number of variables will determine the actual throughput, production and resources required annually. Prior to modelling the feedlot industry expansion projections, further assessment of the industry status (as of 2006) was undertaken.

5.5 Assessment regions

It was decided that using state and territory boundaries as assessment regions may not provide the most useful description of the industry. Therefore, Australia was split into nine regions to reflect differences in climate (tropics/sub tropics/temperate), breeding herd distribution, infrastructure and grain distribution (Figure 36).

This approach is similar to the approach adopted by the NGGIC in estimation of greenhouse gas emissions, though the regions are not identical. The nine regional boundaries are aligned with ABS Statistical Local Area (SLA) divisions, allowing statistical information on cattle numbers and grain production to be extracted for each region. The nine regions are:

- Region 1: southern Western Australia
- Region 2: northern Western Australia
- Region 3: Northern Territory
- Region 4: South Australia
- Region 5: northern Queensland
- Region 6: southern Queensland
- Region 7: northern New South Wales
- Region 8: southern New South Wales
- Region 9: Victoria and Tasmania.

Figure 36 illustrates the geographical distribution of the nine regions within Australia. Western Australia was divided into a northern and southern region. The north of Western Australia has no grain and no abattoirs and is climatically and geographically separate from the south. Queensland was divided into a southern and northern region. Essentially, the southern region includes the Murray Darling catchment and the eastern coastal catchments where most of the current feedlots and grain is currently located. The northern region includes central Queensland and the northern/western pastoral zones. New South Wales was divided in half categorised by a southern, winter-rainfall zone and a northern uniform rainfall zone. Victoria and Tasmania were grouped together into one temperate region.

Subsequent to the new regional boundaries, estimates of the beef herd and feedlot pen capacities for each region were developed based on the industry workshop estimates.

Figure 36 - Geographical distribution of the feedlot assessment regions

5.6 Herd capacity

5.6.1 Beef cattle industry size

The 2006 population of the Australian beef cattle industry was obtained from 2006 ABS data (ABS 2006a).

Figure 37 shows the geographical location of the Australian beef herd in 2006. The population was aggregated into the nine assessment regions based on the SLA divisions in each region.

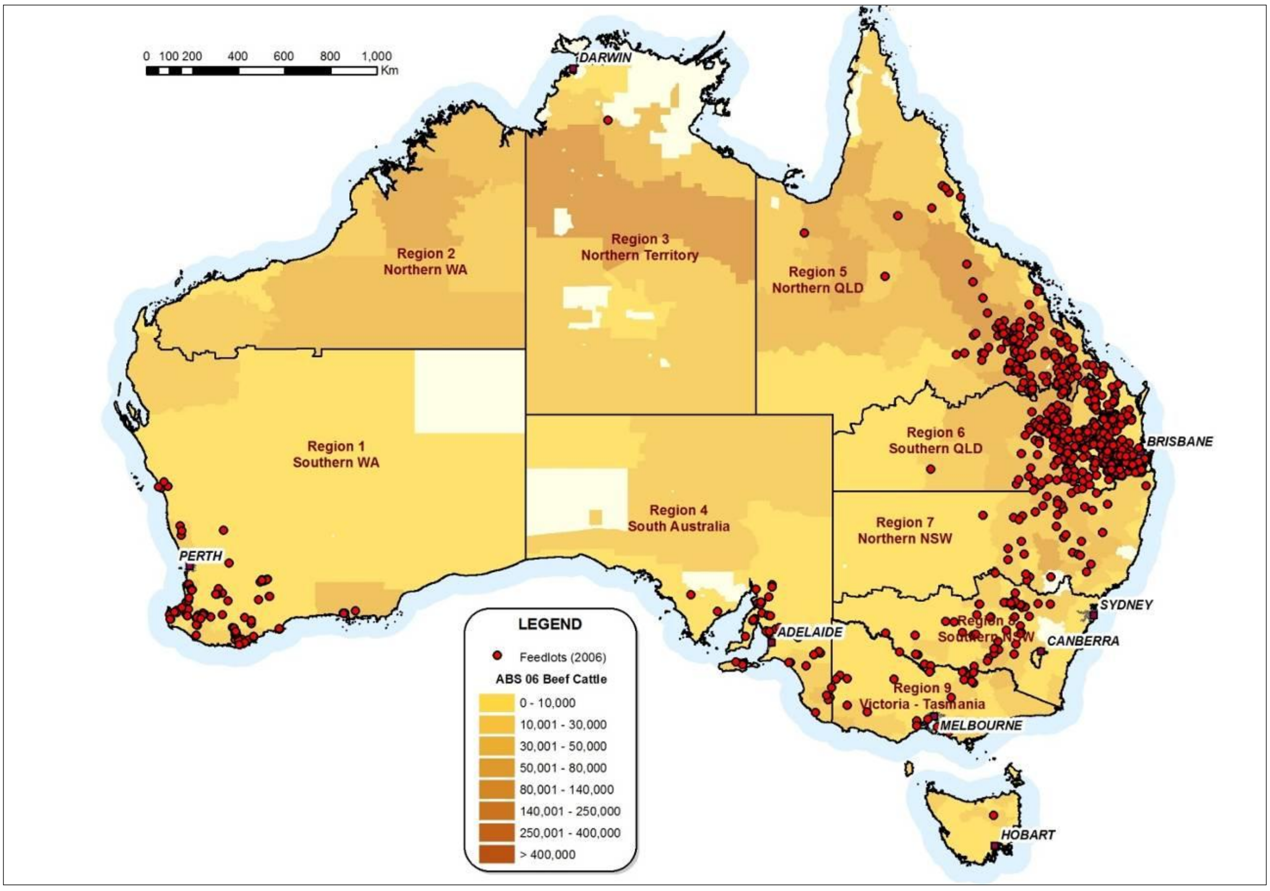


Figure 37 - Geographic location and size of the Australian beef herd in relation to existing feedlot capacity

Table 14 shows that Queensland clearly dominates the Australian beef industry with approximately 45% of the beef population in 2006.

Table 14 - Estimated beef cattle population 2006

Region No	Region	2006
1	Southern WA	1,345,326
2	Northern WA	929,900
3	Northern Territory	1,798,172
4	South Australia	1,160,725
5	Northern Queensland	7,670,447
6	Southern Queensland	3,683,483
7	Northern NSW	3,609,213
8	Southern NSW	2,142,674
9	Victoria and Tasmania	3,145,937
	Australia	25,485,877

5.6.2 Live export

To accurately assess the number of cattle available for lot feeding in Australia it was decided that cattle currently exported live should be removed from the assessment. The total number of beef cattle live exported in 2006 was obtained from 2006 ABS data (ABS 2006a) and live export industry data.

Table 15 shows that, Western Australia dominates the Australian beef live export industry with approximately 50% of the live export numbers in 2006, while the Northern Territory is the largest source of live export cattle for the Indonesian market. The live export projections (2011-2021) were developed by the project team in consultation with the live export industry, indicating fairly similar export numbers over the next 11 years.

Table 15 - Current and proposed live export cattle numbers

Region No	Region	2006[a]	2011[b]	2016[b]	2021[b]
1	Southern WA	172,486	168,244	168,244	168,244
2	Northern WA	231,959	226,255	226,255	226,255
3	Northern Territory	312,270	304,591	304,591	304,591
4	South Australia	1,747	1,704	1,704	1,704
5	Nth Queensland	13,634	13,299	13,299	13,299
6	Sthn Queensland	36,065	35,178	35,178	35,178
7	Northern NSW	-	-	-	-
8	Southern NSW	475	463	463	463
9	Victoria and Tasmania	32,164	30,266	30,266	30,266
	Australia	**800,800**	**780,000**	**780,000**	**780,000**

[a] LiveCorp (2006) [b] Live Export Industry estimates

Projected beef cattle herd numbers in the selected regions were developed using 2006 ABS data (ABS 2006a) as a baseline for expansion.

Table 16 shows the herd numbers by region less live export cattle numbers. These cattle population numbers form the basis for the industry expansion modelling. Live export cattle are generally unlikely to ever enter the Australian feedlot industry in the analysis period for transport cost and market suitability reasons despite the reality that they would be finished in feedlots in the importing country.

Table 16 - Estimated net beef cattle population (less live export) – 2006 to 2021

Region No	Region	2006[a]	2011[b]	2016[b]	2021[b]
1	Southern WA	1,172,840	1,311,614	1,311,614	
2	Northern WA	697,941	796,635	796,635	796,635
3	Northern Territory	1,485,902	1,673,399	1,673,399	1,673,399
4	South Australia	1,158,978	1,159,021	1,159,021	1,159,021
5	Nth Queensland	7,656,813	8,040,671	8,424,193	8,424,193
6	Sthn Queensland	3,647,418	3,832,479	4,016,653	4,016,653
7	Northern NSW	3,609,213	3,609,213	3,609,213	3,609,213
8	Southern NSW	2,142,199	2,142,211	2,142,211	2,142,211
9	Victoria and Tasmania	3,113,773	3,115,671	3,115,671	3,115,671
	Australia	**24,685,077**	**25,680,913**	**26,248,610**	**26,248,610**

The data in Table 16 represent the production base for slaughter cattle in Australia and operate as ground-truthing data for the feedlot modelling predictions.

The known annual slaughter percentage for the Australian herd averages 32.1% per year. Of this, approximately 65% represents young cattle, while the remaining proportion is made up of cull cows and bulls. The feedlot industry currently supplies approximately 34% of the total number of cattle slaughtered per year. In line with proposed expansion, this would rise to approximately 69% to account for all young cattle slaughtered in the country by 2021. This figure was used as a target for feedlot expansion modelling.

5.6.3 Feedlot industry structure

5.6.3.1 Current and future feedlot pen capacity

FSA Consulting further enhanced the FSA feedlot database (FSAFLdB) to gain the best estimate of the 2006 feedlot pen capacity. The existing dataset compiled by Davidson (2007) was enhanced through a review of New South Wales EPA feedlot Licences, the NFAS database, Queensland feedlot register, ALFA survey and the NPI database. Any additional FSA Consulting feedlot client information post Davidson (2007) was also incorporated into the dataset. NFAS list provided the bulk of the information, but it was not a complete list, due to the NFAS being a voluntary program. Similarly, the New South Wales EPA do not licence feedlots less than 1000 head capacity.

Feedlots of greater than 500 head capacity are licensed in South Australia. A list of all licensed feedlots in South Australia was obtained from the SA EPA. The location of these feedlots was found on Google Earth™ to review their as-built capacity and operational status.

A similar process was undertaken to review feedlots in Victoria, Tasmania and Western Australia. A number of smaller feedlots in these states were identified from a review of journals such as Today's Feedlots and Lot Feeding Magazine and FSA client data. These feedlots were located through a search on Google Earth™ and their latitude and longitude coordinates were entered into the dataset along with an estimate of the pen capacity. Known feedlot locations were checked on Google Earth™ and cross checked with the existing dataset.

While data for licensed capacity are good, pen capacity estimates were based on some assumptions. Where additional information could not be obtained, pen capacity was assumed to be equal to licensed capacity. The pen capacities reported here are accurate for Queensland. However in the southern states the pen capacities may be underestimated due to the capacity of smaller feedlots being incomplete.

The pen capacity numbers by state presented in Table 13 were divided into the nine regions and updated from the FSAFLdB. The pen capacity expansion projections by state based on the numbers determined at the industry workshop and shown in Table 13 were also divided into the nine assessment regions. Table 17 shows the estimated feedlot pen capacity expansion projections by region. Figure 38 shows the regional location of feedlots in 2006.

Table 17 - Estimated feedlot pen capacity expansion projections by region – 2006 to 2021

Region No	Region	2006	2011	2016	2021
1	Southern WA	98,711	155,000	330,000	375,000
2	Northern WA	0	15,000	20,000	50,000
3	Northern Territory	8,000	15,000	20,000	50,000
4	South Australia	29,535	40,000	60,000	60,000
5	Nth Queensland	124,223	250,000	375,000	500,000
6	Sthn Queensland	468,601	530,000	600,000	700,000
7	Northern NSW	163,327	180,000	200,000	225,000
8	Southern NSW	202,159	225,000	250,000	275,000
9	Victoria and Tasmania	79,825	90,000	100,000	110,000
	Australia	**1,174,181**	**1,500,000**	**1,955,000**	**2,345,000**

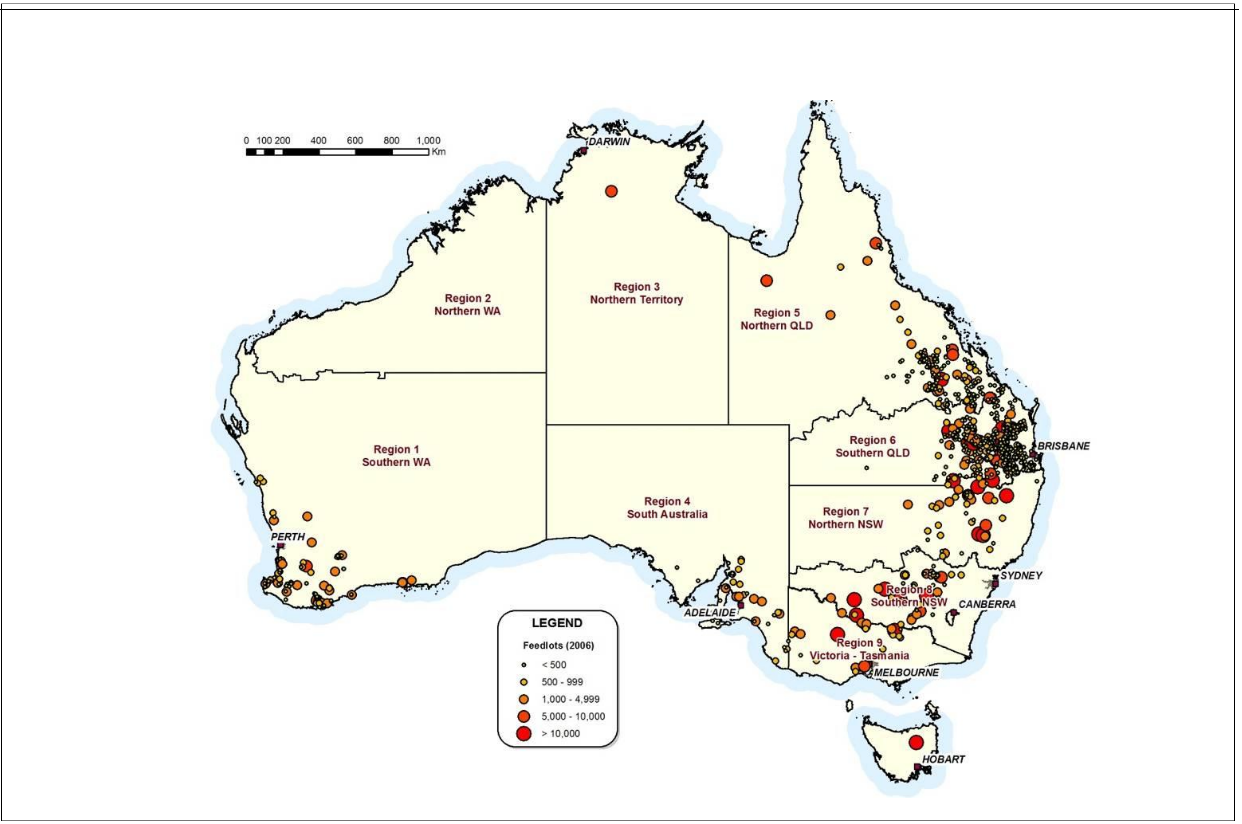


Figure 38 - Distribution of Australian feedlots (2006)

5.6.3.2 Year round occupancy and estimated future pen capacity expansion

Projected pen capacities to 2021 (Table 17) as proposed by the feedlot industry workshop assumed that herd structure and year round occupancy would remain close to the current level (as reported by the ALFA/MLA Feedlot survey). Future capacity expansion would therefore be based on construction of additional pen capacity.

Each quarter the national ALFA/MLA Feedlot survey requests the cattle on feed, the percentage of cattle within five defined feeding periods, feedlot capacity and the cattle turned off for slaughter in each State. The sample data set is then extrapolated to represent the whole industry. The recorded ‘capacity’ is the physical capacity or pen capacity. Over recent surveys, the capacity information has fluctuated significantly. It is known that some operators interpret capacity as the number of cattle on hand at that point in time (Des Rinehart, pers. comm.).

This confusion over the definition of capacity reduces the accuracy of the dataset. The review of 2006 data showed that pen capacity varies month to month, and in some cases it is higher than the estimated pen capacities suggested in this report. Some variation is expected due to expansion. However the degree of variation highlights the identified error in defining capacity, which is then extrapolated to represent whole-of-industry trends. Consequently, the national pen capacity data presented in this report are considered more representative of the industry to date.

Occupancy is defined as the number of head on feed divided by the pen capacity (ALFA/MLA survey). The estimated number of head-on-feed is reliably reported as it is clearly defined and is a readily available figure. If feedlot capacity is interpreted incorrectly this translates into errors in the occupancy percentage. This number represents an estimate of occupancy at four distinct survey periods during the year, which may not be representative over the whole year. For the year ending 2006 the ALFA/MLA survey reported an occupancy level of 81%.

To further check the robustness of the ALFA/MLA Feedlot survey the average number of feeding periods per year was calculated. The ALFA/MLA (2006) survey reports that 2,626,101 head of cattle were turned off feed in 2006. Using the estimated total pen capacity reported in Table 17 (1,174,181 head), this shows that the average number of cycles per year is 2.2 i.e.:

Number of feeding periods (2006) = 2,626,101 / 1,174,181 = 2.2.

This may be lower than data from previous years. However lack of access to accurate pen capacity data makes this comparison difficult. The number of feeding periods appears to be low considering the high proportion of domestic and short fed cattle that can be moved through a feedlot in 60-110 days and calls into question the reliability of the occupancy estimate provided for the industry when total throughput is considered. The relationship between occupancy over a 12 month period and potential throughput based on market types and days on feed is discussed in Section 5.7.

The total number of cattle-on-feed, market breakdown (domestic vs. export) and numbers turned off per year are the basis for validating the estimate of current feedlot pen capacity. A review of the 2006 ALFA/MLA survey data (ALFA 2007) showed only a slight discrepancy in pen capacity when compared with the FSA FLdB.

5.7 The FSA feedlot system model

To assess the scenario where all available sale cattle are channelled through the feedlot supply chain, an FSA Consulting in-house feedlot system model was used. This approach was developed to provide environmental and infrastructure requirements in lieu of some of the COMP.094 output. The model output was also used for economic modelling as part of this project.

The FSA Consulting model estimated the required outputs from physical inputs for the determined expansion scenario. The model is based on the BEEFBAL model but incorporates a number of enhancements. The original BEEFBAL is a Microsoft Excel© based program which was developed by the Queensland DPI (McGahan et al. 2002) to estimate the waste produced by cattle feedlots and to assess the environmental sustainability of associated land application practices.

The feedlot system model can simulate different herd capacities; several market classes (i.e. domestic, mid-fed, long-fed), specific rations for each market, different average daily gains (ADG), liveweight, occupancy and mortalities. The model also predicts a number of physical inputs and outputs from a feedlot, but does not include an economic model. The model can provide an estimate of feed inputs (broken down by each commodity), water and energy requirements, incoming cattle, numbers on feed and cattle trucks, etc. Model outputs include an estimate of the numbers turned off per year, commodity usage, staff required and a prediction of waste production. The model output has been cross-checked against actual feedlot production data that were obtained in the MLA project FLOT.328, which collected feedlot specific data for the red meat life cycle analysis project COMP.094.

The feedlot system model performs a mass balance on the nitrogen, phosphorus, potassium and salt entering the feedlot system (in the forms of incoming cattle, feed and drinking water) to determine the masses of nutrients and salt in the manure and liquid effluent produced by the feedlot. The model includes the incorporation of a derivation of the DAMP (digestibility approximation of manure production) method to determine the "as excreted" manure constituents, based on a wide range of possible ration ingredients and up to five market classes (e.g. domestic, mid-fed and long-fed).

5.7.1 Input parameters

The FSA Consulting in-house feedlot system model was used to estimate the required outputs from physical inputs for the determined expansion scenario.

The feedlot system model requires a number of inputs including herd capacities, market classes (domestic, mid-fed, long-fed) and feeding regimes. For each market class, the liveweight (kg) in and out of the feedlot, average daily gain (kg), mortality rate, days-on-feed and dry matter intake (kg) are required. These inputs can be modified to suit an individual production scenario.

5.7.1.1 Herd composition and feedlot operating parameters

For each region, a herd composition for modelling purposes was developed. This included the typical market classes, an estimated breakdown of these classes and specifications for each class.

The selection of the market classes for each region was based on the current and future market types, demographics of classes fed and an estimation of likely future practice. These initial estimates were circulated by MLA for review by key industry members, and were revised based on feedback from that review. Specifications for each animal class were estimated. These included the liveweight (kg) in and out of the feedlot, average daily gain (kg), days on feed, dressing percentage and dry matter intake (kg). Mortality percentage was also estimated based on data collected the operational records of a number of feedlots.

Feedlot operating parameters included the estimate pen capacities for each region and assumed occupancy (year average). In the case of estimating pen capacities, data from the FSA FLdB were considered to be more accurate and comprehensive than the figures presented in the ALFA/MLA survey, and were therefore used as baseline inputs to the model. Year round occupancy averages presented in the ALFA/MLA survey were used as initial baseline inputs which suggested an industry average of approximately 81%.

Initial assumptions about herd compositions and operating parameters were tested by comparing the modelled industry performance for 2006 against data collected in the ALFA/MLA survey for the equivalent period in order to calibrate the model. Validation of the input data focussed on comparisons of the following modelled parameters against ALFA/MLA survey data (in decreasing order of importance):

- Average annual numbers on feed
- Industry average market type breakdown
- Annual turnoff
- Industry percentage of lot fed slaughter cattle
- Average annual industry occupancy.

The calibration process resulted in close agreement between the modelled average annual numbers on feed (906,468 head) with the survey results (906,469 head). The herd composition inputs were adjusted to ensure the modelled industry average market type breakdown accurately reflected the surveyed data. Modelled annual turnoff slightly overestimated the surveyed data (2,647,733 head vs. 2,626,101, or an overestimation of approximately 0.8%); while the modelled percentage of lot fed slaughter cattle (32%) closely matched the known industry percentage of 34%.

Modelled average annual industry occupancy was marginally lower than the survey data, suggesting 77% in comparison with the reported 81%. However, acknowledging the slight variations that may occur in the ALFA/MLA survey data regarding occupancy (see section 5.6.3); the modelled data are considered an acceptable representation of the industry in 2006. Table 18 shows the modelled occupancy data for 2006 in each of the regions.

The final herd composition parameters used for modelling in each region are provided in Appendix 1.

Table 18 - Modelled year round feedlot occupancy data for base year (2006)

Region No	Region	2006
1	Southern WA	48%
2	Northern WA	0%
3	Northern Territory	80%
4	South Australia	68%
5	Nth Queensland	80%
6	Sthn Queensland	80%
7	Northern NSW	81%
8	Southern NSW	80%
9	Victoria and Tasmania	79%
	Australia	77%

The pen capacity expansion requirements reported on a region-by-region basis at current (modelled) pen utilisation are presented in Table 19.

Table 19 - Pen capacity expansion to 2021 at current year round feedlot occupancy levels

Region No	Region	2006	2011*	2016*	2021*
1	Southern WA	98,711	155,000	330,000	375,000
2	Northern WA	0	15,000	20,000	50,000
3	Northern Territory	8,000	15,000	20,000	50,000
4	South Australia	29,535	40,000	60,000	60,000
5	Nth Queensland	124,223	250,000	375,000	500,000
6	Sthn Queensland	468,401	530,000	600,000	700,000
7	Northern NSW	163,327	180,000	200,000	225,000
8	Southern NSW	202,159	225,000	250,000	275,000
9	Victoria and Tasmania	79,825	90,000	100,000	110,000
	Australia	1,174,181	1,500,00	1,955,000	2,345,000

5.7.1.2 Ration composition

Ration composition was developed for each region and market class within that region. This included a breakdown of grains (summer and winter), protein source (cottonseed, canola, lupins, other), roughage (straw/hay, silage) liquids (molasses, other) and supplements.

Rations were determined through a review of ration data available to FSA Consulting from previous research and through consultation with nutritionist consultants IAP (John Doyle pers. comm.). Additional data were sourced from George (2003).

On the basis of cattle fed, environmental conditions, market suitability, bulk handling characteristics, freight, and availability of commodities, a ration breakdown for each region was estimated. Feed grains were categorised into winter (i.e. wheat, barley, and triticale) and summer (i.e. corn and sorghum).

An estimate of the percentage of each component of the ration required for each market type in the nine regions was prepared. When expressed on a 100% dry matter basis (DMB) cattle feedlot rations usually contain by composition between 70 and 80% grain (George, 2003).

Rations were reviewed by the project team, MLA and selected industry members. Ration data are presented in Appendix 1.

5.7.2 Output parameters

The feedlot system model output parameters relevant to the project include the number of cattle turned off per year for each class, liveweight produced, HSCW produced, commodity usage, water and energy requirements and staff required. These parameters allow current feedlot resources, processing resources, feed and other input resources and ultimately the potential to expand the existing feedlot sector to be assessed.

The following sections provide an overview of model outputs.

5.7.2.1 Number of cattle turned off

The total number of cattle turned off per year is determined from the number of incoming cattle minus the number of mortalities. The number of incoming cattle required is estimated from the defined pen capacity, occupancy level and days on feed (turnover) for each market type.

5.7.2.2 Liveweight and HSCW

The total liveweight turned off from the feedlot system is estimated from the total number of head turned off and their respective exit weight. The exit weight is estimated from the days on feed and the ADG. The HSCW is calculated from the total liveweight turned off multiplied by the estimated dressing percentage for each market type respectively.

5.7.2.3 Commodity requirements

The total daily as-fed feed requirement broken down by each commodity is estimated from the daily feed intake (kg As-Fed/head/day), the mean number of cattle on hand per day and the percentage of the respective commodity in the ration. The total daily feed requirement is as-fed. The total annual feed requirement is estimated from the daily as-fed feed requirement multiplied by the number of days in the year. The feed processing system assumed in the modelling was steam-flaking, hence, the annual as-fed grain component was corrected for the additional water that was added to the grain during processing (assuming the moisture content of the incoming grain was 12% and processed by steam flaking to a moisture content of 21%). Therefore the as-fed grain weight was corrected for the increase of 9% in moisture content.

5.7.2.4 Land and water requirements

The model is able to estimate water requirements by two methods, a predictive daily water consumption model and a regulatory water requirement.

The predictive water consumption mode is based on Winchester and Morris (1956) as reviewed by Watts et al. (1994), which is based on dry matter intake and average daily ambient temperature to determine drinking water usage. The model contains different parameters for *Bos taurus* and *Bos indicus* cattle. The daily water consumption from this model, in litres/head/day, is multiplied by 365 to obtain the annual drinking water consumption. An estimation of the requirements for feed processing, dust control, cattle washing administration and sundry uses can be estimated using data obtained from Davis et al. (2008).

The second method is based on the regulatory requirements developed by the Queensland Department of Primary Industries and Fisheries (QDPI&F). When issuing a licence for a feedlot in Queensland, the QDPI&F requires that the feedlot has a correctly licensed, high-reliability water supply equivalent to 24 ML per year for each 1000 SCU of licensed capacity. The QDPI&F requirement makes a small allowance for other uses such as trough cleaning, minor leakages but does not allow for significant usage for the purposes of dust control, feed processing or evaporation from open storages. Davis & Watts (2006) and Davis et al. (2008), who measured actual water usage levels at a range of Australian feedlots, have shown that the QDPI&F estimate is conservative when compared with actual feedlot water usage.

For the purposes of this report, water requirements have been estimated based on the regulatory water requirements established by the QDPI&F of 24 ML/1000 head capacity.

Land requirements for feedlot development vary greatly depending on the size and management regime of the feedlot. Typically, the feedlot has a very small footprint, with about 4.5 ha per 1000 head of capacity required for the complete facility, excluding effluent and manure reuse areas that may or may not be required. The total land required will depend on site-specific criteria.

5.7.2.5 Labour requirements

Davis & Watts (2006) and Davis et al. (2008) measured actual staffing levels at a range of Australian feedlots. These data were standardised (1.4 full time equivalents/1000 head-on-feed) and were used for the estimation of staff requirements.

5.8 Feedlot industry expansion modelling

A pathway for simulating industry expansion was determined, with the ultimate goal of achieving a doubling throughput of cattle by 2021. Specifically, this involved the expansion of pen capacity as per the industry estimates while maintaining year round occupancy at their current levels (77%).

Industry consultation revealed that a change in feeding regimes is likely in the periods after 2011, with greater feed conversion efficiencies resulting in shorter feeding periods. This change in feeding durations results in a marginal increase in feedlot occupancy as cattle are cycled through the feedlot more quickly. This behaviour is manifested in the occupancy rates shown for 2016 and 2021 in Table 20.

Table 20 - Modelled feedlot occupancy data to 2021

Region No	Region	2006	2011*	2016*	2021*
1	Southern WA	48%	48%	49%	49%
2	Northern WA	0%	80%	83%	83%
3	Northern Territory	80%	80%	83%	83%
4	South Australia	68%	68%	71%	71%
5	Nth Queensland	80%	80%	83%	83%
6	Sthn Queensland	80%	80%	83%	83%
7	Northern NSW	81%	81%	84%	84%
8	Southern NSW	80%	80%	83%	83%
9	Victoria and Tasmania	79%	79%	82%	82%
	Australia	77%	77%	77%	77%

5.9 Grain fed, grass fed or grain finished beef for domestic and export markets

5.9.1 Australia has unique capacity to produce both grain fed and grass fed beef to a range of domestic and export market specifications

The geographic and climatic diversity of Australia enables Australia to produce a full market compass of beef from grass and grain fed sources as well as for live export. Because of the relatively small domestic market size Australia needs to export beef. As a consequence the beef industry is becoming increasingly market driven and niche market channel focused to enable competition with large commodity producers such as Brazil and the United States.

Despite the obvious benefits of lot feeding mentioned previously not all cattle enter the grain fed supply chain. However, Australia remains one of the few countries in the world that can supply beef to suit consumer demands in a wide range of countries (Figure 39).

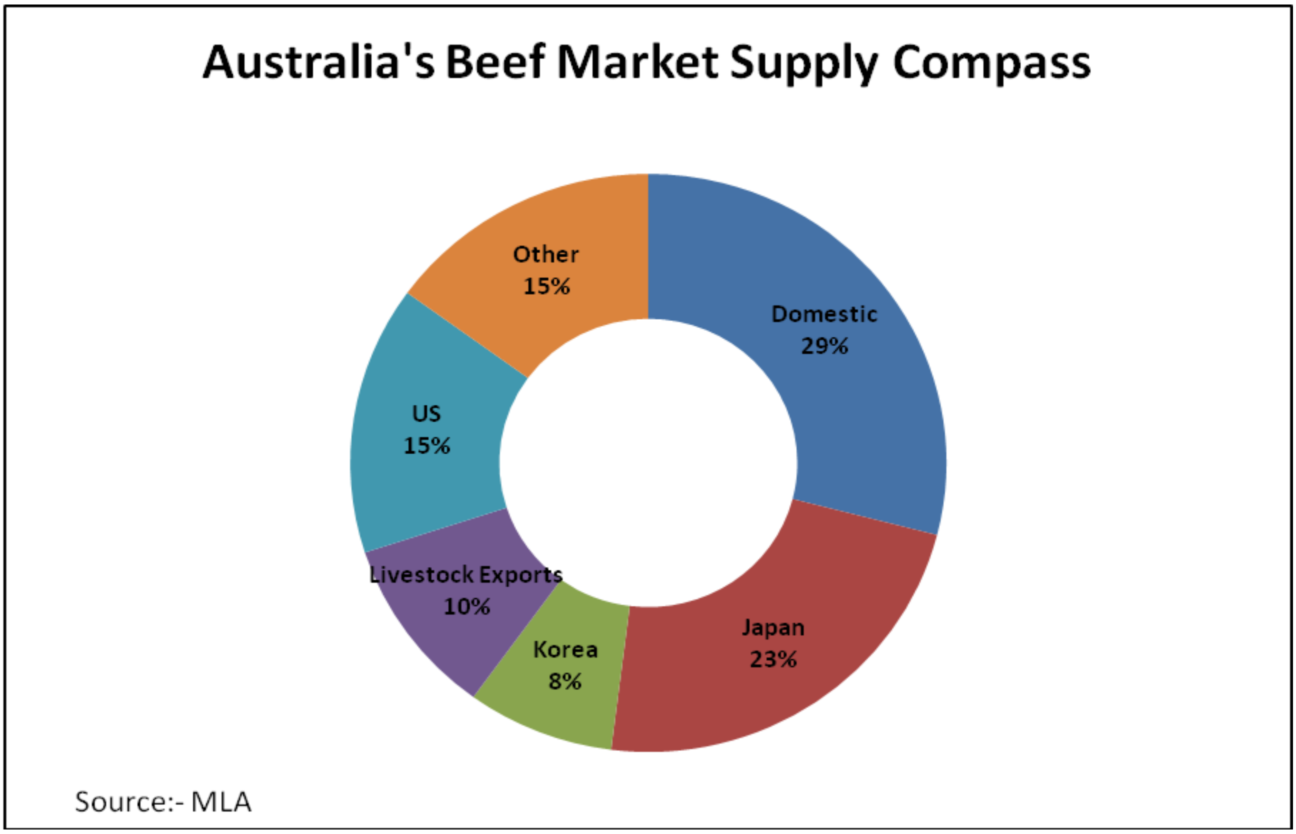


Figure 39 - Australia's beef market supply compass

There are, currently a number of distinct grass and grain fed beef market specifications in Australia as follows:

- **Grain fed** for up to 100 days with steers generally 90 days and heifers 70 days. Up to 260 kg HSCW milk and 2 teeth.
- **Grass fed:** Up to 260kg HSCW milk and 2 teeth.
- **Grain fed** for a minimum of 100 days. 260kg + HSCW milk to 4 teeth.
- These 2 categories are the same with the weight determining the market.
- **Grass fed:** 260kg to 300kg milk to 4 teeth. Grass fed. 300kg + milk to 4 teeth.
- **Grain fed** for a minimum of 100 days. 260kg + HSCW milk to 4 teeth.
- **Grain fed** for a minimum of 120 days (most over 150 days). Milk to 4 teeth.
- **EU:** grass- or grain-finished steers or heifers with carcase weights of 260 to 419 kg (premium 338 to 419 kg HSCW), with no more than 4 permanent teeth and 7 to 17 mm P8 fat. Stock must never have been treated with hormonal growth promotants (e.g. HGP's). Properties must be accredited to supply the EU market.
- **Manufacturing or Grinding Beef.**

5.9.2 Consumer comparative advantages of grain fed beef to grass fed beef

MLA (Barnard, 2006) reviewed the comparative advantages of grain and grass fed beef in Australia with the following outcomes. Australia is not a grain feeder but rather a grain finisher (80% of cattle are fed for less than 130 days).CRC consumer sensory results related to lot feeding showed that grain finishing increased carcase weights and fatness traits (both marbling and fat depth) and decreased ossification scores. In consumer sensory tests grain fed beef had higher flavour and juiciness scores, but this advantage disappeared once adjusted to the same intramuscular fat and age.

In other words, if pasture fed beef could be finished to the same intramuscular fat levels at the same age there would be no difference between feedlot and pasture fed beef. Put simply, there is nothing magical about the lot feeding effect. These results support the MSA approach of describing the lot feeding effect using the outputs of carcass weight, ossification score and marbling rather than a feedlot effect per se.

5.9.3 What has been driving the market mix of grass and grain fed beef

Barnard (2006) also examined the factors driving the market mix of grass and grain fed beef. That analysis showed that cost changes were not driving the increase in lot feeding. Market growth has been mainly to the domestic, Japanese and Korean markets.

In the domestic market of the 620,000 head of MSA cattle graded in 2006 about 60% were grain fed & 40% grass fed. Domestic market use of grain fed beef was driven mainly by supermarkets that did not like marbling but simply wanted a consistent supply of lean tender beef. In key export markets most Australian brands developed for the Japanese retail market are grain fed, while food service is mixture of grain and grass fed beef. Australian long fed beef has been a profitable niche market in Japan.

5.9.4 The future of grain finishing in Australia

The Barnard (2006) analysis reviewed future prospects with the following outcomes. There are production advantages in grain finishing in that lot feeding:

- Allows graziers to turn off cattle younger freeing up land for more cows or other pursuits (e.g. cropping);
- Allows for stable supply alliances and forward contracts in domestic and export markets. In the domestic market Woolworths and Coles currently forward contract about 80% of supply. In export markets the vast majority of grain finished beef for Japan and Korea is through vertically integrated feedlot/processing/exporting/importing operations or are forward contracted; and
- Enables reliable supply all year, every year, regardless of season.

Barnard’s analysis identifies that there is future potential grain fed beef export growth and identified a number of key drivers for that projected growth:

- Total grain fed beef exports to more than double by 2014 compared to 2003. This growth estimate could prove conservative, given expansion in feedlot capacity already in the pipeline but could be constrained by AUD parity impacts;
- Australian consumers are spending more per capita on beef. There has been a 70% increase in consumer beef expenditure over the last decade;
- Improved eating quality is one of the reasons why consumer expenditure has risen 70% over the last decade;

- MLA estimate that grain fed beef consumption is likely to increase in the Australian domestic market because it is estimated 70-80% of cattle by major supermarkets are currently grain fed (generally 50-70 days) and that an estimated 45% of beef in domestic retail and food service is grain fed which is likely to rise to about 60%. There is also a forecast 15% expansion in local consumption by 2010 – mainly through supermarkets and restaurants;
- However, there is a significant constraint to this growth potential in the security of feed grain supply. Feedlot demand for grain will probably double before 2020. Yet feed grain needs are not always met especially in rainfall deficit years and ethanol production needs could further deplete available feed grain supply; but
- The Australian feedlot industry cannot cope with regular sharp jumps in grain prices which are higher than world parity rates– as competitors (US and South America) tend to have reliable grain supplies and pay world parity prices. For the Australian grain fed beef industry to remain internationally competitive there needs to be guaranteed access to world parity priced grain.

5.9.5 Conclusions

Australian beef production systems are built on an effective and cost competitive integration between pasture and lot feeding. Beef & dairy are the only industries to use feed grain that are internationally competitive on global markets. Efficiency of pasture production helps drive this competitiveness; and

Australia does not have a comparative advantage in feed grain production. For Australian grain finishing to further expand to meet customer needs, there has to be access to world parity priced grain.

The Barnard (2006) analysis is consistent with the findings in this report. That is, grain finishing will increase in Australia in future years driven by domestic and export market demands, a need for consistent supply of high eating quality beef irrespective of season and a need to achieve economically efficient carcase weights in the processing sector.

Impediments to future growth potential will be the relative economics of lot feeding businesses and domestic and export demand drivers such as the relative strength of the Australian dollar occasionally dampening demand in export markets.

6 Feedlot expansion modelling results

6.1 Introduction

Results are presented based on the model output and additional data covering infrastructure and regulation not supplied by the model. Environmental and infrastructure opportunities and constraints will influence where expansion occurs. This chapter presents results with respect to the following parameters, with emphasis placed on three parameters (bold):

- Cattle Production and Supply
- Grain Demand and Supply
- **Land and Water Resources**
- Human Resources
- **Infrastructure (grain handling) (abattoirs)**
- **Regulation.**

Modelling data for cattle production, grain production and human resource requirements are presented and discussed briefly.

6.2 Cattle production and supply

6.2.1 Number of head on feed

Number of cattle on feed was calculated from the estimated pen capacity multiplied by year round occupancy. Table 21 shows the estimated number of head of cattle on feed for the nine regions from 2006 - 2021. The total number (906,468) estimated for 2006 based on the model input parameters (market breakdown, etc) provides a reasonably close match with the actual average.

Table 21 - Estimated number of head-on-feed

Region No	Region	2006	2011	2016	2021
1	Southern WA	47,076	73,935	162,772	184,968
2	Northern WA	0	12,000	16,545	41,363
3	Northern Territory	6,400	12,000	16,545	41,363
4	South Australia	20,169	27,320	42,376	42,376
5	Nth Queensland	99,922	201,000	311,770	415,694
6	Sthn Queensland	375,899	425,590	498,212	581,247
7	Northern NSW	132,241	145,800	167,518	188,458
8	Southern NSW	161,628	180,000	206,813	227,494
9	Victoria and Tasmania	63,133	71,190	81,794	89,974
	Australia	906,468	1,148,835	1,504,345	1,812,936

This estimate compares with an average 906,469 head-on-feed for the year ending 2006 as published in the ALFA/MLA survey (2007).

6.2.2 Number of cattle turned off per year and slaughter percentage

Table 22 shows the estimated number of cattle turned off for the nine regions from 2006 -2021. The input parameters were set so that the estimated total number of head turned off for 2006 was very similar to the total number of head turned off (2,626,101) for year ending 2006 as published in the ALFA/MLA Feedlot survey (ALFA 2007). While the modelled number of cattle turned off overestimates the surveyed turnoff, the discrepancy is small in the context of the total turnoff (an overestimation of approximately 0.8%).

Table 22 - Estimated number of cattle turned off per year (Head)

Region No	Region	2006	2011	2016	2021
1	Southern WA	152,548	290,650	639,888	727,146
2	Northern WA	0	47,565	65,583	163,959
3	Northern Territory	23,577	47,565	65,583	163,959
4	South Australia	71,216	177,314	181,967	181,967
5	Nth Queensland	305,727	674,342	1,045,971	1,394,630
6	Sthn Queensland	1,175,198	1,456,765	1,705,344	1,989,569
7	Northern NSW	336,749	404,310	464,537	522,605
8	Southern NSW	379,626	467,274	536,879	590,569
9	Victoria and Tasmania	203,092	247,080	283,884	312,274
	Australia	2,647,733	3,752,865	4,989,636	6,046,678

Table 23 shows the estimated percentage of grain-fed cattle slaughtered on the basis of the total herd slaughter for the nine regions for 2006- 2021. The modelling predicts the output of grain-fed cattle rising to 69% of the total Australian slaughter by 2021. This approximates all young cattle produced (total slaughter – cull cows/bulls).

Table 23 - Estimated grain fed percentage of total herd slaughter

Region No	Region	2006	2011	2016	2021
1	Southern WA	35%	61%	133%	152%
2	Northern WA	0%	14%	20%	49%
3	Northern Territory	4%	7%	10%	26%
4	South Australia	19%	31%	48%	48%
5	Nth Queensland	12%	26%	38%	51%
6	Sthn Queensland	98%	116%	130%	152%
7	Northern NSW	29%	35%	40%	45%
8	Southern NSW	55%	67%	77%	85%
9	Victoria and Tasmania	20%	24%	28%	31%
	Australia	32%	44%	57%	69%

6.2.3 Cattle supply

The expansion modelling depends on an expansion of the national beef cattle herd to reach the production estimates provided. This is considered a fundamental assumption of the modelling. The accuracy of this assumption will not be discussed in this report.

Considering supply on a regional basis, for all young cattle in Australia to be grain-fed will require significant numbers of cattle to be transported from breeding to finishing regions. Most obviously, the trend for cattle movement from Northern Australia (Northern Territory and Queensland) to southern Queensland would need to expand, and similar movement of cattle from northern to southern Western Australia would need to occur. Victoria/Tasmania is the only southern region where a surplus of young cattle is anticipated and this limits the achievement of the goal unless young cattle were exported from this region to southern New South Wales. Interestingly, northern New South Wales also has a low regional density of grain-fed cattle.

However these cattle are likely to supply southern Queensland feedlots, particularly feedlots in the border regions. Earlier discussion highlights the significant movement of cattle from northern New South Wales and the Northern Territory into Queensland feedlots and abattoirs giving higher slaughter percentages than estimated cattle numbers in the southern Queensland region.

Currently in southern Australia many young cattle are finished on temperate pasture and crop. This production system leads to seasonal beef turn off peaks that tend to depress price because of oversupply and create processing problems in some cases. The move to grain fed more young cattle will lead to reliable supplies of young cattle coming forward for processing with a resultant lowering of the supply/demand price volatility. However to increase the volume young cattle finished off grain feedlots will have to deliver competitive costs of gain to compete with grass and crop fatteners.

The movement of feeder cattle from breeding regions to feeding regions is a logical move for the industry, as livestock movements for these animals will have less impact on the sale product than transport of slaughter cattle. Availability of grain is also a consideration, with feedlot expansion likely to follow ready supply of grain over cattle. For these reasons, cattle supply is not considered a serious impediment to feedlot industry expansion in any of the regions.

6.3 Grain demand and supply

6.3.1 Grain demand

From the ration breakdown for each region, the annual total winter and summer grain demand was estimated for 2006-2021. Table 24 and Table 25 show the estimated summer and winter grain demand respectively, while Table 26 shows the total grain demand.

Based on the estimated ration composition the demand for summer grain will be 2.3 times the current demand whilst demand for winter grain will rise by approximately 80%. Actual summer/winter grain usage, however, will depend on availability and price of grains.

Table 24 - Estimated Summer grain demand (tonnes)

Region No	Region	2006	2011	2016	2021
1	Southern WA	0	0	0	0
2	Northern WA	0	34,215	47,173	117,934
3	Northern Territory	18,243	34,215	47,173	117,934
4	South Australia	0	0	0	0
5	Nth Queensland	192,346	386,973	600,232	800,309
6	Sthn Queensland	544,489	616,539	721,744	842,035
7	Northern NSW	128,568	141,777	162,896	183,258
8	Southern NSW	0	0	0	0
9	Victoria and Tasmania	0	0	0	0
	Australia	**883,647**	**1,213,718**	**1,579,219**	**2,061,470**

Table 25 - Estimated Winter grain demand (tonnes)

Region No	Region	2006	2011	2016	2021
1	Southern WA	127,622	200,437	441,272	501,446
2	Northern WA	0	0	0	0
3	Northern Territory	18,243	34,215	47,173	117,934
4	South Australia	54,175	73,358	113,786	113,786
5	Nth Queensland	96,173	193,486	300,116	400,154
6	Sthn Queensland	544,489	616,539	721,744	842,035
7	Northern NSW	244,826	270,006	310,226	349,004
8	Southern NSW	466,054	519,116	596,443	656,087
9	Victoria and Tasmania	180,696	203,831	234,194	257,613
	Australia	**1,714,035**	**2,076,773**	**2,717,781**	**3,120,126**

Table 26 - Estimated total grain demand (tonnes)

Region No	Region	2006	2011	2016	2021
1	Southern WA	127,622	200,437	441,272	501,446
2	Northern WA	0	34,215	47,173	117,934
3	Northern Territory	18,243	34,215	47,173	117,934
4	South Australia	54,175	73,358	113,786	113,786
5	Nth Queensland	288,520	580,459	900,348	1,200,463
6	Sthn Queensland	1,088,978	1,233,078	1,443,488	1,684,070
7	Northern NSW	373,395	411,783	473,122	532,262
8	Southern NSW	466,054	519,116	596,443	656,087
9	Victoria and Tasmania	180,696	203,831	234,194	257,613
	Australia	**2,597,682**	**3,290,492**	**4,297,000**	**5,181,595**

Estimated grain demand is based on cattle production assumptions, feed intake assumptions and ration formulation (see Appendix 1). These numbers have been checked against real feedlot production data and industry expert opinion. It is noted that grain usage is lower than previously thought by the industry. No recent review of grain usage has been carried out through the industry to accurately quantify consumption with more detail than used in the current model. This being said, a review of grain usage by the feedlot industry may be useful to clarify the demand and supply issues at a region-by-region and national level.

6.3.2 Grain supply

The dynamics of grain supply and demand will be discussed in detail by a separate project report. This report will provide some discussion of estimated grain demand and supply for the designated regions based on ABS grain production statistics. This may be seen as a 'status quo' spatial assessment of grain demand and current production.

Table 27 shows grain production for the regions considered in this report, sourced from the 2006 Principal Agricultural Commodities survey (ABS 2006c).

Table 27 - Summer and Winter grain production in regions of Australia (2006)

Region No	Region	Summer (ha)	Winter (ha)	Summer (t)	Winter (t)	Total Grain (t)
1	Southern WA	1,206	6,195,486	1,620	12,138,785	12,140,405
2	Northern WA	877	0	3,372	0	3,372
3	Northern Territory	8	0	8	0	8
4	South Australia	309	3,359,543	824	6,645,697	6,646,521
5	Northern QLD	143,390	163,648	201,593	276,846	478,439
6	Southern QLD	327,182	760,624	965,972	1,115,380	2,081,352
7	Northern NSW	337,465	2,212,558	967,345	4,124,751	5,092,096
8	Southern NSW	20,478	2,999,033	132,204	7,260,828	7,393,032
9	Victoria - Tasmania	2,204	2,475,849	19,995	5,579,347	5,599,342
	Totals:	**833,119**	**18,166,741**	**2,292,933**	**37,141,634**	**39,434,567**

Source: ABS (2006c)

Table 28 shows the estimated grain demand as a percentage of the 2006 supply. It is noted that due to the drought, 2006 was a low crop yield year in some regions.

Table 28 - Estimated grain demand as a percentage of 2006 grain supply within each region

Region No	Region	2006	2011	2016	2021
1	Southern WA	1.1%	1.7%	3.6%	4.1%
2	Northern WA	0.0%	1,015%	1,399%	3,497%
3	Northern Territory	228,041%	427,683%	589,668%	1,474,171%
4	South Australia	0.8%	1.1%	1.7%	1.7%
5	Northern QLD	60.3%	121.3%	188.2%	250.9%
6	Southern QLD	52.3%	59.2%	69.4%	80.9%
7	Northern NSW	7.3%	8.1%	9.3%	10.5%
8	Southern NSW	6.3%	7.0%	8.1%	8.9%
9	Victoria - Tasmania	3.2%	3.6%	4.2%	4.6%
	Totals:	6.6%	8.3%	10.9%	13.1%

Grain demand is expected to significantly exceed supply in Queensland, northern Western Australia and the Northern Territory by 2021. It is anticipated that any significant expansion in the north of Australia would need to import grain or develop grain production regions associated with the feedlot development. As such, the absence of significant grain production in the Northern Territory and northern Western Australia is a key impediment to growth of a feedlot industry in these areas.

Figure 40 illustrates the distribution of grain production across Australia relative to feedlot location, while shows the Australian grain production levels between 1997 and 2007 and the inherent volatility in supply creating an industry risk profile that could limit further sustainable feedlot expansion aspirations.

The projected expansion scenario for southern Queensland would require transport of grain from southern grain growing regions or Western Australia to meet demand, particularly in drought years. Until quarantine protocols change to permit the import of feed grain that can move beyond metropolitan areas to upcountry feedlots, the possibility of importing grain at world parity prices appears remote.

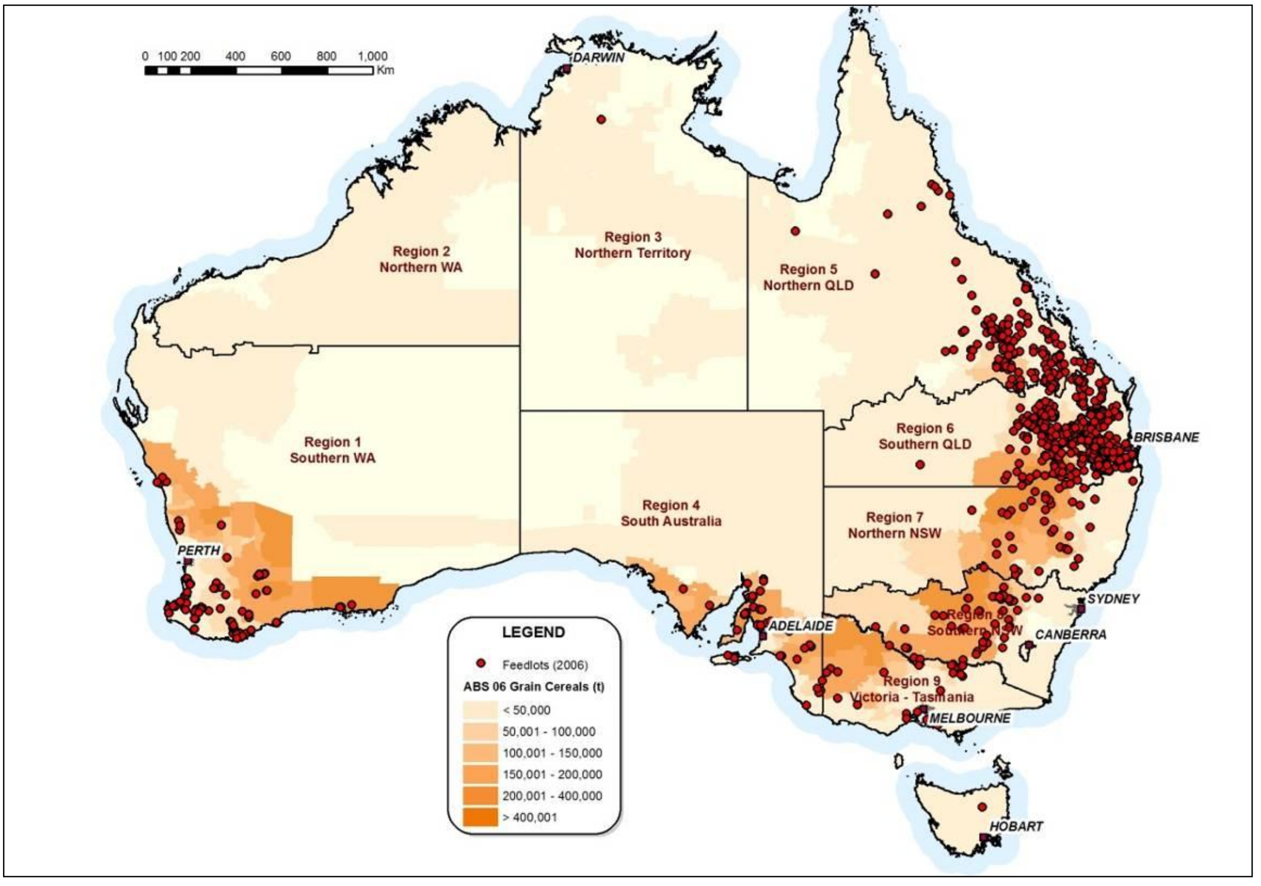


Figure 40 - Distribution of Australian grain production

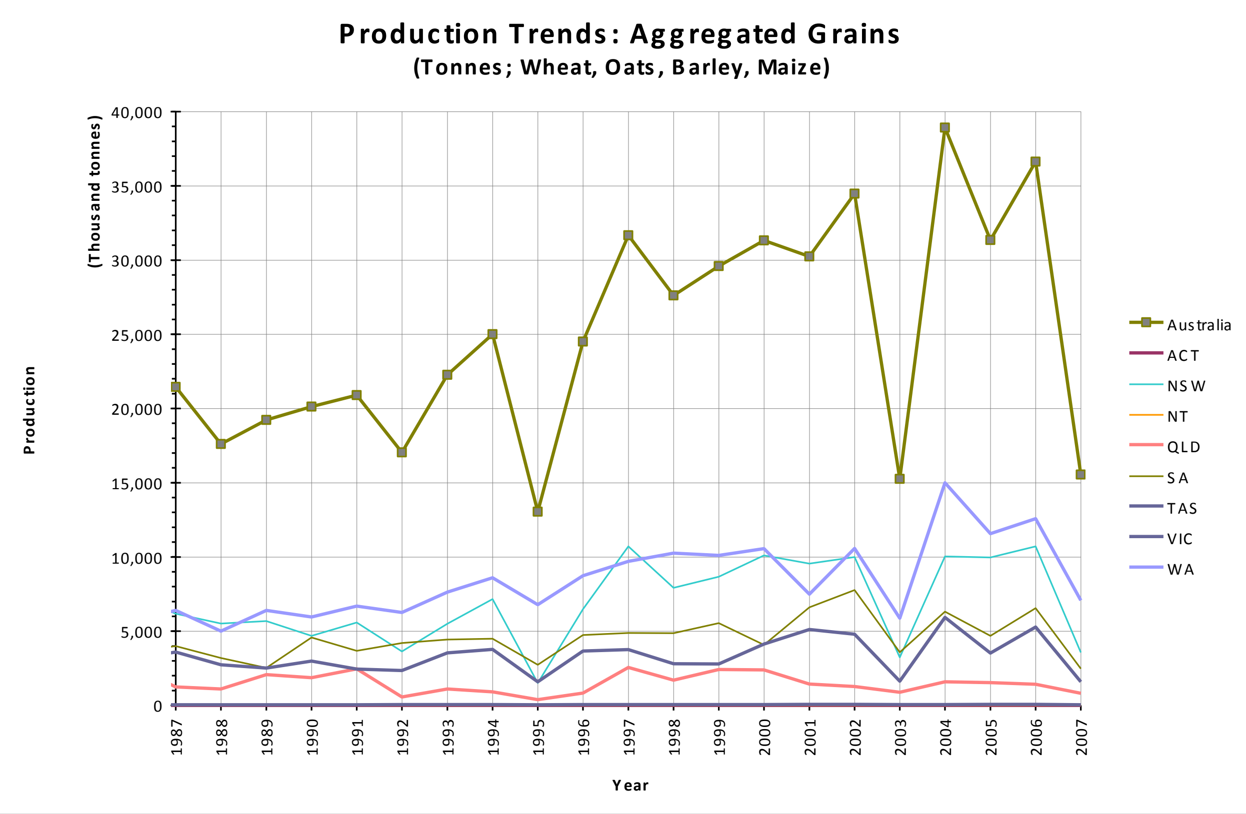


Figure 41 - Australian grain production trends 1987-2007

6.4 Land and water resource requirements

6.4.1 Land resources and land area required for feedlot expansion

Feedlots require a relatively small amount of land to carry out operations. Site-specific requirements such as buffer zones can increase the land requirement significantly. Typically, about 1.5 ha per 1000 head of capacity is required for pen area and an additional 3 ha per 1000 head for support facilities, including feed preparation and storage, cattle handling, runoff control and various roads and buildings. A footprint of 4.5 ha/1000 head is required in the immediate vicinity of the pens.

Land may also be required for effluent and manure reuse areas but this is site-specific and varies greatly depending on rainfall, climate and soils.

The physical footprint of feedlots in Australia is very small. Considering the area of the feedlot footprint without manure and effluent reuse, the current land directly required for feedlots amounts to approximately 5,300 ha. Using the predicted expanded feedlot capacity, the land directly required for feedlots amounts to approximately 10,600 ha by 2021. Clearly, land requirements to support a doubling of feedlot industry capacity are low.

Land resources are best considered on a site-specific basis. Site selection criteria depend on available land for effluent/manure reuse (where required), suitable soil type for construction of pens and ponds and the proximity of water. These factors all interact with state specific regulations.

Considering the very small land footprint required for feedlot beef production, feedlots can be seen as an opportunity to reduce grazing pressure on pasture land, particularly in drought years or enable increases in the size of the breeding herd in normal seasons. Considering the persistent pressure from government for landholders to improve the level of environmental care of rangelands, feedlots may be an option to allow a similar level of production while decreasing the grazing pressure by removing terminal progeny at an earlier age. This could allow grazing property owners to dedicate areas of land for regeneration, particularly if these ‘ecosystem services’ received payment from the government. This may promote the role of feedlots in improving the environmental performance of the beef production supply chain, particularly in the northern beef production system.

6.4.2 Water resource requirements

Australia is the driest inhabited continent in the world. Rainfall is variable and droughts are common. Drought, climate change and water shortages have highlighted the issues of water availability and reliability, water security and water efficiency.

The total feedlot water demand by region and for Australia is very low compared with other agricultural water uses. Figure shows modelled water demand for the feedlot industry (2006 and 2021) compared with three other agricultural industries as reported by ABS in 2005-06 (ABS 2006). Clearly the demand from feedlots is low when compared with other enterprises such as pasture irrigation and irrigation of cereal grains and cotton. Table 29 shows the estimated total water requirements for feedlots on a megalitre (ML/yr) basis for the nine regions from 2006-2021, based on the feedlot water requirements (24 ML/1000 head/yr) reported by QDPI (Skerman 2000).

Table 29 - Estimated feedlot water requirements (ML/Yr)

Region No	Region	2006	2011	2016	2021
1	Southern WA	2,369	3,720	7,920	9,000
2	Northern WA	0	360	480	1,200
3	Northern Territory	192	360	480	1,200
4	South Australia	709	960	1,440	1,440
5	Nth Queensland	2,981	6,000	9,000	12,000
6	Sthn Queensland	11,242	12,720	14,400	16,800
7	Northern NSW	3,920	4,320	4,800	5,400
8	Southern NSW	4,852	5,400	6,000	6,600
9	Victoria and Tasmania	1,916	2,160	2,400	2,640
	Australia	28,180	36,000	46,920	56,280

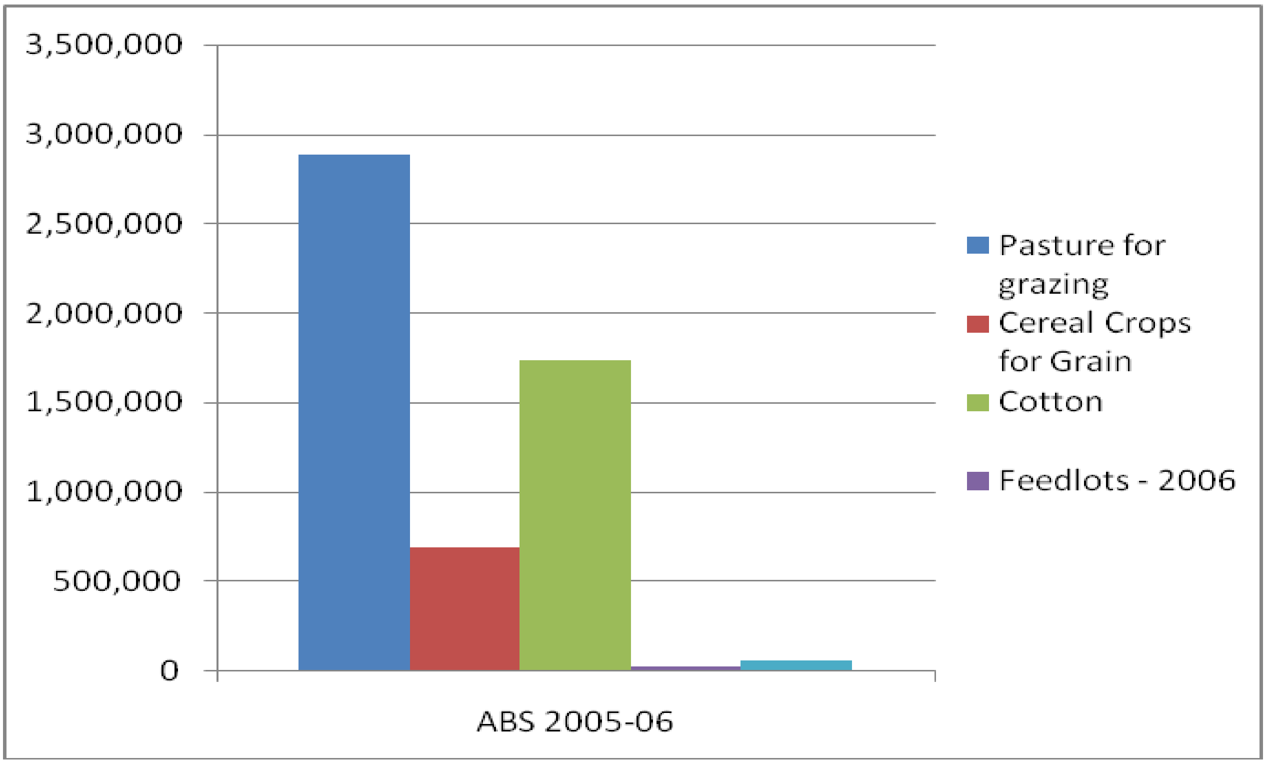


Figure 42 - Water requirements (ML) for the feedlot industry compared to selected other agricultural industries (ABS 2006 and modeling data)

A key issue for expansion of the feedlot industry will be the sourcing and security of water entitlements. The water trading framework that has been established through government policy may improve the opportunity for feedlots to secure water into the future.

Water policy in Australia has been developed over the past 14 years, beginning in 1994 with the Council of Australian Governments (COAG) water reform framework. This separated water rights from land - a necessary first step to expand trade in water. The reforms also sought to open up trading arrangements, including interstate trading.

In 2004, COAG signed off on a policy blueprint to improve the way Australia manages its water resources - the National Water Initiative (NWI). Under the NWI, water trade is the transfer of water access entitlements (permanent) and seasonal water allocations (temporary) between different entities, for example, irrigators, intensive livestock producers, environmental water managers and water authorities (water infrastructure operators). Ongoing water access entitlements and seasonal water allocations form the basis of water trading, and are an important element of water reform in Australia.

Water trading is important for the feedlot industry because it allows effective assessment of risks to water availability with respect to expansion into new areas and/or expansion of existing enterprises, particularly in regions with significant competition for water (e.g. the Murray Darling Basin). Water trading will also allow the feedlot industry to reallocate water resources over time in response to:

- changing commodity prices;
- changing environmental conditions (e.g. salinity levels, river health); and
- the changing availability of water.

In the Australian Water Resources 2005 baseline study (National Water Commission 2005), states and territories estimated the current level of development in each water management area by comparing the current level of entitlements with the environmentally sustainable level of extraction (or sustainable yield). The study reported:

- of 340 surface water management areas, 3 (1%) were over allocated, and a further 44 (13%) were highly developed;
- of 367 groundwater management units, 19 (5%) were over allocated, and a further 85 (23%) were highly developed (Figure 43).

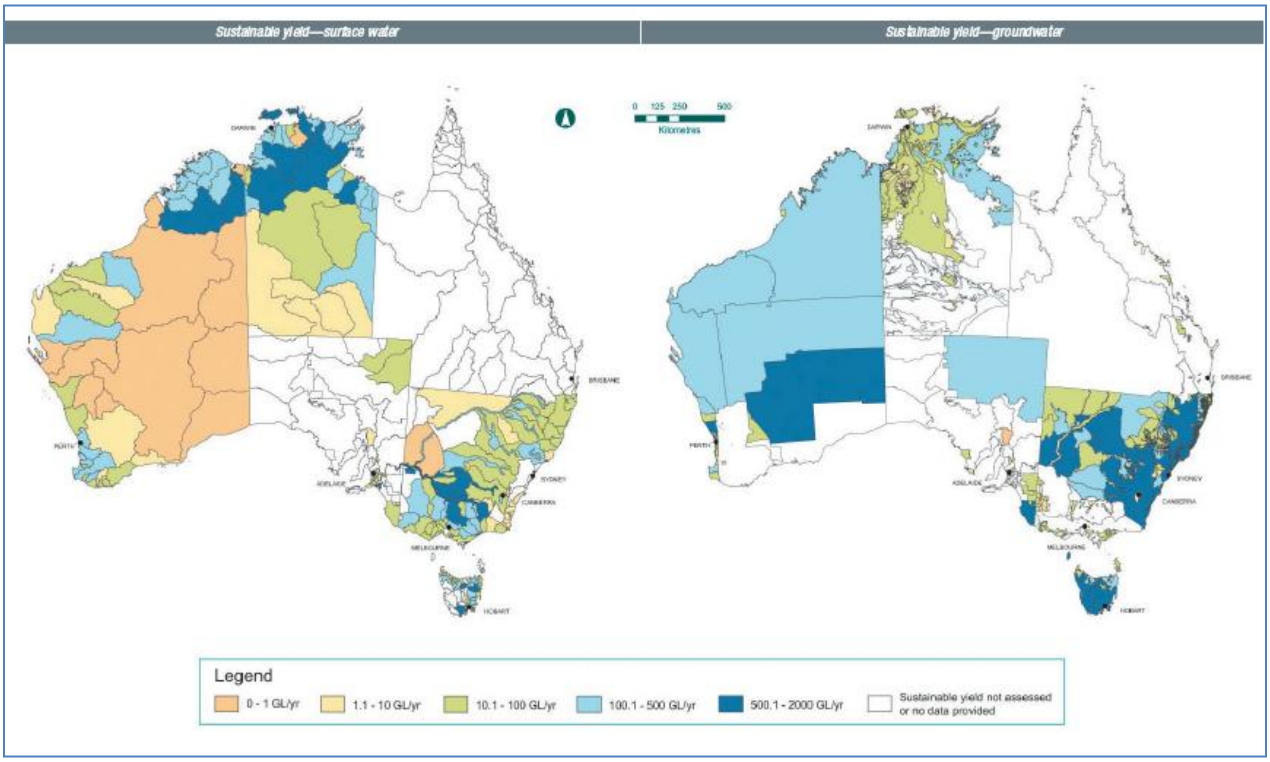


Figure 43 - Water resource assessment for groundwater (right) and surface water (left) (Australian Water Commission, 2005)

The key for the feedlot industry will be finding ongoing water access entitlements with high reliability. Feedlots must access water transfer entitlements to ensure the security of their operations and provide confidence to expand production. This will be most difficult in water management areas with over allocated or highly developed level of entitlements. The feedlot industry should be encouraging governments to look beyond the NWI commitment to develop 'compatible registers' of water entitlements to a common national registry system for water entitlements. This would achieve improved pricing and information disclosure and therefore transparency.

While the roll-out of completed statutory water plans has been slow, the 2008 COAG update report on the water reform progress (National Water Commission 2008) found that almost all states and territories have made good progress in developing water access entitlement and planning frameworks as prescribed by the NWI, particularly in high-priority water systems (Figure 44).

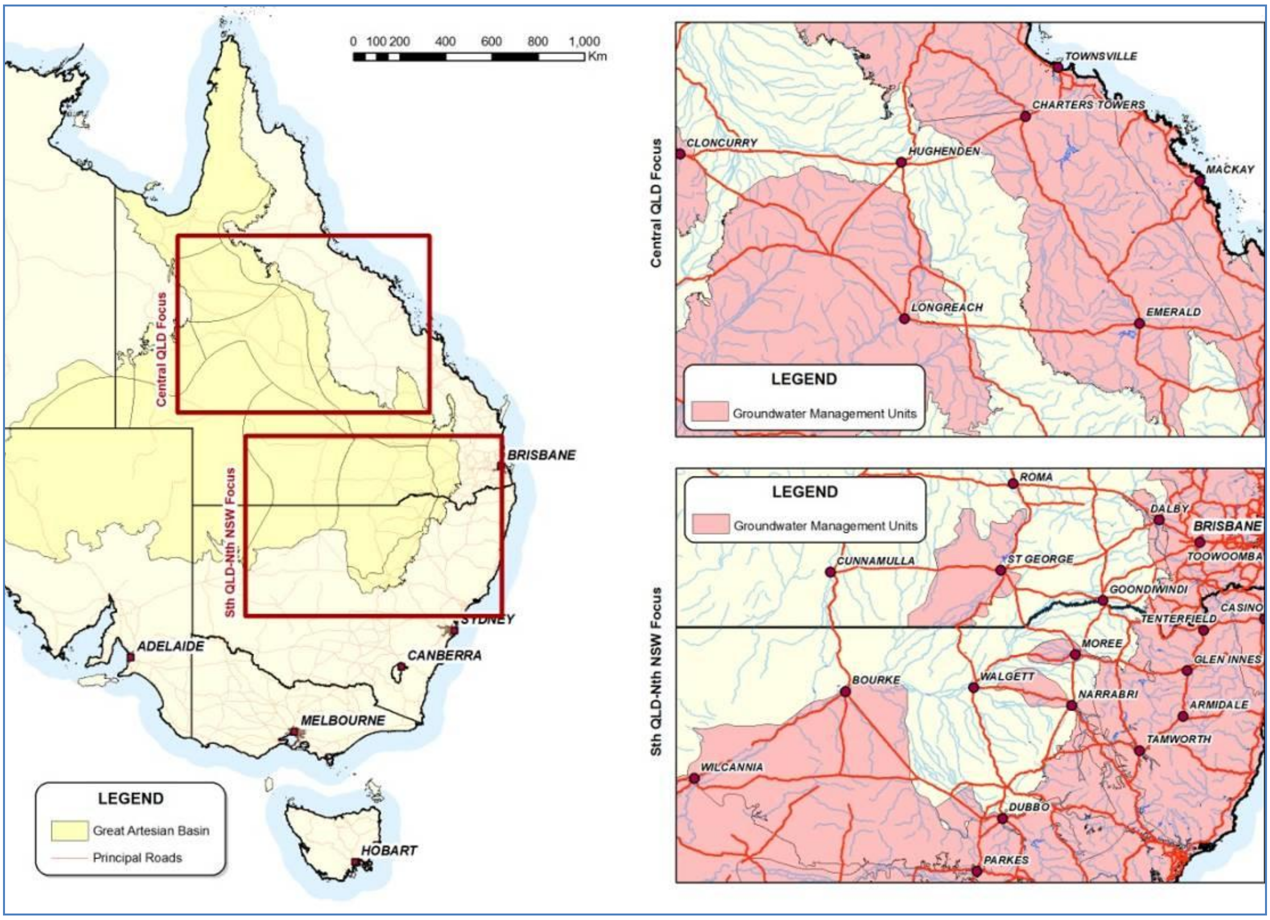


Figure 44 - Ground water management units for two focus regions in eastern Australia

Table 30 illustrates the cost of water per 1000 head of capacity for three water access entitlement pricing units. This represents a capital cost to the development; however it has not been annualised over the life of the feedlot. This shows that the capital cost of water could represent about 2-3% of the total infrastructure cost based on construction costs of $1,500,000/1000 head.

Table 30 - Estimated capital cost of water access entitlement ($)

		Water Usage Levels		
	Cost per ML	**Low [a]**	**High [a]**	**QDPI Requirement [b]**
ML/1000 head	-	15	21	24
$	150	2,250	3,150	3,600
$	1000	15,000	21,000	24,000
$	2000	30,000	42,000	48,000

[a] *Based on water usage measurements reported by Davis et al. (2008)*

[b] *Water requirements reported by Skerman (2000).*

Table 31 illustrates the operational cost of water for three water usage scenarios.

Table 31 - Estimated cost of seasonal water usage ($)

	Water Usage Levels		
	Low [a]	Average [a]	High [a]
L/kg HSCW gain	45	53	75
L/kg LWT Gain*	83	98	138
Water $/ML	0	75	150
Pumping $/ML	44	80	96
Total Cost c/kg LWT Gain	0.36	1.5	3.39
Total Cost** $/Head	0.40	1.68	3.80

[a] *Based on water usage measurements reported by Davis et al. (2008).*

* *Based on dressing percentage of 54%*

** *Domestic Cattle – DOF 70 @ 1.6 kg per day*

The cost of water could represent a significant margin on a per head basis, and highlights the continued need for water efficiency improvements at feedlots. Table 32 and Table 33 show the nominal gross margin per ML for a range of horticultural crops, cotton. and irrigated dairying. Considering the current margins for feedlot production, it is not likely that feedlots will be able to compete for water, on an open market, with dairy production or some horticultural industries.

Table 32 - Estimated cost of seasonal water usage – crops and horticulture ($)

Vegetable Crop	Nominal Gross Margin ($/ha)	Nominal irrigation used (ML/ha)	Nominal Gross Margin per ML ($/ML)
Tomato*	$9,502	4.0	3,167
Potato*	$2,349	3.0	783
Watermelon*	$3,134	2.0	1,567
Pumpkin*	$1,500	2.0	750
Cotton**	$1,830	4.0	250

** Henderson (2006)*

*** NSW Department of Primary Industries (2005)*

Table 33 - Estimated cost of irrigated pastures – Dairying ($) (Walker et al. 2004)

	Irrigated Pasture	Irrigated Pasture	Irrigated Pasture
Milk Yield (L/ML)	1,400	1,400	1,400
Water $/ML	0	75	150
Pumping $/ML	44	80	96
Irrigation Cost c/L	3.1	11.1	17.8
Farm Gate Price c/L	44-52	44-52	44-52

6.5 Human resources

In all regions, human resources are considered a constraint. This is particularly apparent in northern and Western Australia regions where the mining industry has been expanding leading to acute labour shortages for agricultural industries. Availability of human resources will be discussed briefly in regions where particular shortages are anticipated. Human resource requirements are discussed in more detail in the economic impact analysis section.

Table 34 shows the estimated full time labour requirements for projected industry expansion.

Table 34 - Estimated full time staff requirements for feedlot operation based on head-on-feed

Region No	Region	2006	2011	2016	2021
1	Southern WA	69	111	245	278
2	Northern WA	0	19	26	66
3	Northern Territory	10	19	26	66
4	South Australia	30	42	65	65
5	Nth Queensland	151	306	475	634
6	Sthn Queensland	575	658	771	899
7	Northern NSW	191	213	244	275
8	Southern NSW	230	259	298	327
9	Victoria and Tasmania	94	107	124	136
	Australia	1,350	1,735	2,274	2,746

ALFA currently reports that the feedlot industry directly employs over 2000 people (ALFA 2008), or about one and a half times the estimated staff requirements compared to the modelled results. The ALFA number may include staff related to the whole farm operation that were not reported by feedlots used as case studies for the model development. Conversely, the case study feedlots that are used as a basis for model estimates may have greater staffing efficiencies than the broader industry. Considering this, the industry wide staff requirements may be up to 50% higher than the numbers presented above and similar to the ALFA reported figure.

Local towns are required for the provision of labour and services to feedlots. This is not essential, as feedlots can build accommodation on-site for all workers and employ skilled service providers within their company structure. However it is generally beneficial to have the resources of a local town to draw on. Ideal distance to a local town is in the order of 30-50 km.

Considering the constraints labour impose on the industry currently and the expectation that this will increase with industry expansion, there is an on-going need for co-ordination of training and recruiting for the feedlot industry in the future. One option for recruiting workers may be afforded by the Section 457 visa immigration ruling. This has enabled other agricultural industries to benefit from a supply of skilled and un-skilled foreign workers.

6.6 Infrastructure

Regional infrastructure requirements for feedlot development include roads, electricity, abattoirs, local towns and grain handling infrastructure. Most infrastructure requirements can be developed in a given region based on demand. However the cost of upgrading roads and provision of electricity to rural locations may be prohibitive in some specific areas.

The infrastructure needs for feedlot industry expansion in each region have been assessed on a qualitative basis, with attention given to availability of abattoirs, local towns and road transport.

Feedlots should be located as close to abattoirs as possible to reduce transport costs and possible adverse meat quality impacts. This being said, some feedlots in Australia currently truck cattle in excess of 650 km to slaughter. In addition to proximity, having multiple options for slaughtering is desirable. This introduces competition to the market and enables feedlots to send specialist lines of cattle to different abattoirs. In some cases, feedlots will transport cattle some 2-300 km further than the nearest abattoir for particular lines of cattle. Figure 45 shows the location of existing abattoirs in the nine assessment regions with a 500 km buffer zone around each abattoir.

Road transport is the preferred means for almost all cattle and commodity movements in the feedlot industry (Queensland is the only state that transports cattle by rail). Considering a 10,000 head feedlot may require over 6,500 truck movements per year, the impact on local roads can be significant. For commodities that are shifted between regions and states, more efficient means, for grain transport in particular, would be of benefit to the industry. Rail is one obvious alternative; however the state of rail transport is very poor in many regions.

Considering the demand requirements for grain, imported grain may be required for an expanding industry if current quarantine protocol objections to upcountry movement of imported grain can be overcome. Imported grain for the feedlot sector will require access to ports and travel routes between port and feedlot. This may make construction of feedlots in non-grain growing regions (such as northern Australia) more feasible. Inter-regional transport of grain between grain growing areas and lot-feeding areas also represents a limitation to the industry because of the traditional focus on grain transport from production regions to ports. Considering the increased importance of local consumption for feed grain there is a growing case for domestic transport of grain by rail to reduce haulage costs.

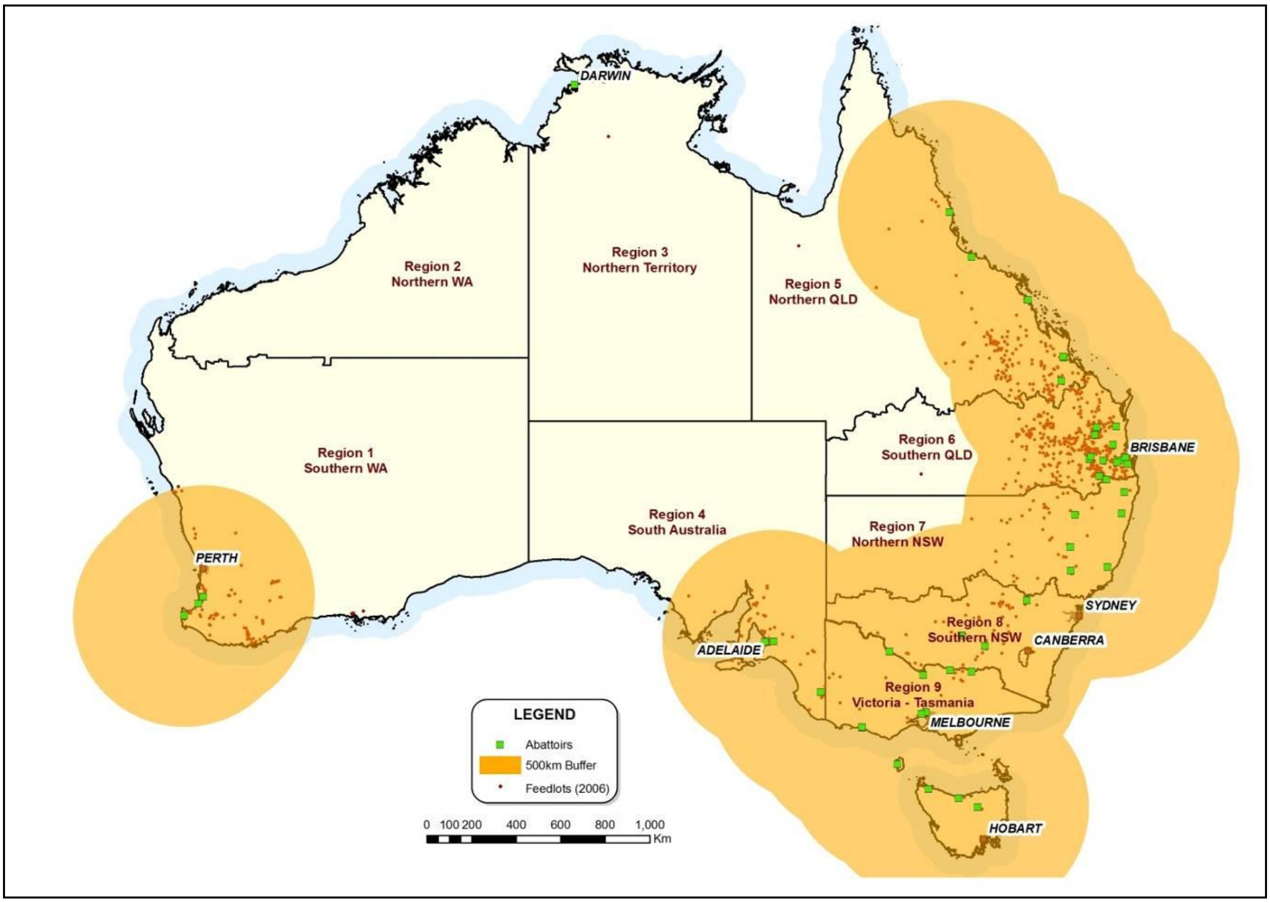


Figure 45 - Current abattoir and feedlot locations with 500km radius zone

Figure 46 shows some infrastructure elements relevant to expansion in eastern Australia, including selling centres, abattoirs, larger feedlots, roads and ports. This figure also identifies areas where a high number of cattle movements occur.

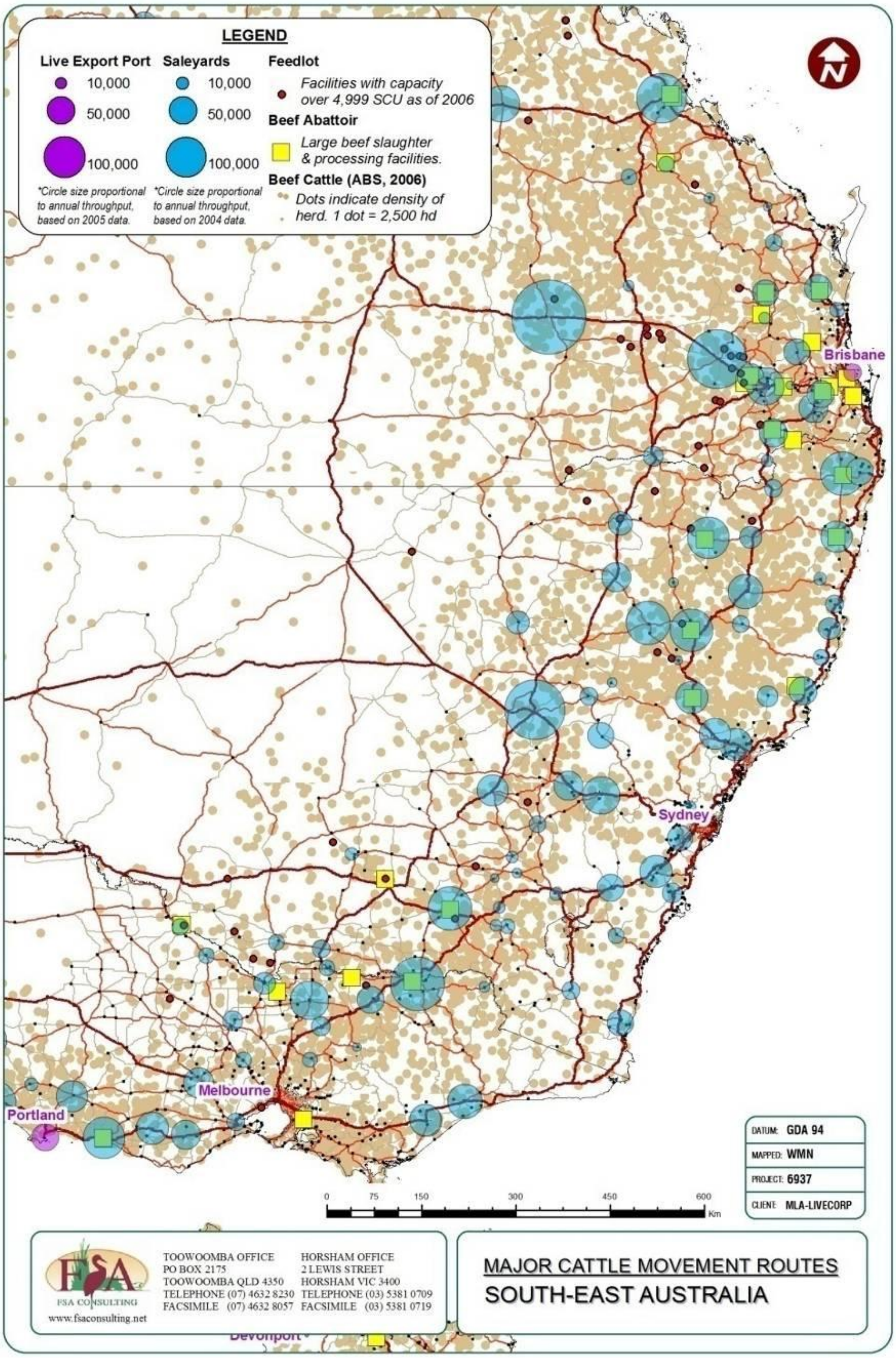


Figure 46 - Major abattoirs, saleyards and feedlots in SE Australia

6.7 Greenhouse gas production

Increasing climate variability in feedlot regions may affect many aspects of feedlot production, particularly grain supply, cattle supply, water availability and security and energy supply. Additional regulations may also be imposed on feedlots relating to greenhouse gas production, energy and water usage. Within the scope of this project it was not possible to include the broad range of possible climate change implications because of the inherent variability in modelling available in the public domain. However, the process and implications of greenhouse gas emissions from feedlots will be discussed in the following section with possible options for mitigating greenhouse gas production.

6.7.1 GHG production at feedlots

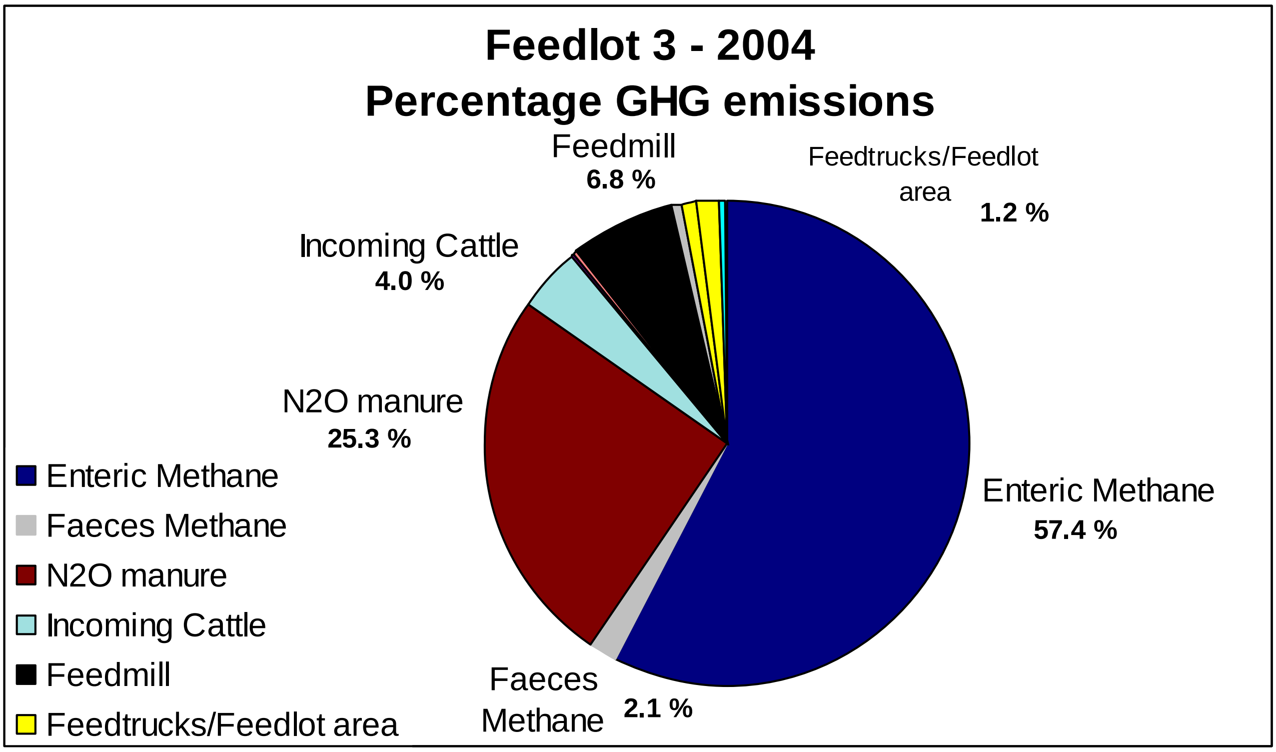
Greenhouse gases (GHG) of greatest relevance to feedlot production are carbon dioxide (CO_2) from energy consumption, enteric methane (CH_4) and methane and nitrous oxide (N_2O) from manure management and reuse. Each of these compounds has a different global warming potential (GWP). GWP depends on both the efficiency of the molecule as a GHG and its atmospheric lifetime. GWP is measured relative to the mass of CO_2 and evaluated for a specific timescale. Thus, if a molecule has a high GWP on a short time scale (say 20 years) but has only a short lifetime, it will have a large GWP on a 20-year scale but a small one on a 100-year scale. Conversely, if a molecule has a longer atmospheric lifetime than CO_2, its GWP will increase with time. Methane (CH_4) has a GWP 21 times that of CO_2 while nitrous oxide (N_2O) has a GWP 310 times that of CO_2 when measured on a 100 year time-scale. Total GHG emissions are expressed as tonnes CO_2-eq where all of the contributing compounds are multiplied by their GWP to determine an equivalent amount of emitted CO_2.

GHG emissions from feedlots can be calculated using the DCC Methodology (NGGIC 2004; 2006). GHG production from feedlot operations have been calculated in an MLA funded project ‘FLOT.328’ (Davis & Watts 2006) which collected Life Cycle Inventory (LCI) data for 9 feedlots (energy, water, feed, herd production, etc). All resource usage/environmental emissions were expressed on a per kg HSCW gain basis, i.e. emission per unit of production. GHG emissions were estimated from the feedlots using actual energy usage data and NGGIC (2004) conversion factors. GHG emissions from manure management were prepared using the methodologies outlined by the NGGIC (2004).

These calculations were not replicated as part of the current project, though relevant conclusions from this work are presented below. The reader is directed to the final report presented for project ‘FLOT.328’ for further information.

Figure 47 shows a representative breakdown of GHG emissions calculated for one feedlot in the project. Enteric methane is the dominant emission but N_2O is very significant. Faeces methane (methane emitted from manure management) is quite small but this is based on the Methane Conversion Factor (MCF) of 1.5% provided by the NGGIC which may underestimate emissions under Australian conditions (Watts 2008). Watts (2008) noted that there has been no scientific work done in Australia to determine that a MCF of 1.5% is appropriate, and that there is good reason to assume that this factor is too low because of the limited baseline research (which was conducted in the northern hemisphere) and the significant differences in climate and management for Australian feedlots.

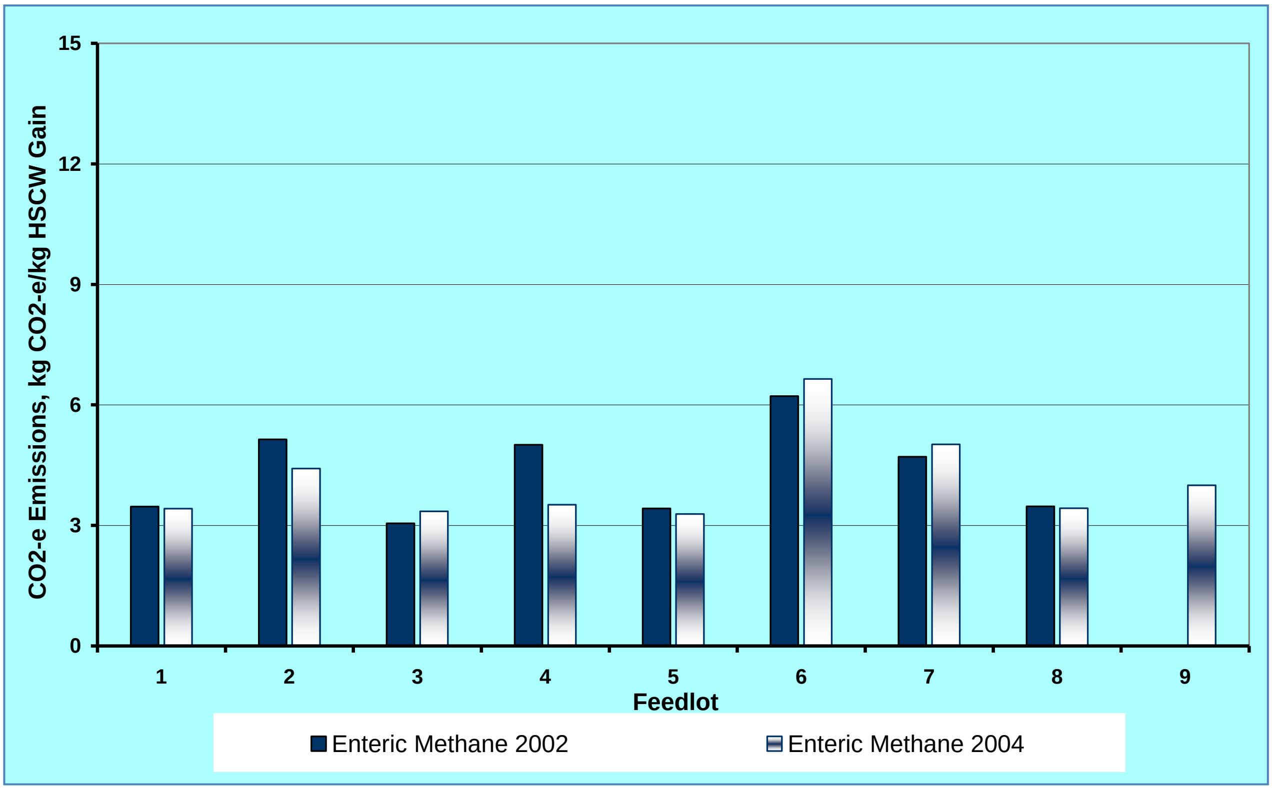
As with methane, N_2O emissions from manure management systems are calculated in the NGGIC (2004) using an international default value sourced from the IPCC. The IPCC method is based on estimating nitrogen excreted by livestock and then a simplistic conversion of excreted N to emitted N_2O using a standard MMS (manure management system) emission factor. For “drylots”, the emission factor is 0.02 kg N_2O-N/kg N excreted. The emission factor summarises all of the feedlot system including pens, manure stockpiles, ponds, effluent irrigation systems and manure spreading. This method does not recognise any variation in manure management between feedlots and does not vary with climatic zone. In short, it is a very simplistic calculation.



Source: Davis and Watts (2006)

Figure 47 - Breakdown of estimated GHG emissions from feedlot 3

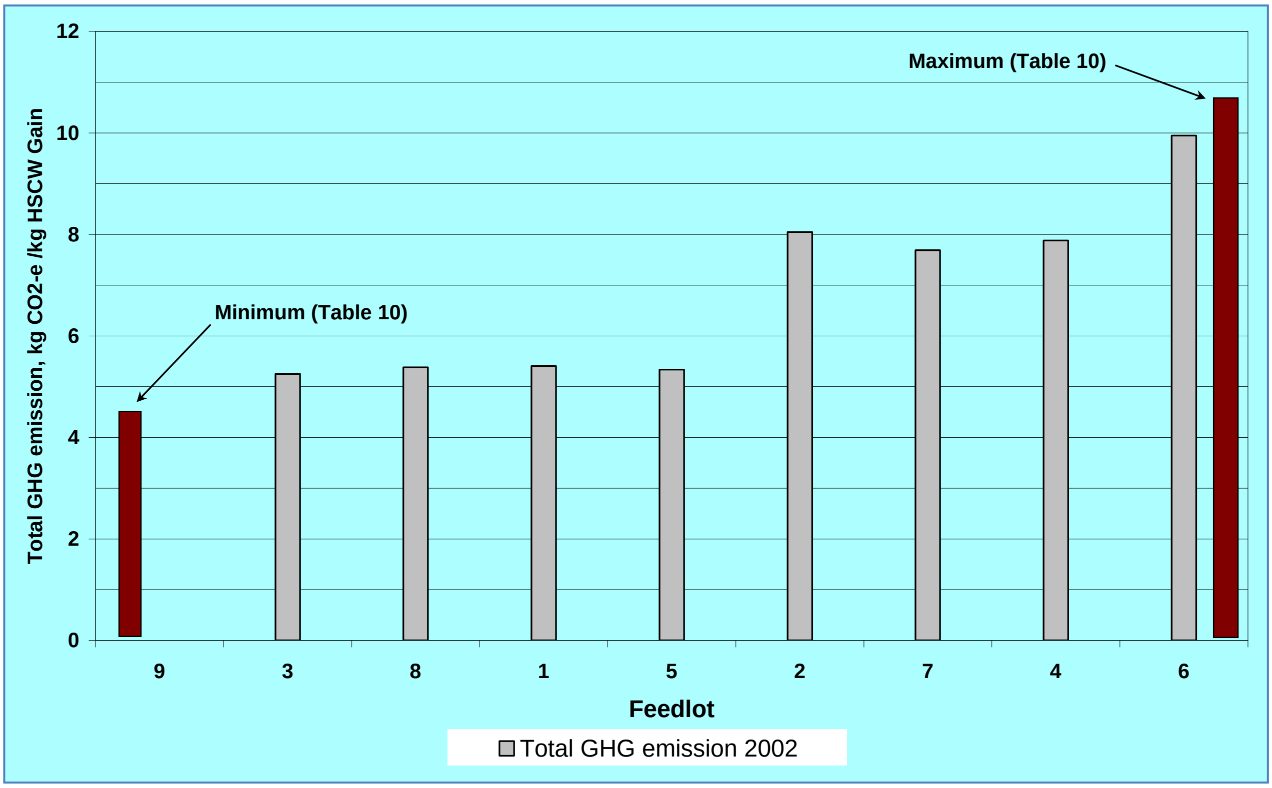
Figure 48 shows the variation of enteric methane emissions (expressed as kg CO_2-eq per kg of HSCW gain). This shows a two-fold variation in emissions due largely to different average daily gain. Short-fed cattle with a large daily gain had the lowest emissions per kg of gain while long-fed cattle with a lower daily gain had a higher emission per kg of gain.



Source: Davis and Watts (2006)

Figure 48 - Variation in enteric emissions per kg HSCW gain

Figure 49 shows the total estimated GHG emission per kg of HSCW gain. Based on these data, there is a range of 5 to 10 kg of CO_2-eq per kg of HSCW gain with a median value of about 6 kg CO_2-eq per kg of HSCW gain.



Source: Davis and Watts (2006)

Figure 49 - Total GHG emissions for nine feedlots

6.7.2 Improving feedlot GHG performance

Based on the total variability within the data, the results presented above suggest there is scope for reducing GHG production from feedlots. Options for reducing GHG production will be of increasing importance as regulations regarding GHG production increase. It is also likely that government funding may become available for on-ground practice change that will lead to quantifiable reduction in GHG emissions from feedlots.

It is important to note that based on research to date, actual GHG emissions from feedlots may be significantly different from those calculated by the standard methodology. It is imperative that the relevant research questions are addressed to ensure accurate quantification of feedlot emissions prior to the introduction of regulations for the emission of GHG from agriculture.

Research needs include:

- Quantification of methane emissions from manure management;
- Quantification of N_2O emissions from manure management

Options to reduce GHG from feedlots that warrant further investigation include:

- Improved energy efficiency within the operation;
- Improved manure management to reduce methane and N_2O emissions;

- Production of energy from manure/effluent to offset energy demands and improve waste stream nitrogen management.

Production of energy from manure is one option that offers a great deal of potential for the feedlot industry. Several possible benefits may come from developments in energy recovery from manure, namely:

1. Reduction of electricity or gas demand at the feedlot (economic savings may be in excess of $250,000/year for larger feedlots).
2. Reduction of GHG emissions through capture and utilisation of methane and potentially a reduction in nitrous oxide from manure management).
3. Reduction of odour from manure stockpiles and effluent ponds.
4. Recovery of valuable nutrients (discussed in the following section).
5. Elimination of pathogen risk from manure/effluent reuse.

An international precedent has been established for the promotion of green energy production and it is highly likely that in the field of energy recovery energy development from feedlot manure would qualify for Government grants under renewable energy programs.

In the broader context of the Australian beef industry, lot feeding of beef cattle will lead to lower overall GHG emissions per kg of beef compared to standard grass-fed production systems. This supposition is supported by the red meat LCA project funded by MLA (COMP.094) which has compared a southern red meat supply chain with and without inclusion of a feedlot. The results of this research found that the supply chain including a feedlot reduced GHG production per kg of HSCW gain by some 16% (Peters et al. in press).

Lot feeding may also reduce GHG production through the potential for greater herd efficiency in northern beef production systems. By decreasing the age of slaughter for sale cattle, enteric methane may be reduced and overall herd production improved in terms of kilograms of beef relative to the size of the breeding herd. This theory has not been quantified by research to date and represents a research need for the industry which could be carried out within a life cycle assessment (LCA) framework. If a clear benefit could be quantified, GHG reduction may be an important driver in promoting feedlot expansion.

LCA is likely to be the approach used to quantify, assess and regulate greenhouse gas production from the feedlot industry in the future. Work to date has shown that there may be an overall GHG reduction for beef production in systems where feedlots are used to finish cattle, primarily because of the improved feed conversion ratio (FCR) for cattle fed a high energy grain based ration (Peters et al. in press) and reduced days of life compared with grass fed cattle of the same weight. There is a significant amount of research still required to underpin high level studies such as LCA. In particular, further research is required to confirm the contribution of the following GHG production and mitigation pathways:

- Nitrous oxide emissions from grain production
- Carbon sequestration at feedlots (i.e. from manure/effluent usage)
- Carbon sequestration from grazing operations.

It is recommended that a northern supply chain LCA project be established to provide baseline data for this comparison. The scope for the LCA project should clearly state the goal of comparing GHG production of the entire Australian herd with and without expansion of the feedlot industry.

6.8 Nutrient management

The feedlot industry produces a very large volume of valuable nutrients each year. Nutrients required in large volumes for crop production include nitrogen, phosphorus, potassium and a range of lesser elements such as sulphur and calcium. Cattle excrete a large volume of these elements in manure and urine which are typically applied to land at or nearby the feedlot.

Table 35 shows the total estimated nutrients in the feedlot waste-stream from 2006-2021 and the value of these nutrients calculated in simple terms compared to current (2008) fertiliser prices.

Table 35 - Estimated nutrient excretion (total reserves) for Australia (tonnes & $ value/yr)

	2006	2011	2016	2021
Nitrogen	46,936	59,039	77,243	92,690
Nitrogen value[a]	$ 131,625,561	$165,564,682	$ 216,614,887	$ 259,935,226
Nitrogen after losses[b]	5,632	28,193	9,269	11,123
Nitrogen value[a]	$ 15,795,067	$ 79,063,559	$ 25,993,786	$ 31,192,227
Phosphorus	6,316	7,744	10,086	12,111
Phosphorus value[c]	$ 46,147,683	$ 56,575,587	$ 73,687,727	$ 88,481,379
Potassium	16,613	21,043	27,552	33,214
Potassium value[d]	$ 39,870,345	$ 50,503,569	$ 66,123,752	$ 79,713,969
Total nutrient value	$ 101,813,096	$ 126,946,919	$ 165,805,265	$ 199,387,575

a *Nitrogen value based on a urea price of $1290/t.*

b *Total nitrogen losses through to reuse at the feedlot are estimated at 88% (FSA Consulting 2006)*

c *Phosphorus value based on MAP at $1600/t.*

d *Potassium value based on Potash at $1200/t.*

It should be noted that nitrogen is very difficult to retain in the current feedlot system. FSA Consulting (2006) estimated that a total of 88% of the nitrogen excreted is lost, primarily as ammonia. If ways were found to retain and capture this nitrogen in a usable form, the value to the industry would be considerable.

The dollar value calculations presented in Table 35 are simplistic as they compare to fluctuating retail prices for fertiliser. If nutrient recovery techniques could be employed by feedlots to recover nutrients in a saleable, chemically available form, it is likely that the price received would be 40-60% of the retail price. Despite this, if the value of these nutrients could be recovered in part, this has the potential to significantly alter the economics of feedlot production.

In the past 12 months, fertiliser prices have increased up to three-fold. While it is highly likely that nitrogen prices will decrease with recent declines in oil price, phosphorus and potassium may not decrease in value to the same extent because of the limited global mining reserves of these resources. For this reason, the economics of nutrient reuse from feedlot manure and effluent are likely to have seen a fundamental shift during this time.

Nutrient overloading in manure and effluent reuse areas is of growing concern for the industry, with several older feedlots facing serious challenges and restrictions from regulators relating to manure and effluent re-use. The environmental problems related to overloading of nutrients can create a serious limitation to feedlot operation and development and this is likely to become more widespread through the industry for two reasons:

1. The average age of operation for feedlots across the industry is increasing. Problems encountered now by older feedlots may be considered forerunners to similar problems throughout the industry, and
2. Regulatory controls are likely to become more severe, increasing pressure on feedlots to develop solutions to nutrient overloading.

There are two options that warrant further attention to address nutrient management concerns and recover value from excreted nutrients at feedlots:

1. Improved nutrient reuse efficiency at feedlots (manure and effluent reuse),and
2. Investigation into nutrient recovery options for larger feedlot enterprises to transform nutrients into new or conventional fertilisers.

6.8.1 Improved nutrient reuse

Improved nutrient reuse from manure and effluent at feedlots offers an opportunity to improve on-farm crop production and reduce the threat of environmental harm and regulatory pressures from nutrient overloading. This is particularly relevant to effluent reuse because of the difficulties in moving effluent to new reuse areas if nutrient overloading occurs.

There is a need for renewed research attention into effective application rates for effluent and manure, particularly with respect to forage crops grown for use in the feedlot.

One tool that shows promise for improving nutrient reuse efficiency is electro-magnetic induction (EM) which is able to provide rapid assessment of nutrient mineralisation and application efficiency for manure and effluent. Promising research in Queensland has trialled the validity of this technique and further industry level research may be warranted to investigate the potential efficiency gains to be made in manure and effluent reuse.

6.8.2 Nutrient recovery

The second opportunity with respect to nutrient management is in the field of nutrient recovery from feedlot manure and effluent. There is growing interest in nutrient recovery (GRDC tendered a project in this field in late 2008) and research by the feedlot industry into the best options for nutrient recovery may provide valuable outcomes, particularly for medium to large feedlots where economies of scale exist. Nutrient recovery options can be integrated with energy recovery technology (discussed in section 6.7.2). This is an emerging field, however promising prospects include a combination of anaerobic digestion and nutrient removal via a range of means. It is an important area requiring research with significant potential gain for the industry.

6.9 Regulation

The feedlot industry is subject to general planning regulations (shire based) and environmental regulations (state based) similar to many other industries. Planning regulations are typical of any industrial development and consider access, amenity, infrastructure demands and appropriate land zoning. Environmental regulations are typically managed by State Environmental Protection Agencies (EPAs) and deal with site suitability for feedlot development with respect to nutrient reuse, land suitability and odour (separation distances).

These regulations can be a significant constraint to development, and may impose considerable pressure on feedlot enterprises if forecast increases in regulatory requirements are carried through. Challenges include environmental sustainability, (protecting air, water and soil quality, managing waste, preventing or controlling pollution), OH&S requirements and resource efficiency (water and energy) programs run by federal, state and territory governments. Some examples of regulation changes that affect the feedlot industry include:

- The Environment and Resource Efficiency Plan (EREP) program (EPA Victoria)
- The Energy Efficiency Opportunities (EEO) program (Federal Government)
- The National Pollutant Inventory (Federal Government)
- The Emissions Trading Scheme (Federal Government)
- The Environmental regulation fee re-structure based on environmental emissions (EPA Queensland)
- Environmental Emissions and Resource Efficiency Programs (Federal Government, EPA Victoria).

These and other issues are discussed in the following sections.

6.9.1 Load based licensing

An example of the new approach to point source environmental emissions is that adopted by the Queensland EPA in its new *Environmental Protection Regulation 2008*. This regulation commenced on the 1st January 2009 and will change the way some environmental matters are managed in Queensland. The new approach is based on evidence and the potential to cause environmental harm. Essentially licensing and fees are to be calculated based on emissions of relevant pollutants measured under the national pollutant inventory. The objective of the new regulation is to protect Queensland's unique environment from point source pollution while allowing ecologically sustainable development.

The key changes include:

- an updated list of environmentally relevant activities (ERAs) that will require regulation;
- a new fee structure for ERAs based on environmental emissions; and
- broader responsibility for local government, who will now manage matters related to environmental nuisance (from both commercial and residential) and minor water pollution.

The new regulations have been accompanied by significant fee increases for feedlots and set a precedent for emissions based fees. This is of concern, considering the possibility of this framework being expanded to include GHG emissions.

6.9.2 Land tenure

A significant regulatory limitation to feedlot location and sizing is the requirement for buffer distances to neighbours and other local developments. For some regions of Queensland, other intensive livestock enterprises (notably poultry) are required by local council (under the local planning scheme) to review license conditions at the point of sale. The council reserves the right to reduce or cancel the operating licence capacity of the facility based on the compliance with minimum buffer distances to sensitive receptors at the time of re-assessment.

There have been several cases where poultry farms have been un-able to meet these minimum buffer distances during the re-assessment process (prior to or post-sale), leading to reduction or cancellation of their operating licence, significantly devaluing the farm and in some cases causing considerable loss to new owners where due diligence investigations were not carried out in sufficient detail. This is particularly contentious where older farms have been surrounded by new housing developments approved by the local council in the region.

As yet, these planning instruments have not been applied to the feedlot industry, though the industry must carefully observe any moves to change the application of planning regulations in the future which may impinge upon the industry.

6.9.3 The appeal process

Legal appeals to feedlot development under relevant state legislation and local council by-laws are continually growing to be a substantial barrier to feedlot development in some regions of Queensland and possibly other states.

While feedlot development and operation may be approved under all the required regulations set by local government and the environmental regulation body, there is increasing pressure on developments from the surrounding community via formal complaints and court appeals during the development phase. Appeals are usually based on community amenity issues such as odour, perceived pollution risk (to water) and dust/pathogen risks to human health. Because of the inherent difficulty in quantifying these impacts, and the lack of substantiating research, the appeal process can be protracted and expensive. Several cases in Queensland relating to pork or chicken production have established a precedent for conservative court rulings based on using the precautionary principle, effectively blocking developments where insufficient information has been presented to the court by the defendant in answer to concerns raised by the opponents.

There has been an observed increase in the number of appeals lodged against proposed feedlot developments in recent years. There is a continuing need for research to quantify issues of concern, particularly:

- Pathogen transmission via air and water;
- Nutrient loss and environmental impacts from manure and effluent reuse areas;
- Odour and dust mitigation options for feedlots.

Regarding odour mitigation, research is needed to quantify the effect of altered manure management practices on odour generation (such as installation of pond covers or anaerobic digesters). Research may allow new factors to be developed for buffer distance calculations within the established regulatory system for assessing existing or proposed developments.

6.9.4 Livestock transport

The feedlot industry’s economic operation relies heavily on the livestock transport industry. Large numbers of livestock are transported across significant distances, primarily on public roads. There are a number of issues facing livestock transport which may inadvertently impinge upon feedlot production, these include:

- Aesthetic and safety issues such as effluent spillage on public roads and odour from transport vehicles; and
- Freight loading regulations (mass and volume loading).

Effluent spillage has developed into a contentious issue in recent years in several identified regions of eastern Australia. These regions of concern generally correspond to where large numbers of livestock are transported through urban communities en route to feedlots and meat processing plants. Meat processing plants are usually located in or close to urban centres and, with population increase, have been encroached by residential land uses in many cases. There is mounting pressure from state departments and local shires to eliminate effluent spillage from livestock transports, particularly in these sensitive areas.

In an effort to address this issue, MLA funded the project B.FLOT.0314 to develop and industry stance and forward direction on the issue. It is imperative that members of the feedlot industry participate in discussions beyond the finalisation of this project to ensure the best outcome for the industry.

A second issue of concern to livestock production relates to freight regulations for livestock transport. Livestock have the highest transport cost of all the rural commodities in Australia, largely because meat is a heavy commodity. The journey from ‘paddock to plate’ typically involves far longer distances than for other rural products. Multiple long-haul journeys are involved from paddock production on-farm, to large feedlots or saleyards, to processing (and onward transport as chilled meat product, post-processing) or to sea ports for live export. The major ‘infrastructure’ of the meat and livestock sector – farms, feedlots, saleyards, processing facilities - are highly dispersed across great distances. These major infrastructure sites are generally not in line with the major urban freight hubs considered ‘strategic corridors’ (Figures 40, 48 and Figure). Therefore, the feedlot industry relies on an efficient freight system to underpin its success.

Currently freight vehicles and their supporting freight infrastructure are not integrated efficiently across jurisdictions. ‘Higher Mass Limits’ is a term that describes trucks that carry slightly more mass than standard mass limits, in return for fulfilling certain higher operator compliance standards to ensure road wear and road safety outcomes are not compromised. This compares with the Standard (Gross) Mass Limit regulation, the national Livestock Loading Scheme and Restricted Access Vehicle regulations in use through various states of Australia.

For example, the Victorian Livestock Loading Scheme is limited to six axle articulated vehicles and nine axle B-Doubles provided they comply with the national maximum loading space for livestock loading vehicles of 12.5 m in length for semi-trailers and constructed to a height of 4.6 m and width of 2.5 m.

The Higher Mass Limits (HML) network is already available on some freight routes across the country. Higher Mass Limits on a B-double truck provide an extra 6 tonnes of freight (livestock) to be loaded – an efficiency dividend of more than 10% over ‘standard weight’s vehicles. However, in most cases, the HML network doesn’t extend to the whole freight task (i.e. from the feedlot, through the highway in question and to the processing plant).

The feedlot industry must become an active part of the solution. The granting of Higher Mass Limits can deliver cost-effective productivity benefits as well as road safety, skills and greenhouse gas emissions dividends.

It is the view of COAG that, *‘Prescriptive regulations that restrict particular types or configuration of heavy vehicles from using certain roads should be replaced, where possible, with performance-based regulations to promote flexibility, innovation and greater productivity in the road freight sector’* (ALTA 2008).

6.9.5 Occupational health and safety

Occupational Health and Safety (OH&S) legislation places a duty upon employers, self employed persons, employees and others with control at the workplace. This duty is to ensure the safety of any person whose safety may be affected by the undertaking of work. New South Wales is one state where particularly stringent OH&S laws are in place and must be adhered to.

In New South Wales, lot feeders who have contractors belonging to a third party on their site, fall under “others with control at the workplace”.

It is a well established legal OH&S principle that duties cannot be contracted away in any agreement. The degree of control of workplace risk by a lot feeder as assessed in their respective State law cannot be diminished or increased by words in an agreement appearing to pass it onto another party.

Therefore, workplace safety is a significant regulation for the feedlot industry and needs to be treated as a priority. The feedlot industry needs to be informed on safety issues and OH&S legislation governing jobs commonly performed by people involved in the industry. There is a large volume of information relating to OH&S in agriculture but it is often desktop based or more suited to use in an office environment.

The feedlot industry could improve the ease of compliance with OH&S regulations through the production of a user-friendly quick-reference guide aimed at increasing adoption of safe work practices on-farm and through the development of generic on-farm safety management packages that can be tailored to individual workplaces. This may reduce the pressure on individual feedlots to develop such plans.

6.9.6 Resource efficiency regulations

The Victorian Government's Environment and Resource Efficiency Plans (EREP) program and the Australian Government's Energy Efficiency Opportunities (EEO) programs are have been implemented in the past 12 months focussed on improving resource efficiency. These programs target large resource using businesses and mandate improvements in resource efficiency and business performance. The programs exert a considerable reporting burden on the business, though they may also lead to opportunities for financial benefits from electricity or water cost savings.

Under the Victorian EPA EREP program, feedlots greater than 7000 head capacity exceed the water usage threshold and hence are be required to participate. Once the reporting threshold is exceeded, the business must report on and improve energy usage also.

This challenges the feedlot industry to action, to implement resource use efficiency measures and minimise environmental emissions, and may offer the opportunity for industry wide collaboration to reduce the burden of reporting and to establish standardised efficiency improvements.

6.9.7 Greenhouse gas regulations

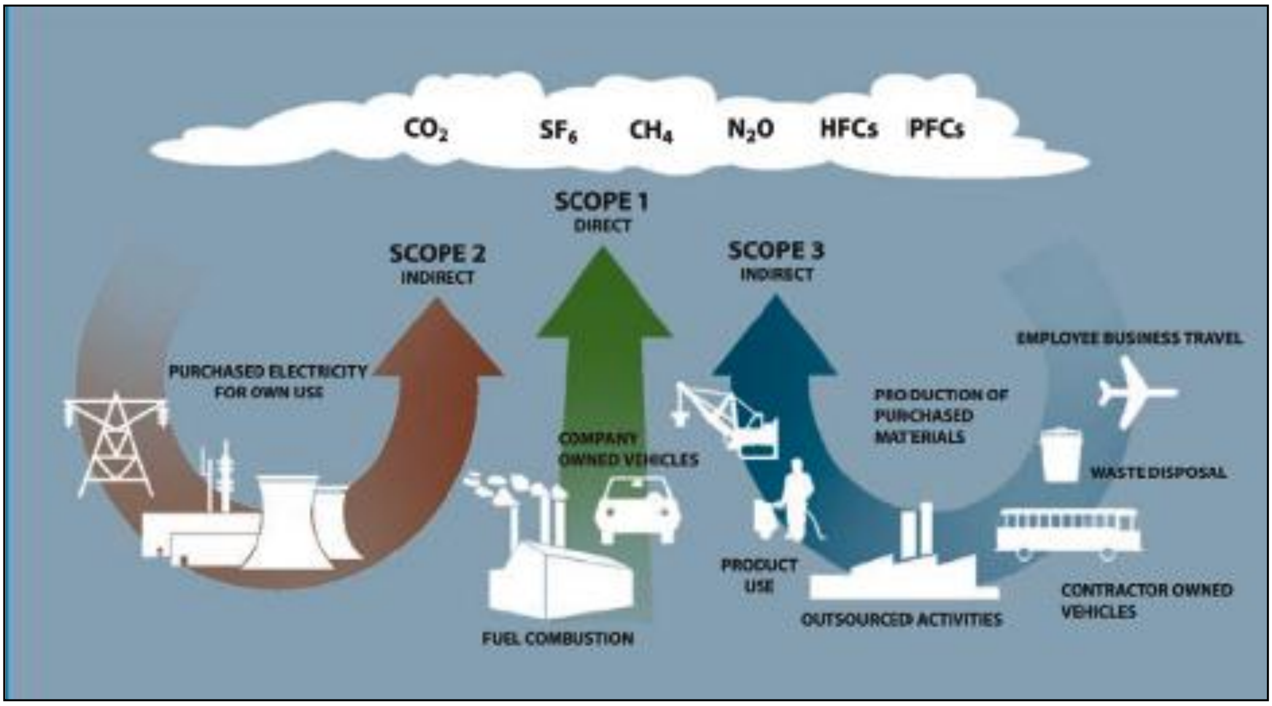
Greenhouse gas emissions (GHG) may become the most significant regulation on the feedlot industry to date if proposed plans to include agriculture within Australia's greenhouse gas regulation framework proceed as planned.

GHG emissions are subject to several levels of reporting and regulation in Australia. At the national level, Australia is obliged to report findings from an inventory of greenhouse gas emissions (the National Greenhouse Gas Inventory - NGGI) under the Kyoto Protocol, an agreement made under the United Nations Framework Convention on Climate Change (UNFCCC).

At the company level, new regulations introduced in 2008 require reporting of scope 1 and scope 2 greenhouse gasses (see Figure 50) for enterprises that emit greater than 25 kt of CO_2-equivalents at a single facility, or greater than 125 kt CO_2-equivalents for a corporation (DCC 2008 – Figure). This does not yet include emissions from agricultural sources (such as CH_4), however agricultural companies that exceed the threshold levels based on CO_2 emissions from energy consumption must report emissions in line with the regulation. These reporting thresholds will be progressively reduced over the next 3 years (DCC 2008 – Figure 51).

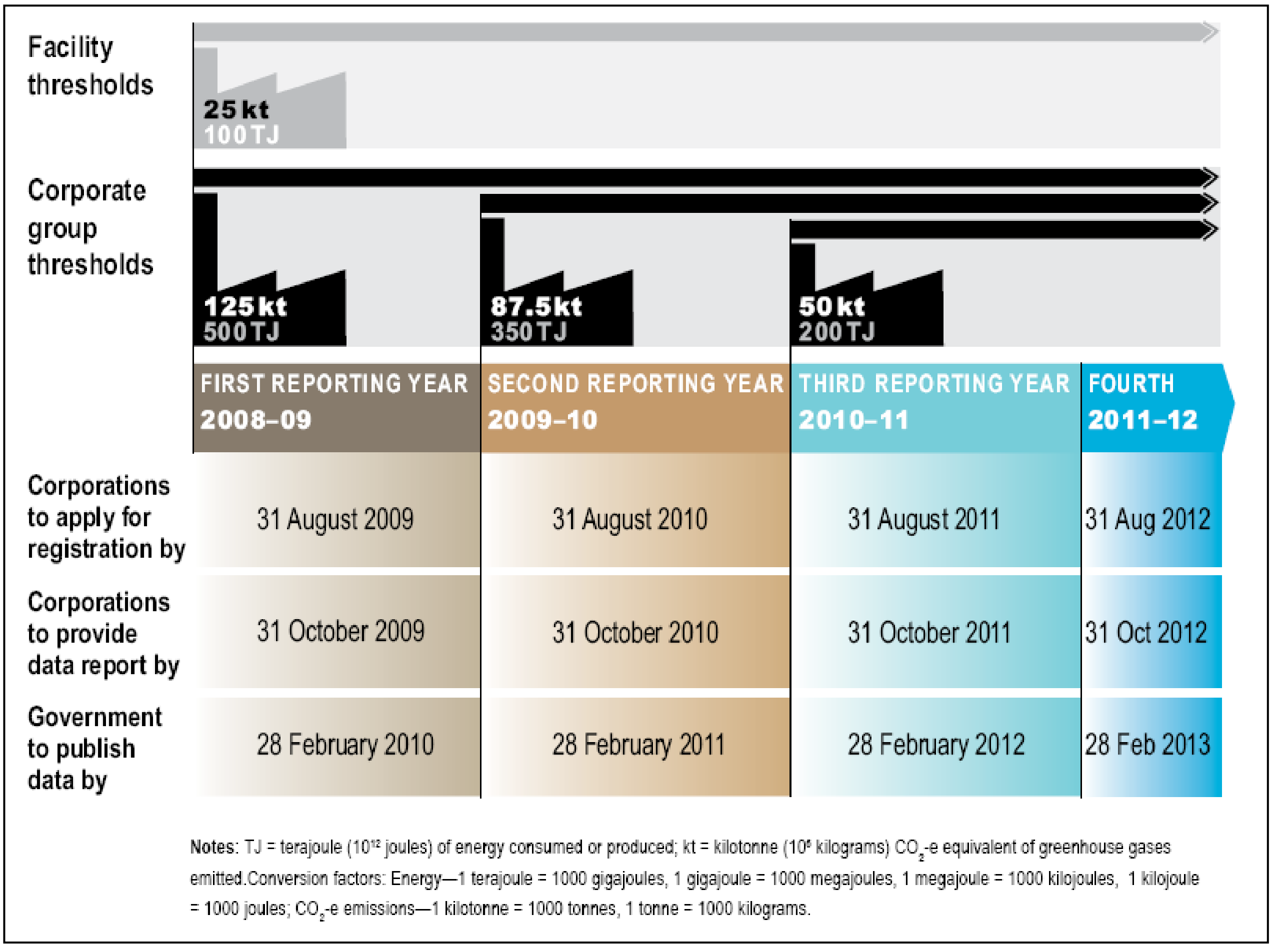
Scope 1 emissions are those directly caused by the enterprise (e.g. CO_2 from diesel consumption at a feedlot). Scope 2 emissions are indirect emissions due to energy usage (e.g. CO_2 from coal burning to generate electricity which is used on-site). In this case, the emission is caused by the usage of electricity but does not occur on-site. Scope 3 emissions are indirect emissions due to the other off-site activities – e.g. air travel. Air travel may be an essential component of operating the enterprise but the emissions do not occur on-site.

Figure 50 demonstrates the differences between Scope 1, Scope 2 and Scope 3 emissions.



Source: (DCC 2008)

Figure 50 - Examples of Scope 1, Scope 2 and Scope 3 emissions



Source: (DCC 2008)

Figure 51 - National greenhouse and energy reporting thresholds for facilities and corporations

Based on the research done to date (Davis & Watts 2006), if agricultural emissions (e.g. CH_4, N_2O) are included in the reporting threshold, larger feedlots (>20,000 head) would be required to report immediately under the aforementioned regulations.

With respect to the regulatory and economic implications of greenhouse gas emissions, the Australian Government is establishing a Carbon Pollution Reduction Scheme as part of an effective framework for meeting the climate change challenge. This scheme will put a price on carbon in a systematic way throughout the economy through an Emissions Trading Scheme (ETS). The scheme will employ a 'cap and trade' emissions trading mechanism to limit carbon pollution.

The ETS will include all greenhouse gases included under the Kyoto Protocol carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), hydrofluorocarbons (HFC's), perfluorocarbons (PFC's) with some distinctions made for highly exposed industries.

Emissions from stationary energy, transport, industrial processes, waste, and fugitive emissions from oil and gas production will be covered from the start of the scheme. The Government does not consider that it is practical to include agricultural emissions in the scheme at commencement. However, given the importance of broad coverage, the Government is disposed to include agriculture in the scheme no earlier than 2015. A final decision on coverage of agriculture emissions will be made in 2013.

The Government will undertake a work program in the lead up to this decision commencing in 2009 to identify cost effective methods for inclusion, and research to improve emissions estimation and development of emissions reporting capabilities (Department of Climate Change 2008).

The feedlot industry will need to be proactive on a number of elements in particular emissions estimation and development of emission reporting capabilities as the cost/value of emissions from feedlots may be considerable (Figure 52).

Total GHG emission estimated at 6 kg CO_2-eq per kg HSCW gain (Davis & Watts 2006).

Assumptions – 90% occupancy, 2.5 times turn-over per year. Cattle in – 300 kg, 90 DOF, 1.7 kg / head ADG, Cattle out – 450 kg

Annual Turnoff	= 22,500 head (150 kg LWT gain, 84 kg HSCW gain/head)
Annual HSCW gain	= 1.9 million kg HSCW / year

= 11,400 t CO_2-eq. emitted per year.

At $40/t CO_2-eq this equates to $456,000/yr.

Figure 52 - GHG emission value for a 10,000 head feedlot

There is expected to be a significant incentive for the feedlot industry to reduce GHG production where possible. This will require sufficient research to quantify production of GHG's from various sources at the feedlot in order to give the industry confidence to change practices.

7 Economic, environmental and social benefits of expansion of the feedlot industry in Australia

7.1 Introduction

This section evaluates the economic impact of the estimated feedlot industry expansion modelling previously described. The analysis examines the projected feedlot expansion capital expenditures, increased pen capacities and throughputs, feedlot input use and labour requirements using the same methodology that was used to determine the regional impact of feedlot industry development MLA Project FLOT.404. The analysis estimates the value of the suggested feedlot industry expansion scenario at the feedlot gate across the analysis time frames to 2021 and on a per state basis.

7.2 Quantifiable economic impacts

In measuring the economic impact of a feedlot development at local, regional, state and national levels consideration is given to their several dimensions, namely:

- **The impact of feedlot establishment (or expansion):** While the principal focus is on the on-going feedlot operation, mention is made of the impact of initial construction and establishment of a feedlot.
- **The direct impacts of feedlot operations:** The on-going operation of the feedlot creates economic activity measured by the dimensions of the enterprise e.g. employment, turnover and value added.
- **The indirect impacts of feedlot operations:** The on-going operation of the feedlot creates demands for goods and services from other firms, which in turn generate similar demand for more labour and more goods and services. Collectively these are known as flow-on or multiplier effects and can be estimated with the aid of input-output analysis.

7.3 The impact of establishment or expansion of representative feedlots

The establishment of a fully equipped commercial feedlot currently costs in the range $1,150-$1,500/SCU. For a 30,000 SCU capacity feedlot this involves an investment of around $35.0m[5]. Investigations indicate approximately 33 per cent of the investment would be spent locally, a further 20 per cent within the broader regional economy, a further 38 per cent within the state economy and a further 9 per cent within the national economy.

Estimates of the impact of the establishment of a 5,000, 15,000 and 30,000 SCU capacity feedlot at the local, regional, state and national levels are presented in Tables 36 to 38 respectively.

For a 30,000 SCU capacity feedlot establishment, a two-year period of construction would create around 25 jobs in the local economy and upward of 60 jobs in the regional economy on average in each year. Even greater impacts would be felt at the state and national levels.

The timing of the construction processes will influence the number of jobs, their duration and the economic impact. If the feedlot is constructed to final capacity in the first instance, there will be a large economic impact felt over a short period of time (possibly less than two years). Typically, however, feedlots are developed in stages and the impacts in a given year would be smaller than those indicated in Tables 36 to 38 but continuing over a number of years.

5 Excluding investment in fully-imported equipment.

Table 36 - Impacts of construction of a 5,000 SCU capacity feedlot

	Expenditure ($m)	Employment (av jobs/an) [a]
Local	2.4	5
Regional	3.6	12
State	6.5	21
National	7.2	25

[a] Two year construction period.

Table 37 - Impacts of construction of a 15,000 SCU capacity feedlot

	Expenditure ($m)	Employment (av jobs/an) [a]
Local	6.8	14
Regional	10.3	33
State	18.4	59
National	20.5	69

[a] Two year construction period.

Table 38 - Impacts of construction of a 30,000 SCU capacity feedlot

	Expenditure ($m)	Employment (av jobs/an) [a]
Local	12.2	25
Regional	19.4	63
State	32.8	105
National	36.6	124

[a] Two year construction period.

7.4 The direct impacts of representative feedlot operations

The on-going operation of a feedlot creates direct and indirect economic activity. The direct economic impacts can be measured by the dimensions of the enterprise itself (e.g. employment, turnover, household income and value added) and are presented in Table 39 for the three representative feedlots (5,000, 15,000 and 30,000 SCU capacity).

In a 30,000 SCU capacity feedlot, for example, annual sales turnover ($109.2m[6]) is calculated on the basis that some 90,000 cattle are turned off annually.

Table 39 - Direct economic impacts of the representative feedlots

Measure	5,000 (SCU)	15,000 (SCU)	30,000 (SCU)
Turnover [a] ($m)	19.9	57.5	109.2
Household income ($m)	0.3	0.8	1.5
Value added ($m)	91.4	3.7	5.9
Value added/SCU ($)	281	243	196
Employment [b] (no. of jobs)			
Full-time	9	19	35
Part-time	1	2	3
Total full-time equivalent	9	20	36

a Turnover includes sales of manure.
b Estimates of employment have been rounded to the nearest job.

In a 30,000 SCU capacity feedlot, the *value added* from the on-going operation of the feedlot over a 12 month period is estimated to be $5.9m, comprising the difference between the value of output and the cost of cattle, feedstuffs, and other goods and services used in the production of that output. As such it is a measure of the value generated by the labour and capital employed by the firm. The value added of $5.9m includes wage and salary payments of $1.5m, with the remaining $4.4m being comprised of interest payments, depreciation, taxes, and net profit to the feedlot. On a per SCU basis, the direct contribution of the feedlot to the regional economy is estimated to be approximately $196/SCU annually.

Value added is consistent with standard measures of economic activity, such as gross domestic product and gross state product, and it provides an assessment of the net contribution to regional economic growth of a particular enterprise or activity.

6 Including sales of manure.

The *work force* in a feedlot is typically comprised of full-time and part-time employees. A 30,000 SCU capacity feedlot is conservatively estimated to require approximately 36 equivalent full-time employees of which the vast majority would be full-time positions. The work force includes management, administration, office staff, stockmen, plant operators and maintenance personnel.

Household income comprises the wages and salaries earned by feedlot employees and include the drawings of an owner operator. Given the skills and experience required, the representative feedlot work force of around 36 full-time employees earns approximately $1.5 million per annum.

7.5 The total (direct plus indirect) impacts of representative feedlot operations

The operation of a feedlot creates demands for goods and services from other firms typically categorised as either *production* or *consumption* related demands.

- Among the **production** related demands, the most important are for cattle and the various feedstuffs. Also significant are demands for inputs such as transport services, energy (electricity, fuel, etc.), financial and business services (accounting, legal, etc.), animal health products and services, repair and maintenance services, and materials such as concrete and steel for on-going repairs and facility upgrading.
- The **consumption** related demands comprise those arising from the expenditure by feedlot employees and of those in related industries (transport, energy, building, financial and business services, repairs and maintenance, etc.). These people spend their incomes on groceries, household services (electricity, telephone, water, gas, council rates) travel, entertainment, household goods, etc., generating extra business for local firms and organisations supplying these goods and services.

These demands (both production and consumption related), in turn, generate demand for more labour, more goods and services with subsequent flow-on effects. Collectively, the aggregate impact of these demands is known as the flow-on or multiplier effect and can be estimated with the aid of input-output analysis, in terms of key economic parameters such as value added and employment.

Input-output tables have been used for a Local Government Area (the local economy), Statistical Division (regional economy)[7] and state and national economies to estimate the indirect impact of feedlot operations.

The compiled input-output tables include a separate sector to represent the operations of the representative feedlots. The data required to specify the separate feedlot sector (details on purchasing patterns of goods and services, and sales patterns of feedlot products) were collected from the co-operating case study feedlots. With the separate feedlot sector specified in the tables, the impact of the feedlot activity was estimated by applying the usual input-output modelling procedures.

The direct and indirect (or flow-on) impacts of the operation of a feedlot and the value added and employment multipliers for each of the economic parameters determined for the representative feedlots are detailed below (Tables 40 - 42).

[7] These tables are considered to be representative of the structure of local and regional economies in the lot feeding areas of eastern Australia.

Table 40 - Value added impacts of a 5,000 SCU capacity feedlot ($m)

Measure	Direct effects	Flow-on effects	Total impact
Local	1.4	0.5	1.9
Regional	1.4	1.0	2.4
State	1.4	2.4	3.8
National	1.4	2.8	4.2

Table 41 - Employment impacts of a 5,000 SCU capacity feedlot [a]

Measure	Direct effects	Flow-on effects	Total impact
Local	8	4	12
Regional	8	12	20
State	9	22	31
National	9	26	35

[a] Number of jobs (full-time equivalent).

Table 42 - Multipliers for a 5,000 SCU capacity feedlot

Measure	Value Added	Employment
Local	1.3	1.5
Regional	1.7	2.5
State	2.7	3.4
National	3.0	3.9

Although the interpretation of the multipliers is straightforward, care is required in their application. For example, the **regional** economy value added multiplier of 1.7 (Table 42) indicates that for each $1 of value added in the feedlot operation, there is an extra $0.70 of value added created in other sectors of the regional economy. That is, given that the direct value added for the representative 5,000 SCU capacity feedlot is estimated to approximate $1.4 million (Table 40), the feedlot operation is estimated to create a further $1.0 million of value added elsewhere in the **regional** economy.

Similarly, the **regional** economy employment multiplier of 2.5 (Table 42) indicates that for each person employed in the 5000 SCU feedlot operation, 1.5 jobs are created in other sectors of the **regional** economy. Given that there are 8 full-time equivalent jobs in the representative feedlot, this infers an additional 12 jobs (Table 41) are generated in other sectors of the **regional** economy.

Care is needed in the use of these multipliers, **as they are, strictly speaking, ratios not indicators of direct causation**. For example, employment in the feedlot itself does not generate additional employment, rather it is the *demand* for the products produced by the feedlot that ultimately generates employment in other sectors of the economy.

Whilst, for example, it may be that a labour intensive (but less efficient) feedlot will employ more than 8 people and generate more flow-on jobs in the local economy than estimated here (Table 41), as long as the market is competitive, it will be difficult for this less efficient producer to survive in the medium- to long-term and so the relatively high employment impacts of such an enterprise will be short lived.

Similar interpretation of the value added and employment impacts and the associated multipliers can be applied to the representative 15,000 SCU capacity feedlot (Tables 43 to 45) and the 30,000 SCU capacity feedlot (Tables 46 to 48).

Table 43 - Value added impacts of a 15,000 SCU capacity feedlot ($m)

Measure	Direct effects	Flow-on effects	Total impact
Local	3.6	1.5	5.1
Regional	3.6	3.1	6.7
State	3.6	7.0	10.6
National	3.7	8.2	11.9

Table 44 - Employment impacts of a 15,000 SCU capacity feedlot [a]

Measure	Direct effects	Flow-on effects	Total impact
Local	20	13	33
Regional	20	35	55
State	20	65	85
National	20	77	97

[a] Number of jobs (full-time equivalent).

Table 45 - Multipliers for a 15,000 SCU capacity feedlot

Measure	Value added	Employment
Local	1.4	1.6
Regional	1.9	2.7
State	2.9	4.3
National	3.3	4.8

Table 46 - Value added impacts of a 30,000 SCU capacity feedlot ($m)

Measure	Direct effects	Flow-on effects	Total impact
Local	5.9	3.2	9.0
Regional	5.9	6.6	12.4
State	5.9	14.2	20.1
National	5.9	16.2	22.1

Table 47 - Employment impacts of a 30,000 SCU capacity feedlot [a]

Measure	Direct effects	Flow-on effects	Total impact
Local	35	25	60
Regional	35	71	106
State	36	130	166
National	36	151	187

[a] Number of jobs (full-time equivalent).

Table 48 - Multipliers for a 30,000 SCU capacity feedlot

Measure	Value Added	Employment
Local	1.5	1.7
Regional	2.1	3.0
State	3.4	4.6
National	3.7	5.2

The input-output model can be used to estimate the magnitude of indirect or flow-on effects of a particular activity, and also to identify the sectors of the economy where the flow-on effects will occur.

The sectoral distribution of the flow-on effects on the local, regional, state and national economies resulting from activities based on the operation of a feedlot are presented in Tables 49 and 50. The value added flow-on effects detailed by industry in Table 49 correspond to the aggregate flow-on effects shown in Table 46. Similarly, employment flow-on effects detailed in Table 50 correspond to the aggregate flow-on effects presented in Table 47.

It needs to be noted the absolute size of these flow-on impacts will depend on:

- the size of the feedlot operation; and
- the capacity of the economy to meet the feedlot operation's demands for goods and services. Generally, the larger the economy and more diverse its economic structure, the better it will be able to meet these demands and hence the greater the total impact of the feedlot operation.

The flow-on effects from the feedlot operation, at the local level, are concentrated in three sectors, namely agriculture, transport and trade. At the regional, state and national level, in addition to the flow-ons in these three sectors, the flow-on effects in the manufacturing and finance and business services sectors are also significant.

The impacts on the agriculture sector result from the demand for feedstuffs. The impacts on the transport sector result from the high demands for transport services, primarily in moving cattle and feedstuffs to and from the feedlot site.

Table 49 - Sectoral distribution of value added flow-on effects from a 30,000 SCU capacity feedlot

	Local		Regional		State		National	
	$m	%	$m	%	$m	%	$m	%
Agriculture	1.0	33%	1.8	27%	2.7	19%	4.3	26%
Mining	0.0	0%	0.0	0%	0.1	1%	0.3	2%
Manufacturing	0.2	8%	0.4	6%	1.8	12%	1.6	10%
Utilities	0.1	4%	0.2	4%	0.5	4%	0.5	3%
Building and const'n	0.1	3%	0.2	3%	0.3	2%	0.2	1%
Trade	0.6	17%	1.1	16%	2.0	14%	2.0	12%
Transport	0.6	19%	1.2	19%	2.0	14%	2.1	13%
Comm'n services	0.0	1%	0.2	2%	0.4	3%	0.4	3%
Finance and Bus Serv	0.2	8%	0.0	16%	3.4	24%	4.0	24%
Public admin	0.0	1%	1.2	0%	0.1	0%	0.1	1%
Community services	0.2	5%	0.3	5%	0.6	4%	0.4	3%
Entert. And rec.serv	0.1	2%	0.1	2%	0.3	2%	0.4	2%
Total flow-ons	**25**	**100%**	**6.6**	**100%**	**14.2**	**100%**	**155**	**100%**

Note: components may not sum to totals due to rounding.

Table 50 - Sectoral distribution of employment flow-on effects from a 30,000 SCU capacity feedlot

	Local		Regional		State		National	
	fte	%	fte	%	fte	%	fte	%
Agriculture	7	26%	25	5%	38	29%	54	35%
Mining	0	0%	0	0%	0	0%	1	0%
Manufacturing	2	8%	4	6%	13	10%	16	1%
Utilities	0	1%	1	1%	2	1%	2	1%
Building and const'n	1	2%	3	4%	4	3%	2	1%
Trade	7	26%	17	23%	28	21%	30	20%
Transport	4	15%	9	12%	12	9%	15	10%
Comm'n services	0	1%	1	2%	3	2%	3	2%
Finance and Bus Serv	2	7%	6	8%	19	14%	19	12%
Public admin	0	1%	0	0%	1	1%	2	1%
Community services	2	9%	4	6%	8	6%	6	4%
Entert. And rec.serv	1	3%	2	3%	4	5%	8	3%
Total flow-ons	**25**	**100%**	**71**	**100**	**130**	**100%**	**155**	**100%**

Note: components may not sum to totals due to rounding.
[a] Number of full-time equivalent jobs.

The impacts on the trade sector result from both production and consumption related expenditures. On the production side, the feedlot uses the services of firms in the trade sector for repairs and maintenance, purchasing fuel, and buying-in parts and materials. On the consumption side, many household transactions also involve the firms in the local trade sector, be it buying weekly items such as groceries, fruit and meat or more durable items such as clothing, household appliances and motor vehicles.

In making these determinations two important assumptions are made.

- First, the grain and cattle supplied to the feedlot would have been produced regardless of the existence of the feedlot. The estimated impacts, therefore, do not include the employment, value added and household income generated in producing the grain and cattle.
- Second, the other material inputs and services supplied to the feedlot (business and financial services, transport services, energy, etc.) were assumed to be new demands that would not have occurred without the presence of the feedlot. In the case of transport services, the net effect is not altogether clear. A general finding was that while not all the feedlot demand for commercial transport services would be "new", there would be a substantial increase in demand arising from:
  1. inputs (cattle and feedstuffs) that would not otherwise be brought in;
  2. inputs being transported further than they otherwise would be; and
  3. a substitution of commercial carriers (farm to feedlot) for farm provided transport (farm to silo/saleyards).

Note that: in calculating the impacts, the expenditure on transport of cattle and grain to the feedlot was **excluded** from the impact because these transport costs would have been incurred regardless of the destination of the cattle and grain. All other transport expenditures were included in the calculations.

The impacts on the manufacturing sector result, principally, from the demand for chemicals, veterinary supplies and materials for repairs and maintenance. The impacts on the finance and business services sector result from the demand for a range of services including, veterinary services, accounting and legal services, insurance, loans etc.

7.6 Impact of feedlot operations at the state and national levels

The information presented in the previous two sections on direct and indirect impacts for representative feedlots can be aggregated to give the *total* impact of feedlots at the state and national levels. The results are presented in Table 48 for direct effects at the national level and Tables 49 and 50 for direct and flow-on value added and employment effects at the state and national levels.

At the national level, feedlots in aggregate were estimated to directly generate approximately 1,450 fte jobs (Tables 51 and 53), over 80 per cent of which were in New South Wales and Queensland. Household expenditure by these employees and expenditure by feedlots on cattle, feedstuffs and transport services was estimated to generate a further 5,300 fte jobs in other sectors of the national economy (Tables 53) from turnover of $3,869m (Tables 51).

Total value added generated by feedlots nationally was estimated to be approximately $950m, $246m in direct value added and $705m in flow-on value added (Table 54). The major contributors to the total national value added impact were Queensland (50 per cent) and New South Wales (33 per cent).

In a previous study of feedlot industry economic impact for FY2002, the direct value added impact was estimated to be almost $190 million and the total impact just over $800m. The increase in economic impact reflects the growth in industry capacity that has occurred since that time.

Table 51 - Direct effects of feedlots at the national level (FY2006)

Investment	
Capital investment (replacement value) ($m)	1,169
Expenditure	
Cattle purchased ($m)	2,370
Feedstuff purchased (4m)	848
Expenditure on transport services	260
Aggregate wages& salaries ($m)	58
Environment compliance costs ($m)	3
Product Monitoring Costs ($m)	3
Local Government road maintenance costs ($m)	22
Sale	
Value of cattle at feedlot gate ($m)	3,869
Jobs	
Direct employment (no of jobs, fte)	1,451

Table 52 - Value added impacts of feedlots at the state and national levels ($m) (FY2006)

Measure	Direct effects	Flow-on effects	Total impact
New South Wales	81	149	230
Queensland	127	228	356
Victoria	16	30	46
South Australia	5	8	14
Western Australia	13	21	34
Northern Territory	2	3	5
Australia	246	705	951

Table 53 - Employment impacts of feedlots at the state and national levels (FY2006) [a]

Measure	Direct effects	Flow-on effects	Total impact
New South Wales	473	1,501	1,974
Queensland	749	2,292	3,041
Victoria	93	298	391
South Australia	32	84	116
Western Australia	76	209	285
Northern Territory	12	27	39
Australia	1,451	5,313	6,764

[a] Number of jobs (full-time equivalent).

7.7 Impact of projected growth

The information presented in the previous section demonstrated the total impact of feedlots at the state and national levels. Summary forecasts for feedlot capacity and numbers on feed are shown in Tables 54 and 55, respectively.

Table 54 - Projected feedlot pen capacity (SCU)

Region	2006	2011	2016	2021
Northern – Central Qld	124,223	250,000	375,000	500,000
Southern – Eastern Qld	468,401	530,000	600,000	700,000
Northern NSW	163,327	180,000	200,000	250,000
Southern NSW	202,159	225,000	250,000	275,000
Victoria/Tasmania	79,825	90,000	100,000	110,000
South Australia	29,535	40,000	60,000	60,000
Northern Territory	8,000	15,000	20,000	50,000
Southern WA	98,711	155,000	330,000	375,000
Northern WA	0	15,000	20,000	50,000
AUSTRALIA	**1,174,181**	**1,500,000**	**1,955,000**	**2,345,000**

Source: FSA Consulting

Table 55 - Projected number of cattle on feed (head)

Region	2006	2011	2016	2021
Northern – Central Qld	999,922	201,000	311,770	415,694
Southern – Eastern Qld	375,899	425,590	498,212	581,247
Northern NSW	132,241	145,800	167,518	188,458
Southern NSW	161,628	180,000	206,813	227,494
Victoria/Tasmania	63,133	71,190	81,794	89,974
South Australia	20,169	27,320	42,376	42,376
Northern Territory	6,400	12,000	16,545	41,363
Southern WA	47,076	73,935	162,772	184,968
Northern WA	0	12,000	16,545	41,363
AUSTRALIA	**906,468**	**1,148,835**	**1,504,345**	**1,812,936**

Source: FSA Consulting

The growth in feedlot activity required to generate this increased capacity and production will have a significant impact on the regional economies of Australia. The estimated impacts, measured in terms of employment and value added, are presented in Tables 53 to 58 for 2011, 2016 and 2021 and summarised in Figure 54 for value added and Figure 55 for employment.

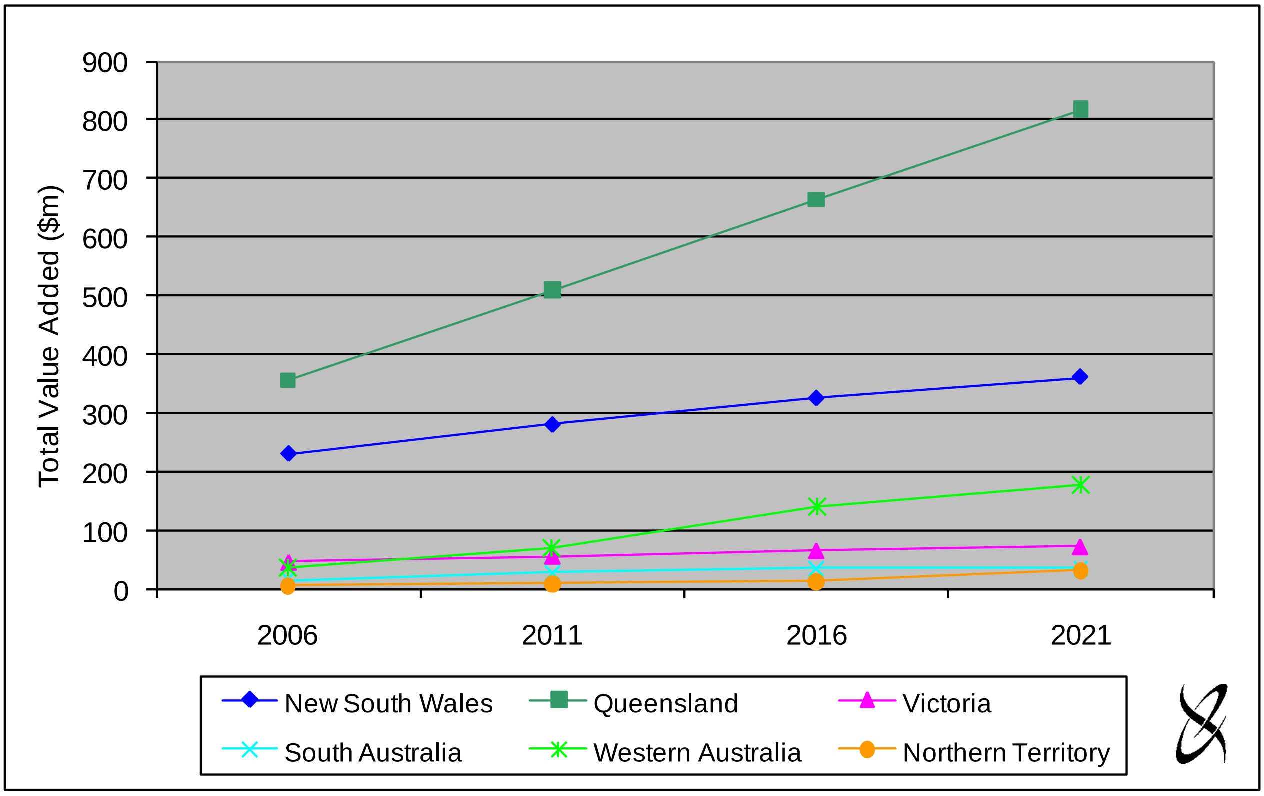


Figure 53 - Total value added impact of feedlots at the state level, 2006 to 2021

The estimated economic impacts have been made on the basis of:

- current employment to output ratios in the feedlot industry;
- labour productivity improvements of 1.0% per annum over the forecast period;
- total factor productivity of 1.5% per annum over the forecast period;
- current economic linkages expressed in the state and national input-output models.

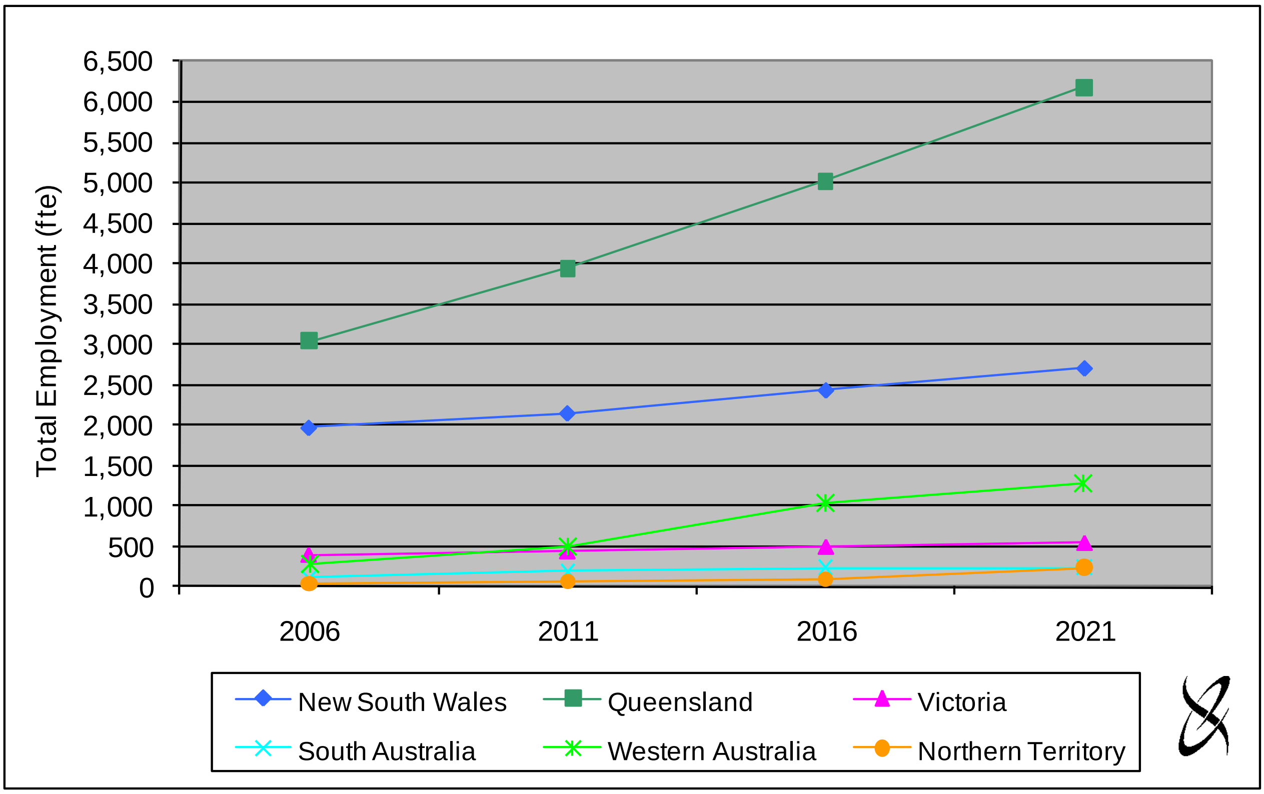


Figure 54 - Total employment impact of feedlots at the state level, 2006 to 2021

Total value added generated by feedlots nationally was forecast to increase from approximately $609m in 2006 (Table 52) to almost $1.4 billion in 2021 (Table 60). The 2021 forecast impact is comprised of over $500m in direct value added and almost $900m in flow-on value added. The major contributors to the total national value added impact in 2021 are expected to be Queensland (53 per cent) and New South Wales (25 per cent).

Table 56 - Value added impacts of feedlots at the state and national levels ($M) (FY2011)

Measure	Direct effects	Flow-on effects	Total impact
New South Wales	74	205	279
Queensland	130	379	509
Victoria	14	42	56
South Australia	10	17	27
Western Australia	20	47	67
Northern Territory	3	6	9
Australia	264	973	1,238

Table 57 - Employment impacts of feedlots at the state and national levels (FY2011) [a]

Measure	Direct effects	Flow-on effects	Total impact
New South Wales	524	1,629	2,153
Queensland	986	2,960	3,946
Victoria	104	330	434
South Australia	43	151	194
Western Australia	130	367	497
Northern Territory	22	47	69
Australia	1,853	6,189	8,042

[a] Number of jobs (full-time equivalent).

At the national level, direct employment in feedlots is forecast to increase from around 1,100 in 2006 (Table 53) to almost 2,200 in 2021 (Table 61). Aggregate employment (direct plus flow-on) is forecast to rise from around 5,000 to 9,200 over the same period (Tables 53 and 61).

Table 58 - Value added impacts of feedlots at the state and national levels ($M) (FY2016)

Measure	Direct effects	Flow-on effects	Total impact
New South Wales	101	223	324
Queensland	197	467	664
Victoria	18	46	65
South Australia	19	15	34
Western Australia	51	90	141
Northern Territory	4	8	12
Australia	433	1,121	1,554

Table 59 - Employment impacts of feedlots at the state and national levels (FY2016) [a]

Measure	Direct effects	Flow-on effects	Total impact
New South Wales	582	1,855	2,437
Queensland	1,232	3,790	5,022
Victoria	116	376	492
South Australia	65	170	235
Western Australia	268	761	1,029
Northern Territory	29	65	94
Australia	2,415	7,544	9,959

[a] Number of jobs (full-time equivalent).

Table 60 - Value added impacts of feedlots at the state and national levels ($M) (FY2021)

Measure	Direct effects	Flow-on effects	Total impact
New South Wales	112	248	360
Queensland	243	574	817
Victoria	20	51	71
South Australia	19	15	34
Western Australia	61	117	178
Northern Territory	10	20	30
Australia	507	1,272	1,779

Table 61 - Employment impacts of feedlots at the state and national levels (FY2021) [a]

Measure	Direct effects	Flow-on effects	Total impact
New South Wales	647	2,061	2,708
Queensland	1,516	4,665	6,181
Victoria	128	413	541
South Australia	65	170	235
Western Australia	326	952	1,278
Northern Territory	72	162	234
Australia	2,897	8,486	11,383

[a] Number of jobs (full-time equivalent).

7.8 The value of the estimated feedlot industry expansion to the Australian beef industry and Australian economy

Based on the assumptions used in this study and economic modelling described above, the estimates of feedlot industry expansion value at the feedlot gate will increase from $3.9 B in 2006 to approximately $7.4B in 2021 (Table 62). This estimate is probably conservative. If the feedlot industry realises the estimated expansion targets it value as an industry could possibly exceed the values quoted here.

Table 62 - Changes in estimated feedlot gate values of the industry 2006-2021($M)

	NSW	QLD	Vic	SA	WA	NT	Aust
2006	1,307	2,005	258	78	188	28	3,869
2011	1,408	2,570	283	101	333	49	4,744
2016	1,618	3,322	326	157	694	67	6,183
2021	1,797	4,089	358	157	879	167	7,448

8 The roadmap for change to bring the Australian lot feeding industry from its current position to an expanded industry in 2020

8.1 Expansion in current feedlot regions

Regions that currently have a significant density of feedlot operations (in order of current capacity) include southern and northern Queensland, northern and southern New South Wales, Victoria & Tasmania and southern Western Australia. All other regions produce less than 100,000 head from feedlots annually (2006) and will be discussed as ‘new’ regions.

Of the current feedlot regions, the three showing the most potential for increased production under the expansion predictions made by the Advisory Committee are northern Queensland, southern Queensland and southern Western Australia.

Beyond 2021, development of a feedlot industry may be possible in northern Western Australia and the Northern Territory as tropical grain production and abattoir capacity increases to satisfy any potential feedlot development activity. As a broad overview,

Table 63 gives qualitative positive and negative assessments of various attributes of each region with respect to increased feedlot capacity.

Table 63 - Feedlot expansion potential based on current feedlot activity, abattoir proximity, grain supply and infrastructure

Region No	Region	Current Feedlot Activity	Abattoir Proximity	Grain Supply	Infrastructure	Regulation and site availability
1	Southern WA	●●●	●	●●●●	●●	●●●
2	Northern WA	✗✗✗	✗✗✗	✗✗✗	✗✗	●●●●
3	Northern Territory	✗✗✗	✗✗✗	✗✗✗	✗✗	●●●●
4	South Australia	●	●●●	●●●	●●	●●
5	North Queensland	●	●●●	●	●	●●●●
6	Southern Queensland	●●●	●●●	●●	●●●	●●
7	Northern NSW	●●●	●●●	●●●	●●●	●●●
8	Southern NSW	●●●	●●●	●●●	●●●	●●●
9	Victoria and Tasmania	●	●●	●●●	●●	●

● = positive attribute, ✗ = negative attribute

The remainder of this chapter explores the drivers for change and likely impediments to achievement of estimated feedlot expansion in the various target regions across Australia.

8.1.1 Southern Queensland

Feedlot expansion in Queensland has been an industry trend over the past 10 years, with expansion in both the traditional eastern and western Darling Downs region (southern Queensland) and more recently in central Queensland (northern Queensland region). There are several factors driving expansion in southern Queensland that would enable further growth.

Southern Queensland forms part of a traditional cattle supply pathway which flows from the Northern Territory and northern Queensland cattle breeding regions through to the Channel Country, central Queensland and the Darling Downs where cattle are finished for slaughter and sold or exported from Brisbane.

Modelling shows that, as a percentage of the breeding herd located in the region, grain-fed cattle are the highest proportion of marketed cattle, well beyond the Australian average of 32% of total slaughtering. This reflects the large number of cattle brought into the region from the north.

The traditional supply chain flow of cattle and the availability of grain is a primary driver for the current level of feedlot development in the region. Modelling shows that by 2021, as a percentage of the breeding herd located in the region, grain-fed cattle will be about 152% of the nominal annual slaughter percentage. Currently the proportion of cattle slaughtered compared to the breeding herd is 98%, highlighting the significant slaughter capacity located in the region which draws cattle from all over the country. These cattle are predominantly drawn from northern Queensland and northern New South Wales, with cattle also moving from the Northern Territory and southern New South Wales in smaller quantities. This region also includes many livestock selling centres including Dalby and Roma, which is the largest cattle selling centre in Australia (see Figure 55).)

Continued development of feedlots in the region will demand the flow of greater numbers of cattle from Northern Territory, northern Queensland and northern New South Wales. With strong trade networks, this supply is expected to continue under the influence of other driving factors such as the presence of an established feedlot industry in the region and abattoir and port infrastructure.

The eastern and western Darling Downs are traditional grain growing areas for both summer (sorghum) and winter (primarily wheat) crops. Total grain production in 2006 was close to 2.1 Mt which was lower than average. The region is also able to import grain from northern New South Wales. In 2006, estimated grain consumption by the feedlot industry was 1,089,000 tonnes, or approximately half of local production. The feedlot industry also competes with dairy, pigs, poultry and biofuel for grain supplies in the region, which can, at times, limit supply at current feedlot numbers, especially in drought years.

Expansion of the industry in southern Queensland would result in grain demand rising to 1,684,000 t by 2021. This is likely to stretch supplies significantly, particularly in drought years or if there is significant competition for grain supply from new or emerging industries such as biofuel. In reality, grain supply is likely to limit the expansion of feedlots in the region or draw development closer to grain supply. This would promote development close to the New South Wales *border* (Figure 55) *or close* to the Queensland border in the northern New South Wales slopes and plains region (Figure 55). Development on the Queensland side of the border may be favoured because of preferred regulation systems with respect to development/environmental controls and cattle transport (volume vs. mass loading of cattle trucks). Expansion in the northern Queensland region may also be preferred where developers find lower population and sites north of the tick line.

Feedlots are located on properties that vary in size, management regimes and enterprise mixes. A qualitative assessment of the region suggests adequate sites are available to accommodate industry expansion, particularly in the New South Wales border and western Downs regions. Regulatory criteria may limit the availability of feedlot sites in eastern parts of the region, particularly with relation to community amenity (odour) issues and availability of high security water.

Expansion of the feedlot industry in southern Queensland will most likely be on the western Downs (Meandarra / St George / Roma) and along the New South Wales border areas of the region (Dumaresq, Goondiwindi, North Star – Figure 55). This will be primarily driven by availability of sparsely populated areas suitable for large feedlot developments; better availability of bulk feed grain and high reliability water available from existing irrigation licences. The aforementioned advantages of development in Queensland rather than New South Wales may also promote this.

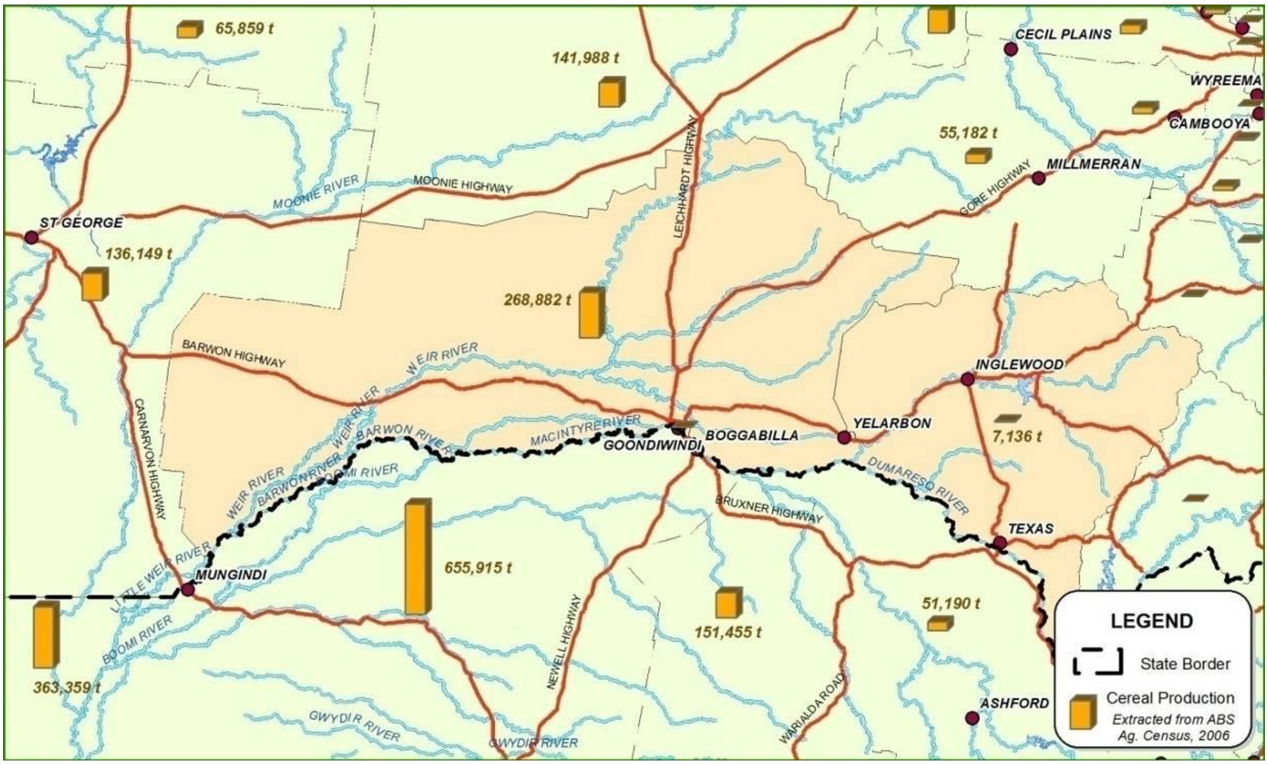


Figure 55 - Southern Queensland focus region – New South Wales border

Infrastructure to facilitate cattle movement and processing is well developed with a comprehensive road network and a number of processing plants currently servicing the region. This is a key opportunity that will facilitate further development.

Regarding water availability, the south-west of southern Queensland is part of the Murray-Darling Basin (MDB) which is considered highly stressed. A 1995 audit of the MDB showed that if the volume of water diversions continued to increase, this would exacerbate river health problems, reduce the security of water supply for existing irrigators in the Basin, and reduce the reliability of water supply during long droughts. Therefore, a Ministerial Council Cap was placed on the MDB to restrain further increase in water diversions. However the cap does not constrain new developments provided the water for them is obtained by using water more efficiently or by purchasing existing water entitlements. Southern Queensland includes the Border Rivers, Condamine-Balonne, Paroo and Warrego water management areas. The final cap in these areas will be finalised within the next 12 months.

These areas have a well developed water resource and resource operations plans compared with other water management areas in Queensland such as the Fitzroy.

The Border Rivers and Condamine-Balonne catchments are the areas which are most likely to be targeted for feedlot development. Therefore, the opportunity for allocation of new surface or underground water in this region is limited. However a number of options are available including trading (existing irrigation licences) and new water such as coal seam gas water.

Debate is ongoing regarding the use of coal seam gas water as a resource due to inherent high salt concentrations which pose additional risks, particularly with respect to land application. Typically, the salt concentration from extracted water is too high for cattle drinking water requirements without prior treatment by reverse osmosis (RO) or other means. Treatment methods (such as RO) are becoming more widespread and may be feasible to supply feedlot water. Recent announcements by the State Government indicate that treatment and sale of coal seam gas water (rather than evaporation) will become mandatory.

The expansion of mining operations poses challenges and potential benefits to development in the region. Mines are in open competition for labour and land resources, but may also offer benefits from water and energy supply. For example, coal seam gas developments may provide a ready supply of low cost energy (gas) to run feedlot boilers. There currently exists one example of this partnership on the western Downs.

Other constraints to development in the region include:

1. Labour shortages: The expansion of the feedlot industry will be challenged by shortages in skilled and unskilled labour to which the industry is currently adjusting. This labour supply deficit situation is expected to remain in the medium to long term due to the competition offered by the rapid expansion of coal seam gas and coal developments on the western Downs. The industry may be able to overcome this by recruiting foreign workers under the Section 457 visa immigration ruling, which has been done with success in the local pork industry.
2. Regulations imposed by local council planning schemes on the eastern Darling Downs and the legal appeal process: This is likely to restrict new developments and expansions in effected regions.

8.1.2 North Queensland

The majority of existing feedlots in the north Queensland region are scattered on the central highlands around Emerald. There is only one large feedlot greater than 10,000 head in this region (Australian Agricultural Companies' Goonoo Feedlot) although a large feedlot is under development west of Townsville. More recently, the Fitzroy river catchment has been targeted for development of intensive livestock production. The development of the Feedlot industry in this region has been mostly due to the availability of land and water. In particular, availability of cropping land and land suitable for backgrounding cattle from breeder blocks prior to finishing in the feedlot is an opportunity within this catchment.

The modelling shows that, as a percentage of the breeding herd located in the region, grain-fed cattle currently comprise about 12% of total slaughtering; significantly lower than the Australian average of 32%. This reflects the large breeding herd, backgrounding capacity and "export" of feeder cattle to southern Queensland for feeding. Expansion of lot feeding in the region would reduce the distance cattle are transported for finishing and boost local economies in northern regions of the state.

Central Queensland is a grain growing area for both summer (sorghum) and winter (primarily wheat) crops. Total grain production in 2006 was close to 480,000 t representing about a quarter of the production level of southern Queensland. In 2006, estimated grain consumption by the feedlot industry was 290,000 tonnes, or approximately 60 % of local production, making feedlots the predominant user of grain in the region. Expansion of the industry in northern Queensland would result in grain demand rising to 1,200,000 t by 2021. The requirement for feed grain would most likely significantly exceed production and grain imports would be required from southern regions or interstate. Considering the availability of suitable land for grain production in the region, it is likely that improved demand would lead to expansion of local grain production. Feeding of silage based rations in northern regions may also alleviate pressure on grain supplies.

Expansion of the feedlot industry in this area should not be limited by regulatory criteria such as amenity (odour) because of the low population and abundance of large properties. The northern areas of the region are constrained by climatic conditions (e.g. rainfall and to some extent heat stress – see Figure 56) and grain supply.

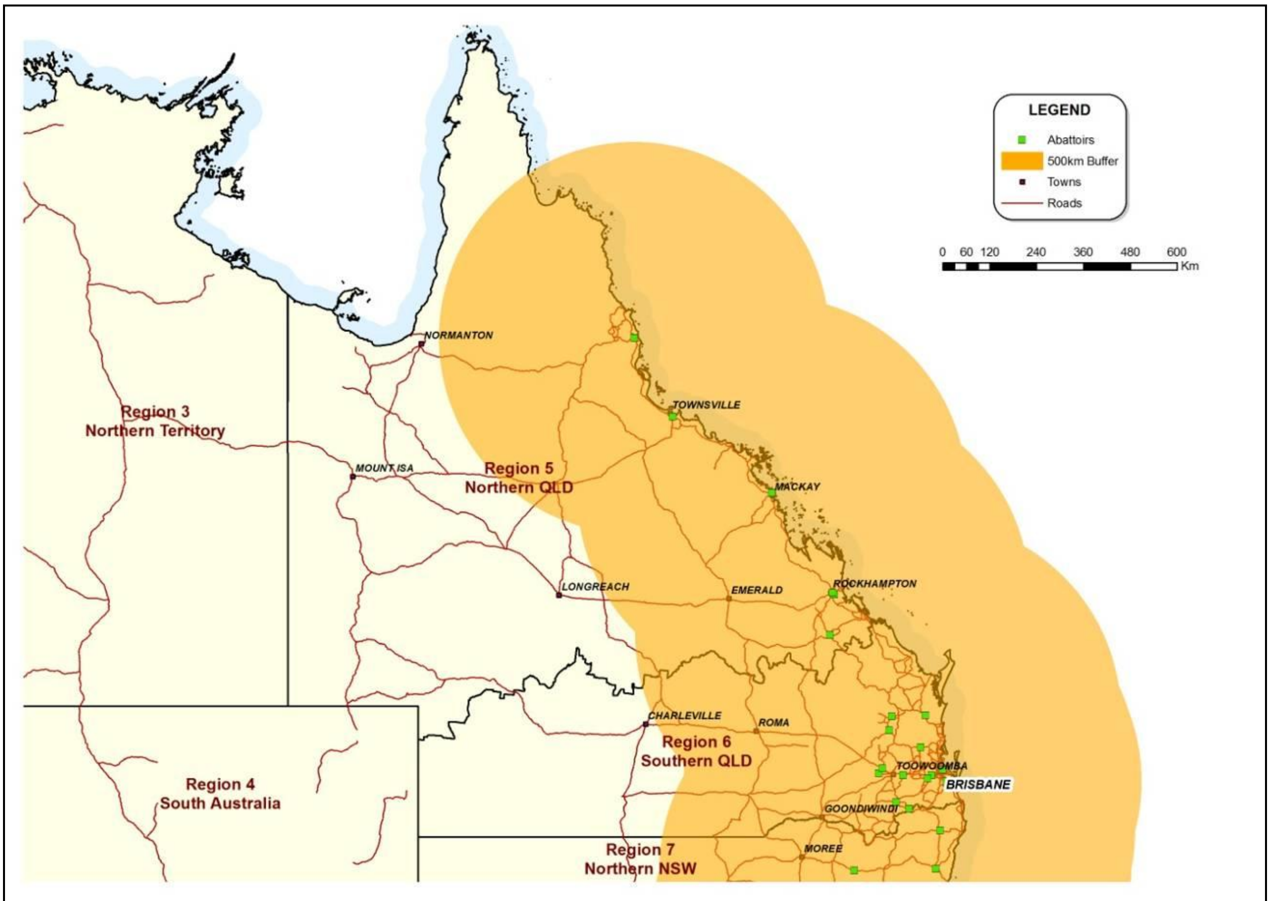


Figure 56 - Current abattoir locations and major road networks with 500 km radius zone in Queensland

North Queensland has highly developed artesian and sub-artesian groundwater management units. As such, groundwater extractions may exceed the sustainable yield and there is very little or no unallocated water available. In keeping with the National Water Initiative's aim to restore surface and groundwater systems to environmentally sustainable levels it will be very difficult for developments to gain new water from these systems. Hence, in many areas, water trading of water access entitlements will be the only option to guarantee a permanent share of the consumptive pool and hence the required high security water resources.

Water planning in north Queensland is governed by catchment-specific water and resource operation plans which have been developed to determine current and future water demands and allocation priorities. The catchments within this region are the Fitzroy, Burdekin, Gulf, Cooper Creek and Georgina and Diamantina. These catchments have finalised water resource and resource operations plans.

Water trading commenced in the Fitzroy catchment in 2006/2007. During that period there were fifty permanent transfers, representing about 2% of Queensland's permanent water trading. The average price paid per ML for high security water entitlements in the Fitzroy catchment was $1912.

Access to high-security water may cause a shift in focus from existing feedlot developments in Central Queensland to other areas where guaranteed allocations of groundwater and/or surface water can be achieved through trading (e.g. Fitzroy basin).

It is unlikely that water availability will limit future feedlot developments within north Queensland. However, each development will need to be considered on a site specific basis and consultation with the respective catchment authority to ascertain water supply resources will need to be a primary focus. Water will also represent a capital cost to development where trading is required to secure entitlements.

Infrastructure to facilitate cattle movement and processing is well developed with a comprehensive road network and a number of processing plants currently servicing the region as shown in Figure 57.

Figure shows the location of existing feedlots with 5000 head or greater capacity in Queensland and northern New South Wales relative to the tick line. Locating feedlots in north Queensland – north of the tick line - removes the expense of dipping cattle, which is a requirement for those feeding in southern Queensland feedlots in the tick area. This is one factor that favours expansion in this region and is considered a significant advantage to companies sourcing cattle from the north.

Other constraints to development in north Queensland include:

1. Expansion of the coal industry in the Bowen basin presents a potential limitation to feedlot expansion through competition for land and water and/or threat from acquisition of existing land where facilities may be located.
2. Staff shortages exist in this region due to mining which could significantly hamper development unless long term solutions for training and retaining staff are implemented by the industry. One option is to bring in workers under the Section 457 visa immigration ruling.

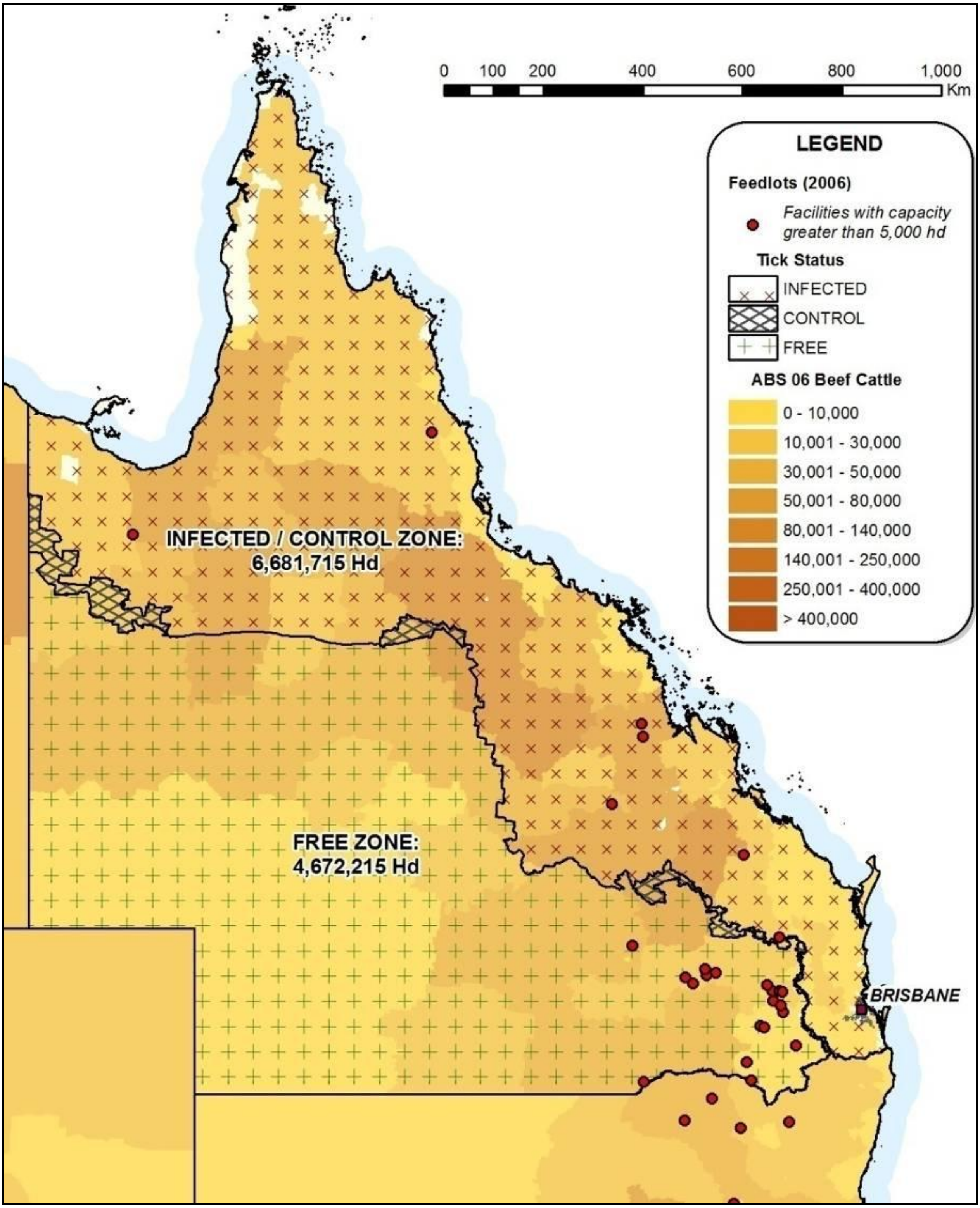


Figure 57 - Queensland cattle tick line with red dots indicating location of 5000+ SCU feedlots

8.1.3 Southern Western Australia

Compared to other States, the Western Australia lot feeding sector is relatively small. However there are several factors that could enable industry expansion in the region. Western Australia does not have any large feedlots (> 10,000) and 70% of lot feeding occurs in facilities of 1,000-10,000 head. About 35% of cattle in southern Western Australia are currently finished in feedlots.

The projected expansion in southern Western Australia would increase the grain-fed percentage of slaughter to above 150% by 2021 – an expansion of 430% in 13 years. This would require importation of cattle into the region for feeding, most likely from northern Western Australia and/or the Northern Territory. However, there will be strong competition for feeder cattle from the live export dominated northern industry.

In Western Australia, there is a trend to feed cattle predominantly through the summer, driven by cattle supply and climatic conditions, leaving pens empty through the winter months when slaughter cattle are sourced off grass and winter crop. This is in contrast to most other regions where occupancy remains relatively stable year round. Because of this, throughput could increase without increased pen capacity if winter feeding can be adopted. This approach could serve to provide more reliable year round supply for slaughter.

Cattle from northern breeding regions are currently transported via road. Road routes either follow the coastline, or come from Port Headland to Perth via the Pilbara. The second option may present some challenges for transportation of cattle (e.g. animal welfare). No rail infrastructure is in place. Current MLA research (B.FLT.0339) has shown that cattle are being sourced directly from up to 1200 km away from feedlots in southern Queensland. Considering the very large distances from northern to southern Western Australia, staged transport through backgrounding and grow out may be preferred and this is likely to develop if a strong market signal was in place. However, not all cattle from northern Western Australia would be suitable for finishing in southern feedlots so some change in northern breed type might be needed if these cattle were directed towards grain finishing in feedlots.

The ready availability of grain is a clear opportunity for the feedlot industry in Western Australia. Southern Western Australia is the largest grain producing area in Australia and provides ample supplies to meet all local requirements for feed grain. In 2006, this region produced some 12.1 Mt of grain, while demand from the feedlot industry is currently estimated at approximately 128,000 tonnes, rising to 501,000 tonnes in 2021.

Increased national demand for feed grain could provide a competitive advantage to Western Australia lot feeders compared to regions where grain must be imported at a substantial cost. Southern Western Australia is a traditional winter grain growing area with crops of wheat, barley, oats, lupins and canola grown from Northampton to Esperance. This area also accumulates a vast amount of roughage each year in the form of crop stubbles. Significant amounts of hay are produced throughout the wheat belt and high-quality silage can be viably produced in the south-west and west-coast. There are also opportunities to further enhance feed supplies through the development of high yielding grains and legumes specifically for the local fodder market.

The beef-processing sector in southern Western Australia has seen substantial restructuring over the past decades to the point where there is now only one relatively large export abattoir (Harvey Beef) whose capacity is about 1.5% of national kill, well below that of major operators in the eastern states. However, a new large abattoir has been approved for construction near Cataby about 150 km north of Perth, and if construction goes ahead on this development new opportunities for feedlot expansion may occur. The beef-processing sector in southern Western Australia is dependent on favourable seasons. Lot feeding could be one solution to minimise reliance on seasonal supply and bring forward suitable livestock to accommodate processing capacity. However to date this has not lead to significant expansion of processing capacity and this is still a limitation to the industry.

Project modelling shows that by 2021, about 9,000 ML of high-security water will be required to meet feedlot expansion in Western Australia. In southern Western Australia, the estimated total sustainable yield of groundwater in the Perth and Yilgarn-Southwest groundwater management units is in the order of 2,011 GL/yr (Australian Natural Resources Atlas 2008). The current total groundwater use in these areas is estimated as 769 GL/yr. About 35% of current groundwater use is for irrigation (approximately 260 GL/yr) with a dominant proportion (>90%) of that irrigation usage being on the Perth coastal plain. Most groundwater management units are in the category 1 level of utilisation reflecting a generally low level of allocation stress.

The ready availability of high security water, along with other favourable factors, is an opportunity for feedlot development north of Perth. Other factors include the availability of feed grain and lower priced land compared to the south-west. Expansion in this region would reduce livestock cartage distances from northern Western Australia and will also reduce grain cartage costs that are normally more than double the cost of carting cattle. Expansion to the north minimises the winter rainfall issues with feedlots in the SW corner.

Ongoing constraints to development in this region include:

1. Labour supply: In Western Australia this is likely to constrain feedlot development because of the strong demand for skilled and unskilled labour by mining. This constraint must be addressed by the industry in order to access and maintain staff. One option to overcome this constraint may come through accessing workers under the Section 457 visa immigration ruling.
2. Site suitability – soils: A constraint to feedlot construction in many parts of the state is the suitability of soil types for construction of compacted feedlot pads. Because of the predominant sandy loam soil, the risk of nutrient leaching can be significant. Several feedlots located in the region have experienced pressure from environmental regulators because of this issue, and it is clear that a cost effective solution is required to allow expansion to occur economically.

8.1.4 Northern New South Wales

Feedlot expansion in New South Wales has been an industry trend over the past 10 years. The majority of this expansion has been via expansion of current feedlots. Modelled expansion for the region, based on estimates provided by the steering committee, is 40% growth to 2021 though in reality this could be higher considering the constraints on grain supply in southern Queensland. There are several factors providing an opportunity for expansion in northern New South Wales that would enable further growth. The modelling shows that, as a percentage of the breeding herd located in the region, grain-fed cattle are about 29% of slaughtered cattle to date, less than the Australian average of 32% total slaughtering. This reflects the size and location of the New South Wales breeding herd which predominantly occupies the New England and North West Slopes regions and the strong local trade of grass-fed yearlings and bullocks.

The availability of cattle and feed grain is a driver for feedlot development in the region. Project modelling estimates that by 2021, as a percentage of the breeding herd located in the region, grain-fed cattle will comprise about 45% of the cattle slaughtered. Additional herd capacity in this region will continue to supply feeder cattle to southern New South Wales and southern Queensland.

Availability of grain is an opportunity for feedlot development in the region (Figure 58). Northern New South Wales is a traditional grain growing area for both summer (sorghum, corn) and winter (wheat, barley) crops. Total grain production in 2006 was close to 5.1 Mt and provides adequate supplies to meet local requirements for feed grain, though markets for this grain are well established (Sydney basin, Wollongong and the Darling Downs). In 2006, estimated grain consumption by the feedlot industry was 373,000 tonnes, about 7% of local production. Expanding the industry in northern New South Wales would result in grain demand rising to about 532,000 t by 2021.

Land availability for feedlot development is an opportunity in this region with many large properties and relatively sparse population in many parts of the region. Water security will be the key issue for an expanding feedlot industry in this area. Northern New South Wales is part of the Murray-Darling Basin (MDB) and as such the Ministerial Council Cap on the MDB restrains further increase in water diversions. However it does not constrain new developments provided the water for them is obtained by using water more efficiently or by purchasing water from existing developments.

While the opportunity for allocation of new water in this region is very limited (existing water resources in many of the irrigation areas are already over allocated), water trading may offer some solution to this problem. In particular, trading of water between Queensland and New South Wales may be an emerging opportunity. Each development will need to be considered on a site specific basis and consultation with the respective catchment authority to ascertain the required water supply resources will need to be a first priority.

Expansion of the feedlot industry in northern New South Wales will most likely be on the North-West slopes and along the New South Wales/Queensland border (e.g. Dumaresq, North Star, and Moree – Figure 58). Central western regions around Dubbo may also offer the opportunity for feedlot development. This will be primarily driven by availability of large properties and low population density, the ready availability of grain and high security water available from existing irrigation licences.

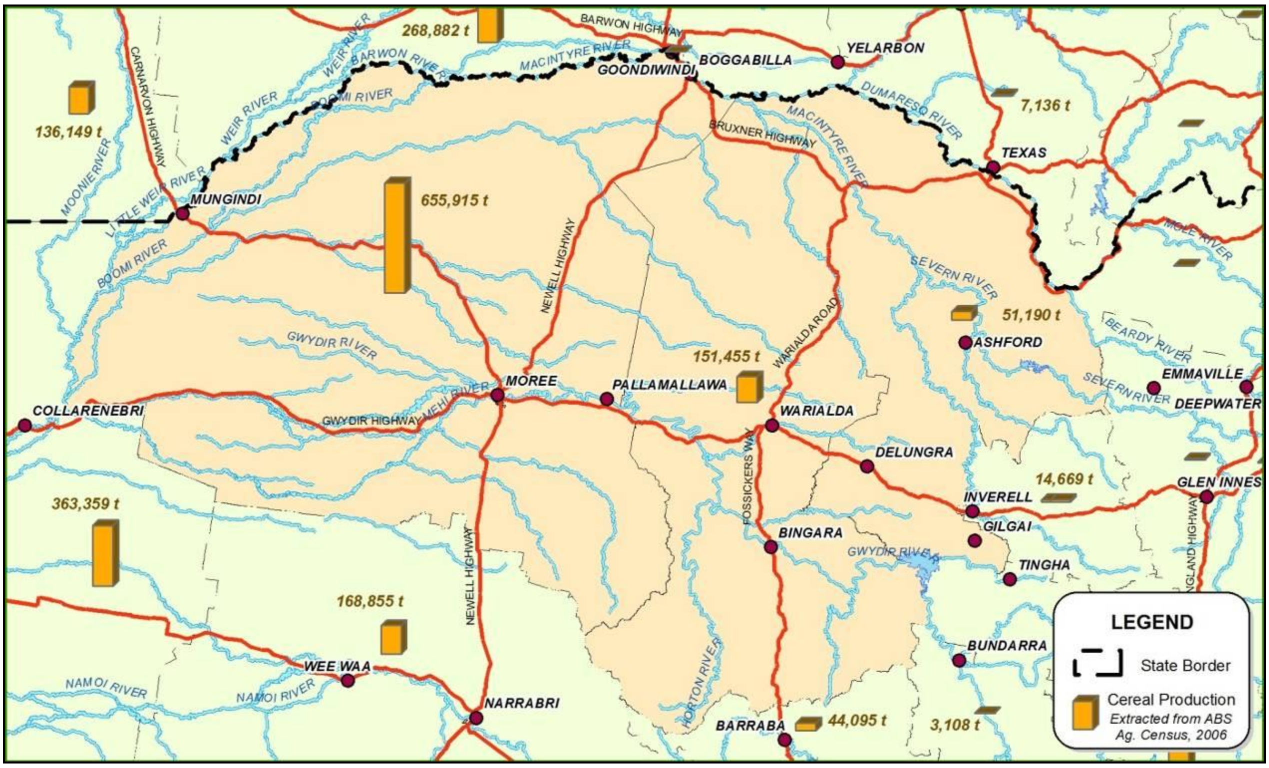


Figure 58 - Northern New South Wales focus region – north west slopes and plains

Infrastructure to facilitate cattle movement and processing is well developed with a comprehensive road network, major selling centres (Tamworth, Dubbo, Armidale and Inverell saleyards) and a number of processing plants currently servicing the region.

Other constraints to development in the region include:

1. Availability of skilled and unskilled labour: As in other regions, the feedlot industry is under pressure to compete with other industries for labour, particularly with the expansion of mining industry in central northern New South Wales around Quirindi and Gunnedah.
2. OH&S: Legal requirements for OH&S are stringent in New South Wales and place a considerable burden on feedlot businesses.

8.1.5 Southern New South Wales

The lot feeding sector in southern New South Wales has remained relatively static over the past 5 years. The area is characterised by a small number of large capacity (>18,000 head) feedlots. However, there have been several development applications approved in the region recently, including the staged development of an 80,000 head feedlot at Moira Station at Mathoura (approved in June 2006) and Yambinya Station at Wakool (to 25,000 head).

Southern New South Wales has a current capacity estimated at 202,000 head. The modelled expansion would see this rise by 35% to the year 2021. The majority of this expansion could be absorbed via expansion of current feedlots rather than new developments. The availability of land, water and feed grain, along with the evenly distributed low rainfall are the primary drivers for the current level of feedlot development and predicted expansion in the region.

Project modelling shows that, as a percentage of the breeding herd located in the region, grain-fed cattle were 55% of slaughtered cattle in 2006, significantly greater than the Australian average of 32%. Proposed industry expansion to 2021 would see the proportion of grain-fed cattle increase to about 85% of all cattle slaughtered. Continued development of feedlots in this region will demand the supply of greater numbers of cattle from Victoria and northern New South Wales. Demand for feeder cattle in South Australia will also be strengthened if the South Australian lot feeding sector develops, which will introduce competition for Victorian cattle. This may favour development of feedlots to the north of the region.

Southern New South Wales is a traditional winter grain (wheat, barley) growing area. Total grain production in 2006 was close to 7.4 Mt. Lot feeding of cattle represents the major demand for grain with a requirement in 2006 of about 466,000 t. The feedlot industry in this region also competes with dairy, pigs and poultry for feed grain supplies which can at times limit supply at current feedlot numbers. Expanding the industry in southern New South Wales would result in grain demand rising to about 656,000 t by 2021.

Toohey (2006) estimated that annual feed demand in the southern Murray-Darling Basin (SMDB) was about 1,445 Mt (594,000 t wheat and 523,000 t barley) based upon 100% utilisation of intensive livestock facilities in the region. Of this, only 25 % is required for the feedlot sector with the balance being fed to poultry, pigs and dairy cattle.

Site-specific property selection in the region will depend largely on access to high security water from existing irrigation licences. In the southern Murray-Darling Basin, the irrigation water resource is about 4,910 GL. A high proportion of the irrigation water in the SMDB is used on crops or pastures. For example, irrigated winter cereals in the major gravity irrigation districts of New South Wales represent in excess of 20% of water used in most recent years. Irrigation of increased areas of winter cereals at the expense of traditional irrigated crops (e.g. rice) is occurring in response to the low water allocations for much of the past decade, and strong local and export markets for milling and feed grade cereals (Toohey 2006).

Project modelling shows that by 2021, about 6,600 ML of water will be required for feedlots, a small requirement compared to the total resource currently available. Water security will be the key issue for an expanding feedlot industry in this area, with strong competition from other high value, permanent crops (e.g. grapes, citrus). The opportunity for allocation of new water in this area is limited with existing allocations in many of the irrigation districts overcommitted. However, water trading and purchase of secure licences could provide an opportunity for the feedlot industry.

The beef-processing sector in southern New South Wales is serviced by processing facilities at Yanco (Rockdale Beef Pty Ltd), Wagga Wagga (Cargill), and Tongala (HW Greenham & Sons), Yarrawonga (Tasman Group Services) and Wodonga (Norvic Food Processing) in Victoria. The estimated annual average turnoff in this region is about 380,000 (2006) and 591,000 head (2021) respectively. This equates to about 121,000 and 188,000 TCW (based on 600 kg animal at 53% dressing).

Whilst it is known that some grain-fed cattle are slaughtered at abattoirs in other regions (e.g. JBS Swift Australia), current grain-fed levels processed are at or about total plant throughput. Therefore, processing capacity could be a constraint on future expansion.

Other constraints to development in the region include:

1. Labour: As with other regions, expansion of the feedlot industry in this region is constrained by shortages in skilled and unskilled labour. This has been cited as a constraint for several feedlots currently operating in the region.
2. OH&S: Legal requirements for OH&S are stringent in New South Wales and place a considerable burden on feedlot businesses.

3. Transport Issues. Feedlot industry supply chains can extend across state boundaries with cattle and feedstuffs sourced from interstate. There is significant variation in transport loading regulations between the states. For example, there is no recognition of the inherent differences between state authorities, which in turn creates inequities between state jurisdictions. For example, livestock loading volume schemes exist in Victoria and Queensland however an equivalent scheme does not exist in New South Wales where legal loads are calculated on a mass balance basis.

8.1.6 Victoria and Tasmania

Compared to other states in Australia, the Victorian and Tasmanian lot feeding sector is relatively small. Victoria has two large feedlots, whilst Tasmania has only one large feedlot greater than 10,000 head. Seventy percent of Victorian lot feeding occurs in facilities of 1,000-10,000 head. Only small proportions (20%) of Victorian and Tasmanian cattle were finished in feedlots in 2006.

The projected feedlot expansion in Victoria and Tasmania is estimated at 38% to the year 2021, which is comparable to southern and northern New South Wales.

There are several factors which may limit the expansion of the feedlot industry in this region. In Victoria, these include restrictive state and local government planning schemes, limited site availability and climatic conditions that do not favour development, particularly the wet winter and potential for odour/separation distance problems.

The potential for expansion of the feedlot industry in Tasmania is limited due to limited feed grain and competition from grass fed beef. Climate will also present some challenges to feedlot management and community amenity issues.

In Tasmania, the main processing grain is barley, which is used for malting as well as feed. Wheat and triticale are both cultivated on a relatively small-scale. The great majority of the grain used is imported from interstate and an increase in feedlot capacity would increase the demand for mainland feed grain.

The distribution of rainfall throughout the year has a significant bearing on the management of a feedlot. Victoria and Tasmania with their winter dominant rainfall and low evaporation rates have greater problems with pen and manure management compared to lower rainfall, warmer regions. A wet pad is the main cause of odour generation and also leads to dirty cattle which require washing prior to slaughter. This translates into greater operational and licensing constraints on feedlot developments and limits the capacity for expansion in many regions.

Tasmania has the climate and rainfall to provide prime, quality pasture all year round, which translates into quality grass fed beef. There is a limited marketing advantage for grain fed beef within the state.

Two regulatory criteria which limit the availability of potential feedlot sites in Victoria are community amenity (odour) and protection of ground and surface water. The Victoria Planning Provisions (VPP) provides the framework from which the planning schemes for all Victorian local government areas are derived. The Victorian Code for Cattle Feedlots (DAEM 1995) is a State planning document which is incorporated into all planning schemes in Victoria. The Code deals with a range of measures and developments must demonstrate that they comply.

Many catchments supplying water for domestic, irrigation or other purposes within Victoria are protected under the Catchment and Land Protection Act 1994. Some of these catchments have been excluded from any form of feedlot development. Separation distances between the feedlot and various sensitive receptors will also constrain the development of large feedlots in most areas.

At a regional level, the Wimmera and Mallee regions of western Victoria do provide an opportunity for feedlot development if a reliable water supply can be provided. A project is currently being undertaken to replace the existing open channel supply system with a pipeline to provide water savings and a reliable, high quality water supply to farms in the area. This is the Wimmera-Mallee Pipeline Project (WMPP).

Figures 59 and 60 illustrate the areas suitable for development of 5,000 SCU and 15,000 SCU cattle feedlots respectively within the Wimmera Mallee region (areas that are not coloured) after considering site selection criteria from the Victorian Code for Cattle Feedlots and local shire planning provisions. Larger cattle feedlots (15,000 SCU) will be more difficult to establish. However several areas have been identified where close examination of sites is warranted. The legend shows factors imposed by regulations that will limit feedlot development. Areas that remain not coloured have potential for feedlot site construction, subject to site-specific requirements.

(Areas not coloured show potential for feedlot development)

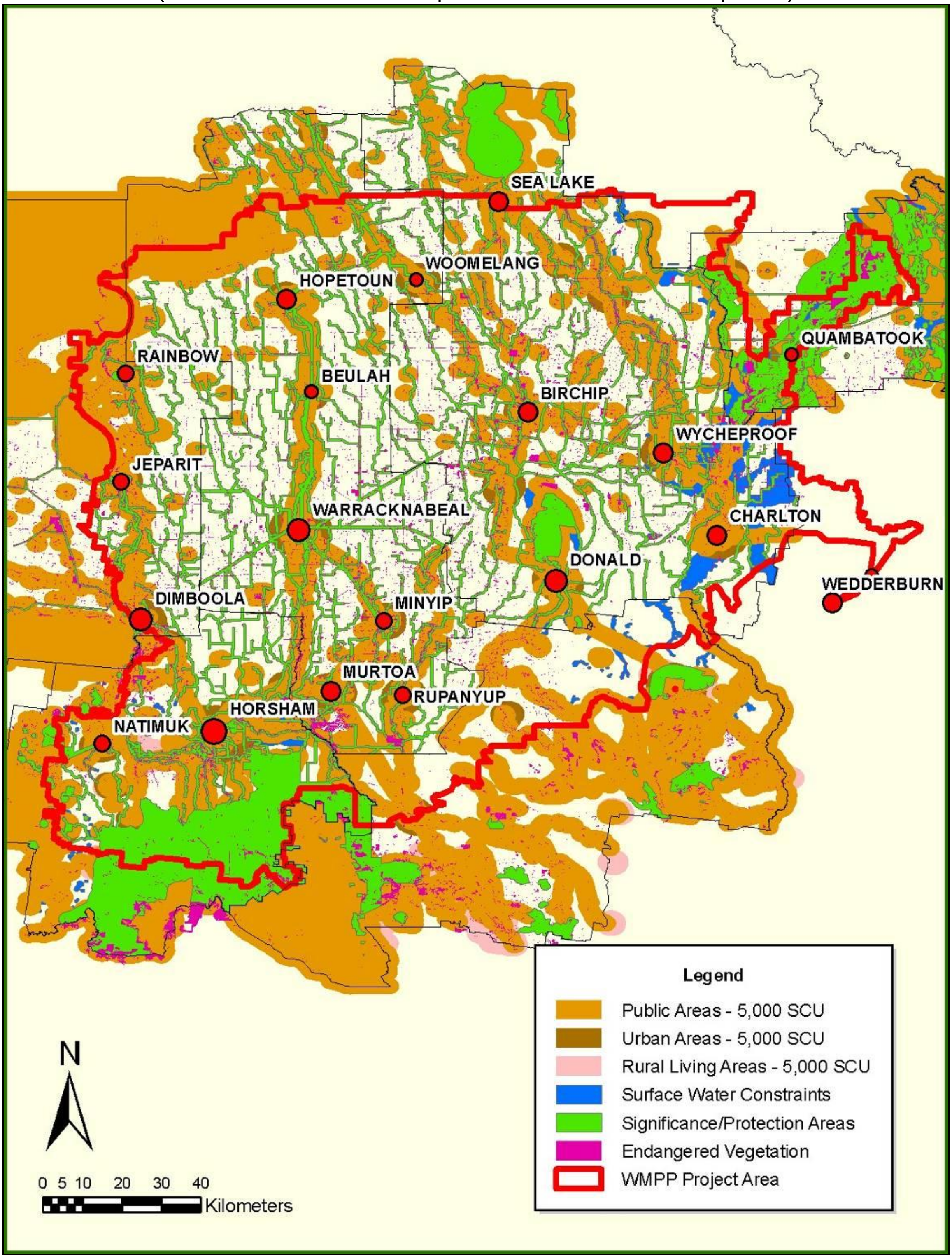


Figure 59 - Suitable sites for 5,000 SCU feedlots in Wimmera Mallee region

Figure 60 shows the small amount of land suitable for a large feedlot development after the six environmental constraints have been laid over the region. However there are still large areas where further development assessment would be warranted.

(Areas not Coloured Show Potential for Feedlot Development)

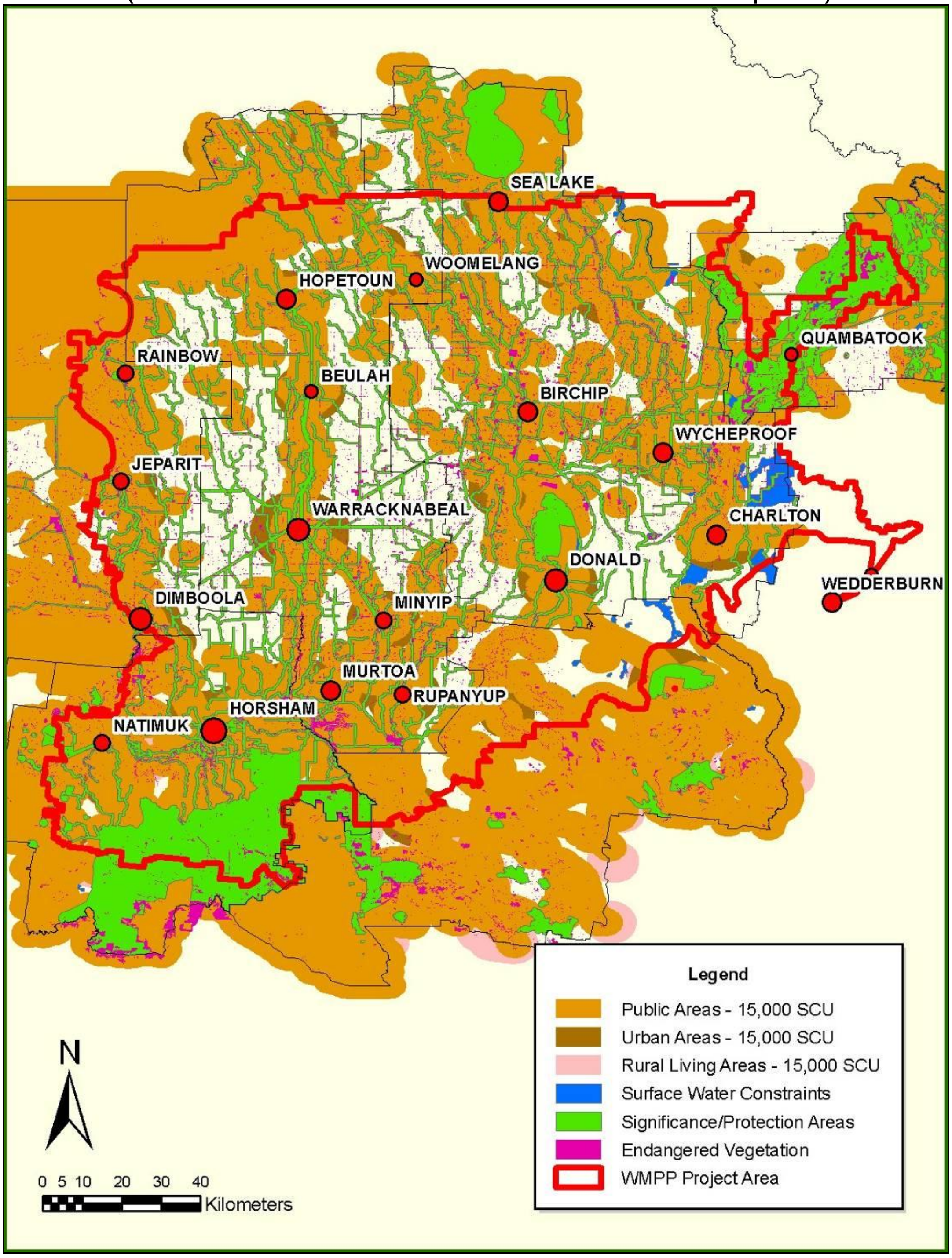


Figure 60 - Suitable sites for 15,000 SCU feedlots in Wimmera Mallee region

8.2 Expansion into new feedlot regions

The new feedlot regions in Australia have been defined as regions not currently having a significant industry but with potential for expansion. With the exception of South Australia, the new regions in northern Australia are characterised by a series of constraints, i.e.

- Lack of current feedlot infrastructure to use as a base for expansion;
- Lack of a significant grain industry;
- Lack of meat processing infrastructure;
- Significant livestock supply competition from the live export industry.

Development of traditional 'high energy ration' feedlots would need to include integrated grain supply and possibly slaughter facilities. Alternatively, feedlots may be developed to augment the established live export industry rather than competing with it.

8.2.1 Northern Western Australia

Three industries support most of the northern Western Australia economy. These are the pastoral, agricultural and the mineral/energy resource sectors. Pastoral activity stretches over a large area of semi-arid to arid land, and predominantly involves, from a livestock perspective, the export of live cattle primarily to South-East Asia and Indonesia in particular.

The rise of the live export industry over the past 10 years has been a major development in the marketing of Western Australia beef. In 2007, over 260,000 head of cattle were shipped through northern Western Australia ports (Port Headland, Broome, and Wyndham). Over the past decade, the value of exported meat and live cattle products has averaged about 70 % (range 57-73 %) of the total value of Western Australia beef production (Burggraaf 2004).

Northern Western Australia is a significant net exporter of feeder cattle which provides an opportunity for the development of a feedlot industry. However, redirecting these cattle to feedlots would create strong competition for feeder cattle from the live export trade, many of which are fed on arrival in South-East Asian feedlots. In the current market climate it is not likely that feedlots will be able to compete for these cattle.

There are currently no conventional feedlots in northern Western Australia. The projected expansion of pen capacity in this region is 50,000 head (163,960 head annual turn-off) by 2021. This represents one large feedlot development or 2-3 medium sized facilities.

The logistics of live export trade provides opportunity for the development of feedlots. Typically, in order to facilitate timely supply of cattle to the port, staging facilities are used to hold and process live export cattle. These facilities contain similar infrastructure to a feedlot. The live export trade is undertaken during the dry season; therefore utilisation of these facilities is low year round. The pre-feeding of live-export cattle has expanded significantly in recent years and estimates suggest that as many as 50,000 head in northern Western Australia/Northern Territory are fed annually. Continuation of this trend represents the major opportunity for developing feedlots in the region. Considering this expansion would comprise cattle already destined for the live-export trade, they do not contribute to the analysis presented in this report.

Availability of land and water in northern Western Australia represents an opportunity for the feedlot industry. Water is particularly abundant and could be used to support grain and fodder production in an integrated farm/feedlot operation.

Currently, grain production in northern Western Australia is focussed on hybrid seed production for sorghum, corn and sunflowers. Total grain production in 2006 was about 3000 t. The supply of feed grain is one of the key limitations to the expansion of the industry in this region. Grain supplies for an expanding feedlot sector in this area will need to be developed from available land resources or sourced from further afield. One option is to import grain from southern ports via sea, which could promote feedlot development closer to the coast.

Western Australia has a particularly good reputation for its 'clean, green' image which can be verified by various programs such as the Western Australia Rangelands Monitoring System, Rangeland Resource Inventory and Pastoral Lease Inspections. These programs monitor land and other resources, including trends, on which sustainability and environmental planning can be based and reflect a commitment to, environmental sustainability and enhanced future market opportunities. Northern Western Australia is affected by tropical weather systems and this will present challenges to the sustainability of a lot feeding sector. Heat stress would be an issue (see Figure 61) although this can be addressed with shade and correct management. The Western Australian Government strongly supports the establishment and expansion of industries targeting export market growth, particularly in the area of agricultural production and value adding through further processing (WA Dept of Agriculture and Food 2008). Expanding the feedlot industry presents opportunity for value adding to the live export cattle.

There is no rail network in northern Western Australia (apart from mining infrastructure in the Pilbara) which could be considered a minor constraint to commodity transport for lot feeding in the region. However, in most states of Australia road transport is the preferred option for cattle and commodity transport.

As in other regions, further constraints to development include:

1. Access to labour: This will be a critical constraint for this region; however feedlots may be able to access workers under the Section 457 visa immigration ruling.
2. Processing capacity: As there is currently no beef-processing capacity in northern Western Australia, the lot feeding sector would need to consider a vertically integrated operation, or export grain fed cattle for slaughter in Asian countries. Considering the need for infrastructure and labour to develop a feedlot in this region, expansion would favour a large, vertically integrated company already involved in the live export industry.

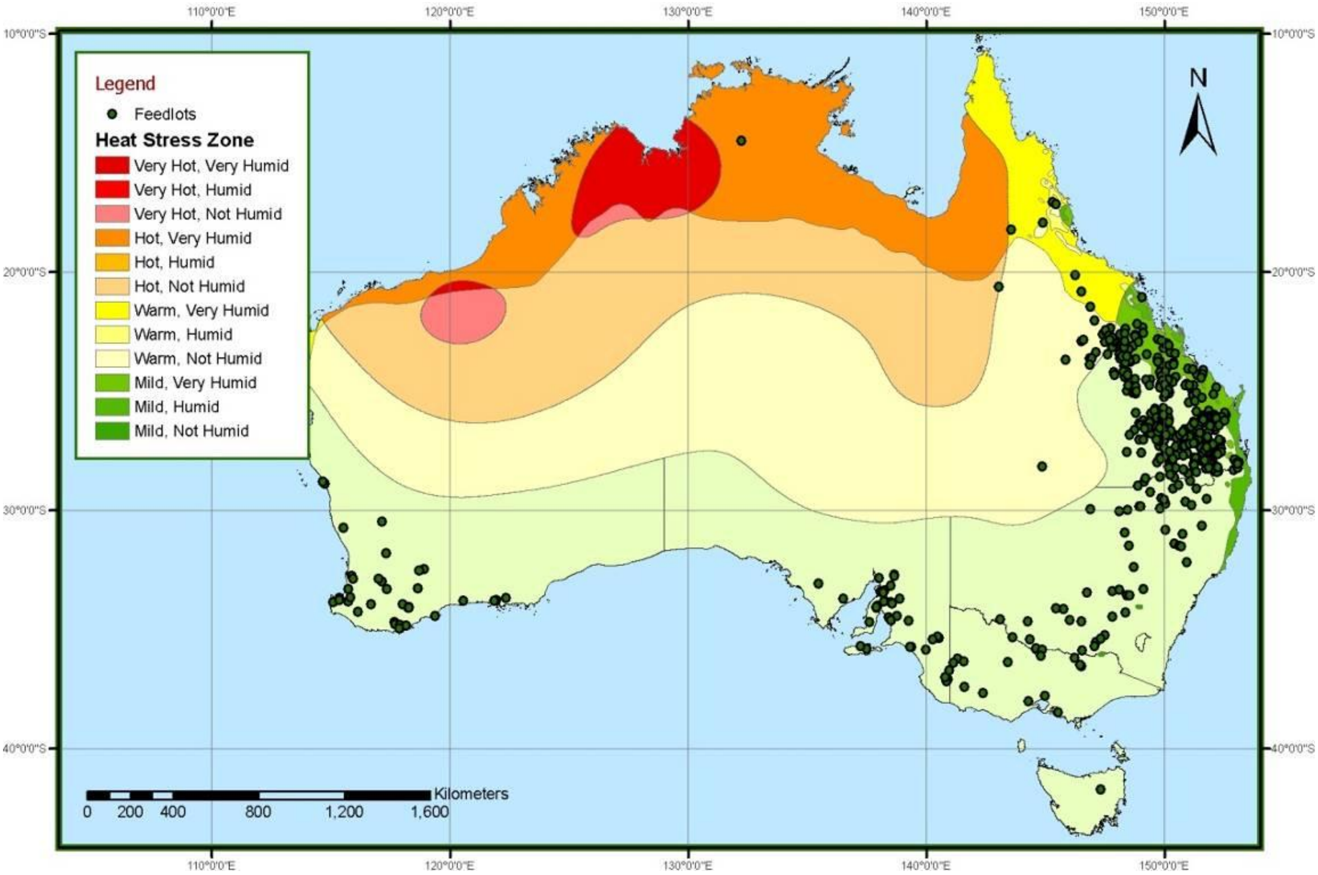


Figure 61 - Indicative heat stress zones for lot feeding

8.2.2 Northern Territory

The Northern Territory supplies cattle to all states and territories of Australia and animals suited for the growing live export trade to South-East Asia. The movement of stock is predominantly directly from breeding properties via road transport, especially from the Barkly Tableland to Queensland. Only one saleyard exists in the Northern Territory, located at Alice Springs. The key trend during the past decade is the rise of live exports in the marketing of Northern Territory beef. In 2007 over 318,000 head of cattle were shipped through Darwin, with 45% of the total Northern Territory production destined for the export trade in Asia (NTCA 2008). Domestic turn-off goes to markets throughout Australia, directly into or value-added though backgrounding operations, feedlots, saleyards or abattoirs.

There is currently one operation in the Northern Territory near Katherine with a capacity of 8,000 head which is classified as a feedlot in this work. However, this operation may be more appropriately defined as a live export staging facility. The sector has remained static over the past 5 years. The projected expansion in the Northern Territory by the steering committee for pen capacity is estimated at 50,000 head by the year 2021.

As in Western Australia, the logistics of live export trade provides opportunity for the development of feedlots. Typically, in order to facilitate timely supply of cattle to the port, staging facilities are used to hold and process cattle. These facilities contain similar infrastructure to a feedlot. The live export trade is undertaken during the dry season; therefore utilisation of these facilities is low year round. The pre-feeding of live-export cattle has expanded significantly in recent years and estimates suggest that as many as 50,000 head in Northern Western Australia/Northern Territory are fed annually. Continuation of this trend represents the major opportunity for developing feedlots in the region. Considering this expansion would comprise cattle already destined for the live-export trade, they do not contribute to the analysis presented in this report.

Project modelling shows that, as a percentage of the breeding herd located in the region, grain-fed cattle are about 4% of marketed cattle (if the Katherine facility is classed as a feedlot), significantly less than the Australian average of 32% total slaughtering. This reflects the size and location of the Australian breeding herd and the dominance of the live export market.

The supply of feed grain is one of the key limitations to the expansion of the industry in this region. The Northern Territory produces very little grain (about 8,000 t in 2006), with sorghum being the predominant crop. Grain supplies for an expanding feedlot sector in this region would need to be sourced from further afield or through expansion of local production. The Darwin-Adelaide rail link does provide an opportunity for feed grain movement from South Australia - however this would incur additional logistical and transport costs.

The beef-processing sector in the Northern Territory has seen substantial restructuring over the past 10 years to the point where there is now only one small domestic abattoir (Litchfield). Teys Bros have an abattoir at Katherine, designed to process overflow from the live export trade. This plant is currently not operating due to climatic and market conditions. Similar to the southern Western Australia industry, expansion of the feedlot sector would minimise reliance on seasonal supply and bring forward suitable livestock to accommodate processing capacity.

The development of a feedlot industry will be challenged by shortages in skilled and unskilled labour. This may be relieved by workers brought in under the Section 457 visa immigration ruling which may be an opportunity for all sectors of the cattle supply chain in the region.

8.2.3 South Australia

The feedlot industry in South Australia is an important sector of the domestic and export beef industries. Compared to other states, the South Australian feedlot sector is relatively small, accounting for about 2.5% of national pen capacity.

South Australia does not have any large feedlots (greater than 5,000). Seventy percent of South Australia’s lot feeding occurs in facilities of 1,000-3,500 head. About 19% of cattle slaughtered in South Australia are finished in feedlots. The projected expansion in South Australia proposed by the steering committee is 100% by 2021 from current capacity.

The modelling shows that by 2021, as a percentage of the breeding herd located in the region, grain-fed cattle will be about 48% of estimated cattle slaughtered. This is in line with the aim to feed all young cattle through feedlots.

Grain supply is a major opportunity for growth in the South Australia feedlot sector. South Australia’s total grain production in 2006 was 6.6 Mt (about 25% greater than the 10 year average of 5.2 Mt). Average seasonal production of feed grains is anticipated to grow from 1.75 million tonnes in 2003 to 2 million tonnes by 2010 due to yield increases of approximately 1 to 2% per annum (PIRSA 2008). By 2010, feed grain demand is anticipated to have grown from 25% of available cereal production to nearly 50% (PIRSA 2008).

The feedlot industry also competes with dairy, pigs and poultry for feed grain supplies in the region. Expansion of the industry in South Australia would result in grain demand rising to about 114,000 t by 2021.

Cattle supply may also be an opportunity for this region if cattle can be sourced economically from the Northern Territory, especially from the Alice Springs area. This trade has operated for many years and could be enhanced if transport by rail became a feasible option.

Water security will be one of the key issues for an expanding feedlot industry in this area. The opportunity for allocation of new water in this area is limited with existing allocations in many of the irrigation areas overcommitted. Water supply security could be overcome by water trading and purchase of secure properties with water allocations.

South Australia has two relatively large export abattoirs located at Naracoorte (Teys Bros) whose capacity is about 600 head per day and the T&R abattoir at Murray Bridge which has a capacity of 700 head per day. Small to medium sized multi-species plants are located at Keith and Lobethal. The region could also be serviced by processing facilities in Victoria at Swan Hill (Ashton) and Warrnambool (Midfield Meat International). However, these facilities are multi-species and together only represent less than 1% of the national kill. Therefore, processing capacity could be a constraint on future expansion.

The expansion of the feedlot industry will no doubt be challenged by shortages in skilled and unskilled labour which the industry in other states sees as a significant problem to further industry expansion. Feedlots may be able to access workers under the Section 457 visa immigration ruling however.

9 Feedlot expansion opportunities - conclusions and recommendations

9.1 Introduction

This project assessed the industry-wide economic, environmental and social benefits of moving the beef industry to a production system where all available sale cattle are channelled through the feedlot supply chain. The industry development scenario identify on a state by state and regional basis the expansion opportunities but also the limitations to further industry expansion. The feedlot expansion scenario assumed that current pen occupancy strategies would remain consistent with current practice (an average of 77% nationally), resulting in turnoff from feedlots representing approximately 69% of total annual slaughter. This figure is believed to be the sustainable capacity, representing the slaughter of all young cattle. Since average annual pen occupancy is to remain constant, expansion would be achieved through the construction of additional pen capacity.

9.2 Overview of implications of industry expansion for the future of the Australian feedlot industry

The Australian feedlot industry has developed significantly over the last ten years based on increased domestic demand and new market opportunities derived from the absence of the US from key Pac Rim markets because of BSE concerns in those markets. Those market opportunities have seen significant new feedlot capacity development, replacement of old capacity and retirement of small opportunity feedlots.

Feedlot capacity utilisation has declined in recent years due to droughts, high grain prices, tight buy-sell margins for feeder cattle and the inability to supply grain fed beef to export markets, resulting in overall declines in feedlot profitability.

The feedlot industry will have to compete for livestock supply with the live export industry and the capacity in southern regions to seasonally produce quality beef off pasture and crop for parts of the year. Over summer months, southern feedlots will be able to effectively provide base levels of abattoir slaughter capacity. However , the capacity to produce pasture/crop fed beef with a lower cost of gain than feedlots for parts of the production year presents an ongoing feedlot capacity utilisation challenge and for further feedlot development in those southern regions.

The rapid emergence of a grain fed dairy milk sector in response to increasing irrigation water costs will also present the beef lot feeding sector with feed grain competition pressures.

Despite those impediments, the preceding analysis shows that grain fed cattle as a percentage of all cattle slaughtered in Australia will likely increase from 32% to approximately 69% by 2021.

Feedlot pen capacity is expected to increase from 1.17M head to 2.35M head by 2021 if the current 77% capacity utilisation can be maintained. The number of cattle on feed will increase from approximately 906,000 head to approximately 1.81M head by 2021. Inherent in this capacity expansion is the reality that there will continue to be challenges in achieving profitable levels of capacity utilisation until older and less efficient feedlot capacity is retired from the industry. The other reality is that this level of lot feeding has the capacity to account for up to 6.0M head of turnoff a year or roughly the equivalent of all young cattle currently turned off in Australia. Current cattle numbers are below peak numbers of 31.8 M which occurred in 1975-76 indicating significant scope to increase cattle numbers contingent on favourable climatic , economic and market conditions.

It is expected that the size of the national beef herd will remain relatively constant, albeit with some productivity increases due to improved management practices particularly in the northern beef herd. While Australian slaughter levels are likely to remain constant at around 9M head in the short term, the quantity of beef to be produced will increase to approximately 2.3Mt driven by higher slaughter weights due largely to increased lot feeding. However should cattle populations increase, slaughter numbers will increase accordingly with commensurate increases in beef tonnage and undoubtedly higher levels of grain fed cattle turn off.

The expected increase in export demand for Australian grain fed beef, when Asian economies recover from the current poor economic conditions, is likely to support the projected feedlot expansion estimate given the relatively static beef demand profile in the Australian domestic market.

The 77% occupancy rate is consistent with profitable industry practice and is a realistic goal for the feedlot industry. Maintenance of the 77% occupancy goal will depend on the feedlot industry's capacity to deliver cost competitive live weight gain compared to crop and grass fattened cattle, especially in the southern states. In the southern states the reality is that lot feeding has to integrate with pasture and grass feeding regimes. Australia also does not have a comparative advantage in feed grain production with periods of high grain prices driven by drought induced feed grain supply constraints and resultant impacts on feedlot profitability.

To satisfy the higher level of grain feeding, the modelling predicts that – between 2006 and 2021 – the feedlot pen capacity of Australian feedlots will almost approximately double; requiring an additional 1,170,000 head of pen capacity to be built. Table 64 shows the predicted pen capacity expansions for each of the modelled regions.

Table 64 - Pen capacity expansion to 2021

Region No	Region	2006	2011	2016	2021
1	Southern WA	98,711	155,000	330,000	375,000
2	Northern WA	0	15,000	20,000	50,000
3	Northern Territory	8,000	15,000	20,000	50,000
4	South Australia	29,535	40,000	60,000	60,000
5	Nth Queensland	124,223	250,000	375,000	500,000
6	Sthn Queensland	468,401	530,000	600,000	700,000
7	Northern NSW	163,327	180,000	200,000	225,000
8	Southern NSW	202,159	225,000	250,000	275,000
9	Victoria and Tasmania	79,825	90,000	100,000	110,000
	Australia	1,174,181	1,500,000	1,955,000	2,345,000

The feedlot industry in 2021 will be significantly different from that of 2006. Based on the assumptions used in this study the industry is likely to double in size driven primarily by domestic and export market demand. That growth will require a significant increase in demand for feedlot inputs.

Projected industry expansion is estimated to increase the feedlot gate value of the feedlot industry from $3.9B to approximately $7.4B in 2006 dollar values.

Table 65 summarises the key impacts and requirements for the projected feedlot industry expansion between 2006 and 2021.

Table 65 - Estimated impacts and requirements for projected feedlot industry expansion between 2006 and 2021

Feedlot Expansion Impact/ Requirement	2006	2021
% of slaughter cattle that are grain fed	34%	69%
Estimated number of cattle on feed	906,468	1,812,936
Estimated number of cattle turned off from feedlots annually	2,647,733	6,046,678(1)
Estimated pen capacity at 77% utilisation	1,174,181	2,345,000
Estimated Summer feed grain demand (tonnes)	883,647	2,061,470
2006 Summer feed grain production (tonnes)	2,292,933	
Estimated Winter feed grain demand (tonnes)	1,714,035	3,120,126
2006 Winter feed grain production (tonnes)	37,141,634	
Estimated total grain demand (tonnes)	2,597,682	5,181,595
Estimated total feed grain demand as a % of 2006 feed grain supply	6.6%	13.1%
Additional land area required for feedlot expansion & development over 2006 (Ha)	0	5,300
Water required or feedlot use (ML)	28,180	56,280
Estimated full time staff equivalents	1,451	2,897
Value of the feedlot industry at feedlot gate ($B) in 2006 $terms	3.869	7.448

(1) This turnoff number might be constrained by the competition in southern states that feedlots will incur in competitive cost of gain from pasture and crop fed turnoff. Further constraints may occur with drought induced feed grain supply shortages driving up feed grain and feeder steer prices making lot feeding unviable in some regions in these circumstances.

9.2.1 Pre-requisites for success

To enable this projected feedlot industry expansion there are a number of pre-requisites that feedlot industry needs to address to achieve the estimated growth targets including:

- **Water regulation and policy:** There is a need for the feedlot industry to participate in the on-going water regulation changes. Considering the importance and value of this resource, investigation into the capacity of feedlots to pay for water and development of an industry stance regarding water needs may be warranted.
- **Water and energy usage research and extension:** Considering the increasing value of water and energy, on-going research that can lead to real water and energy savings at feedlots will be of value to the industry.
- **Development of a feedlot industry plan for GHG research:** It is important to note that based on research to date, actual GHG emissions from feedlots may be significantly different from those calculated by the standard Australian methodology because of potential errors in this methodology. The key research areas to be covered by the plan include:

  - Quantification of methane and nitrous oxide emissions from manure management at all stages through the feedlot system (feedlot pad, manure and effluent storage, manure and effluent reuse).
  - Identification of feasible options to reduce GHG production at feedlots, such as:
    - Production of energy from manure/effluent to offset energy demands and improve waste stream nitrogen management.
    - Improved energy efficiency within the operation.
    - Improved manure management to reduce methane and N_2O emissions.
    - Quantification of soil carbon sequestration capacity of feedlots through manure/effluent usage.
    - Development of an industry plan for managing GHG regulatory requirements.
- **Quantification of the potential GHG emission benefits to the beef industry from expansion of the feedlot industry:** This research need could be addressed within the scope of a northern beef LCA project.
- **Nutrient management research and extension:** Considering the very high potential value of nutrients excreted by feedlot cattle and the potential this has to alter feedlot economics, research is warranted to investigate:
  - Nutrient recovery options from manure and effluent, and
  - Nutrient reuse from manure and effluent on feedlot farms (which would lead to reduced input costs, increased crop production and improve ongoing regulatory compliance).
- **Regulation:** Regulatory pressures need to be addressed through constant review of changes to policy on a state-by-state basis. Identified research needs include:
  - New options for odour mitigation and review of according separation distances;
  - Quantification of pathogen transmission risk via air and water;
  - On-going participation in the effluent spillage regulation debate;
  - Improved nutrient reuse effectiveness.
- **Labour supply:** This may be addressed through recruitment and training of foreign workers under the Section 457 visa immigration ruling and extension of training and incentive programs for young workers and graduates. Importantly the feedlot industry needs to actively promote the exciting careers and personal development opportunities in the industry.
- **Improvement of industry data:** This project identified two main data requirements, namely the need for improved livestock occupancy and pen capacity data, and grain consumption data. It would be of benefit to establish a mechanism for keeping up-to-date geo-referenced data on feedlot capacity and this should be explored by the industry.
- **Grain LCA data:** While not a feedlot research need, there is a need for improved LCA data from grain production that contribute to the carbon footprint for feedlot beef production (particularly with respect to GHG emissions, notably N2O). This research should be promoted to GRDC.

At the industry-wide level, environmental drivers for feedlot expansion include:

- Opportunity to reduce the impact of cattle production on the natural environment by reducing stocking rates and transferring young animals to feedlots.
- Opportunity to reduce GHG production through feeding young cattle in feedlots in preference to low productivity grazing system and the opportunity to introduce feed additives if developed

to reduce enteric methane emissions. In the broader context of the Australian beef industry, lot feeding of beef cattle will lead to lower overall GHG emissions per kg of beef compared to standard grass-fed production systems.

- Opportunity to make significant financial gains through energy and nutrient recovery from the feedlot waste stream. Nutrient value at 2006 feedlot throughput levels may be as high as $218 million dollars if the total excreted nitrogen could be captured, or $102 million under current management systems (based on a simplistic calculation from current fertiliser values). Additional benefits from this process may include:
  - Reduction of GHG emissions through capture and utilisation of methane, and potentially a reduction in nitrous oxide from manure management;
  - Reduction of odour from manure stockpiles and effluent ponds;
  - Elimination of pathogen risk from manure / effluent reuse;
  - Potential government funding for developments that generate green energy.

Environmental and infrastructure constraints to expansion that relate to the whole industry include:

- Shortages of skilled and un-skilled labour.
- Increasingly stringent and complex development regulation and appeal processes: These largely relate to odour, nutrient management and new topics of concern such as air-borne pathogens.
- Greenhouse gas regulations: Site-based mandatory reporting of GHG, efficiency targets and the inclusion of agriculture in the proposed ETS represent a very significant reporting and financial burden if progressed as planned.
- Water costs: With the introduction of water trading and a cap on the overall resource, the capacity of feedlots to compete for water may be limited given likely increases in water costs.
- Increasing environmental regulation problems relating to nutrient reuse at feedlots.

Other constraints identified by this project include the lack of accurate, detailed data on current industry year round occupancy and capacity, and annual grain usage in feedlots.

9.3 Regional conclusions

The modelling was carried out on a regional basis. The regions were broadly based on state and climatic conditions. The modelling provided results for pen capacity expansion, cattle supply requirements, grain requirements, water, and staff requirements. In addition to these parameters, the review of expansion predictions in each region considered infrastructure requirements, land requirements and regulation. The following conclusions have been drawn from the region-by-region assessment of industry expansion.

Current feedlot regions with the highest predicted expansion are northern and southern Queensland and southern Western Australia.

The expansion of lot feeding in southern Queensland will result in higher numbers of cattle being transported from north to south, tightening of grain supplies and the shift of feedlots to sparsely populated areas with high security water supply. However recent increases in fuel costs and changes to regulations covering the transport of livestock may place constraints on north-south cattle movement.

Expansion is expected to stretch feed grain supplies and lead to regular importation of grain from southern regions and possibly further afield. This highlights the need for expanded grain infrastructure development in the region and further investment into grain research and development to sustain and increase yields to meet this demand.

Availability of land, particularly for newer and larger feedlot developments, will focus attention to regions where large properties and secure water are available. Significant expansion on the western Darling Downs and in the New South Wales border region could occur through construction of approved developments and expansions of current feedlots. Development regulations are a constraint to development in the traditional eastern Darling Downs region.

Industry expansion in northern Queensland is favoured by availability of land and water and location in the tick zone, eliminating the need to dip cattle en-route from northern regions. There are few region-specific limitations to expansion.

In southern Western Australia, the potential for expansion is facilitated by large grain supplies and potential access to reliable groundwater in some areas. Expansion could occur by sourcing northern cattle to feed through the winter. Constraints to development include state environmental regulations and current limitations in processing capacity.

Expansion of the feedlot sector in northern and southern New South Wales and Victoria/Tasmania is expected to be less than in the above regions.

Northern New South Wales shows several opportunities for expansion, including abundant grain supply, cattle supply and availability of land. This may favour development in this region in preference to southern Queensland. However, OH&S regulations, competition for cattle from grass fed markets and transport of cattle and feedstuffs sourced from interstate with variations in loading regulations may present constraints.

Southern New South Wales has potential for expansion through further development of existing feedlots and new proposed feedlots currently approved. The region has reasonable levels of grain available though supply may be limited in some years. Potential for sourcing water and sites available for very large developments are an opportunity in this region. However, expansion would require cattle to be sourced from northern New South Wales and Victoria to enable this. Constraints in this region include availability of abattoirs and labour.

Victoria and Tasmania are predicted to expand at a relatively slow rate. This expansion is likely to occur in western Victoria where land and water is available for developments. Development in Victoria is constrained by tight regulations from local councils and development controls in many river catchments. EPA regulations can be a constraint because of climatic conditions (wet winters) that promote odour problems. The Wimmera-Mallee region may provide the best options for development as the Wimmera-Mallee Pipeline Project is undertaken by the state.

Feedlot production in Tasmania is not expected to expand significantly, largely in response to the low availability of grain, less favourable climate and competition for cattle supply from grass finishing operations.

Feedlot development in new regions (northern Western Australia, the Northern Territory and South Australia) generally have less potential for feeding large numbers of cattle on traditional grain rations, though significant expansion above current levels may be achieved by construction of only one medium sized feedlot (>10,000 head) in each of the regions.

In northern Western Australia and the Northern Territory, there will be strong competition for feeder cattle from the live export dominated northern industry, though opportunity exists for expansion of short term silage based feedlots that are integrated into the live export supply chain. This expansion has not been taken into account in the current modelling. The supply of feed grain is one of the key limitations to the expansion of the industry in northern Western Australia and the Northern Territory. Grain supplies for an expanding feedlot sector in these areas will need to be sourced from further afield if development is to occur.

Considering the need for infrastructure and labour to develop a feedlot in northern Australia, expansion would favour large, vertically integrated companies already involved in the live export industry.

Expansion of the South Australian industry is favoured by a readily available supply of feed grain. However, water security and processing capacity will present some challenges to expansion.

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11 Appendices

Appendix 1 Regional feedlot operating assumptions

Table A1 – Region 1 (southern Western Australia) herd composition parameters

Market type	Domestic	Short Fed	Mid Fed	Long Fed	
Days on feed (range) - 2006	60	100-140	150-180	220-240	300+
Entry Weight (kg)	335	412	407.5	380	415
Exit Weight (kg)	455	640	705	705	735
Net Gain (kg)	124.8	228	297.5	325	320
Dressing Percent	55%	56%	57%	57%	57%
Dressed Carcase Wt (HSCW)	250	355	400	405	420
Days on Feed – 2006	75	120	175	250	320
Days on Feed – 2011 to 2021	70	110	160	210	300
ADG (kg gain/head/day)	1.6	1.9	1.7	1.3	1
DMI (kg DM/hd/day)	9.3	10.3	10.9	11	9.9
FCE (kg DM/kg gain)	5.8	5.4	6.6	8.5	9.9
Mortality Rate (No in/No Out)	2.0%	2.0%	2.0%	2.0%	2.0%
Percent in Lot	60.0%	0.0%	20.0%	20.0%	0.0%

Table A2 – Region 2 (northern Western Australia) herd composition parameters

Market type	Domestic	Short Fed	Mid Fed	Long Fed	
Days on feed (range) - 2006	60	100-140	150-180	220-240	300+
Entry Weight (kg)	335	412	407.5	380	415
Exit Weight (kg)	455	640	705	705	735
Net Gain (kg)	124.8	228	297.5	325	320
Dressing Percent	55%	56%	57%	57%	57%
Dressed Carcase Wt (HSCW)	250	355	400	405	420
Days on Feed – 2006	75	120	175	250	320
Days on Feed – 2011 to 2021	70	110	160	210	300
ADG (kg gain/head/day)	1.6	1.9	1.7	1.3	1
DMI (kg DM/hd/day)	9.3	10.3	10.9	11	9.9
FCE (kg DM/kg gain)	5.8	5.4	6.6	8.5	9.9
Mortality Rate (No in/No Out)	2.0%	2.0%	2.0%	2.0%	2.0%
Percent in Lot	40.0%	60.0%	0.0%	0.0%	0.0%

Table A3 – Region 3 (Northern Territory) herd composition parameters

Market type	Domestic	Short Fed	Mid Fed	Long Fed	
Days on feed (range) - 2006	60	100-140	150-180	220-240	300+
Entry Weight (kg)	335	412	407.5	380	415
Exit Weight (kg)	455	640	705	705	735
Net Gain (kg)	124.8	228	297.5	325	320
Dressing Percent	55%	56%	57%	57%	57%
Dressed Carcase Wt (HSCW)	250	355	400	405	420
Days on Feed – 2006	75	120	175	250	320
Days on Feed – 2011 to 2021	70	110	160	210	300
ADG (kg gain/head/day)	1.6	1.9	1.7	1.3	1
DMI (kg DM/hd/day)	9.3	10.3	10.9	11	9.9
FCE (kg DM/kg gain)	5.8	5.4	6.6	8.5	9.9
Mortality Rate (No in/No Out)	2.0%	2.0%	2.0%	2.0%	2.0%
Percent in Lot	40.0%	60.0%	0.0%	0.0%	0.0%

Table A4 – Region 4 (South Australia) herd composition parameters

Market type	Domestic	Short Fed	Mid Fed	Long Fed	
Days on feed (range) - 2006	60	100-140	150-180	220-240	300+
Entry Weight (kg)	335	412	407.5	380	415
Exit Weight (kg)	455	640	705	705	735
Net Gain (kg)	124.8	228	297.5	325	320
Dressing Percent	55%	56%	57%	57%	57%
Dressed Carcase Wt (HSCW)	250	355	400	405	420
Days on Feed – 2006	75	120	175	250	320
Days on Feed – 2011 to 2021	70	110	160	210	300
ADG (kg gain/head/day)	1.6	1.9	1.7	1.3	1
DMI (kg DM/hd/day)	9.3	10.3	10.9	11	9.9
FCE (kg DM/kg gain)	5.8	5.4	6.6	8.5	9.9
Mortality Rate (No in/No Out)	2.0%	2.0%	2.0%	2.0%	2.0%
Percent in Lot	70.0%	10.0%	10.0%	10.0%	0.0%

Table A5 – Region 5 (northern Queensland) herd composition parameters

Market type	Domestic	Short Fed	Mid Fed	Long Fed	
Days on feed (range) - 2006	60	100-140	150-180	220-240	300+
Entry Weight (kg)	335	412	407.5	380	415
Exit Weight (kg)	455	640	705	705	735
Net Gain (kg)	124.8	228	297.5	325	320
Dressing Percent	55%	56%	57%	57%	57%
Dressed Carcase Wt (HSCW)	250	355	400	405	420
Days on Feed – 2006	75	120	175	250	320
Days on Feed – 2011 to 2021	70	110	160	210	300
ADG (kg gain/head/day)	1.6	1.9	1.7	1.3	1
DMI (kg DM/hd/day)	9.3	10.3	10.9	11	9.9
FCE (kg DM/kg gain)	5.8	5.4	6.6	8.5	9.9
Mortality Rate (No in/No Out)	2.0%	2.0%	2.0%	2.0%	2.0%
Percent in Lot	30.0%	30.0%	20.0%	20.0%	0.0%

Table A6 – Region 6 (southern Queensland) herd composition parameters

Market type	Domestic	Short Fed	Mid Fed	Long Fed	
Days on feed (range) - 2006	60	100-140	150-180	220-240	300+
Entry Weight (kg)	335	412	407.5	380	415
Exit Weight (kg)	455	640	705	705	735
Net Gain (kg)	124.8	228	297.5	325	320
Dressing Percent	55%	56%	57%	57%	57%
Dressed Carcase Wt (HSCW)	250	355	400	405	420
Days on Feed – 2006	75	120	175	250	320
Days on Feed – 2011 to 2021	70	110	160	210	300
ADG (kg gain/head/day)	1.6	1.9	1.7	1.3	1
DMI (kg DM/hd/day)	9.3	10.3	10.9	11	9.9
FCE (kg DM/kg gain)	5.8	5.4	6.6	8.5	9.9
Mortality Rate (No in/No Out)	2.0%	2.0%	2.0%	2.0%	2.0%
Percent in Lot	28.0%	42.0%	15.0%	15.0%	0.0%

Table A7 – Region 7 (northern New South Wales) herd composition parameters

Market type	Domestic	Short Fed	Mid Fed	Long Fed	
Days on feed (range) - 2006	60	100-140	150-180	220-240	300+
Entry Weight (kg)	335	412	407.5	380	415
Exit Weight (kg)	455	640	705	705	735
Net Gain (kg)	124.8	228	297.5	325	320
Dressing Percent	55%	56%	57%	57%	57%
Dressed Carcase Wt (HSCW)	250	355	400	405	420
Days on Feed – 2006	75	120	175	250	320
Days on Feed – 2011 to 2021	70	110	160	210	300
ADG (kg gain/head/day)	1.6	1.9	1.7	1.3	1
DMI (kg DM/hd/day)	9.3	10.3	10.9	11	9.9
FCE (kg DM/kg gain)	5.8	5.4	6.6	8.5	9.9
Mortality Rate (No in/No Out)	2.0%	2.0%	2.0%	2.0%	2.0%
Percent in Lot	17.0%	25.0%	30.0%	0.0%	28.0%

Table A8 – Region 8 (southern New South Wales) herd composition parameters

Market type	Domestic	Short Fed	Mid Fed	Long Fed	
Days on feed (range) - 2006	60	100-140	150-180	220-240	300+
Entry Weight (kg)	335	412	407.5	380	415
Exit Weight (kg)	455	640	705	705	735
Net Gain (kg)	124.8	228	297.5	325	320
Dressing Percent	55%	56%	57%	57%	57%
Dressed Carcase Wt (HSCW)	250	355	400	405	420
Days on Feed – 2006	75	120	175	250	320
Days on Feed – 2011 to 2021	70	110	160	210	300
ADG (kg gain/head/day)	1.6	1.9	1.7	1.3	1
DMI (kg DM/hd/day)	9.3	10.3	10.9	11	9.9
FCE (kg DM/kg gain)	5.8	5.4	6.6	8.5	9.9
Mortality Rate (No in/No Out)	2.0%	2.0%	2.0%	2.0%	2.0%
Percent in Lot	15.0%	15.0%	25.0%	35.0%	10.0%

Table A9 – Region 9 (VIC/TAS) herd composition parameters

Market type	Domestic	Short Fed	Mid Fed	Long Fed	
Days on feed (range) - 2006	60	100-140	150-180	220-240	300+
Entry Weight (kg)	335	412	407.5	380	415
Exit Weight (kg)	455	640	705	705	735
Net Gain (kg)	124.8	228	297.5	325	320
Dressing Percent	55%	56%	57%	57%	57%
Dressed Carcase Wt (HSCW)	250	355	400	405	420
Days on Feed – 2006	75	120	175	250	320
Days on Feed – 2011 to 2021	70	110	160	210	300
ADG (kg gain/head/day)	1.6	1.9	1.7	1.3	1
DMI (kg DM/hd/day)	9.3	10.3	10.9	11	9.9
FCE (kg DM/kg gain)	5.8	5.4	6.6	8.5	9.9
Mortality Rate (No in/No Out)	2.0%	2.0%	2.0%	2.0%	2.0%
Percent in Lot	38.0%	20.0%	17.0%	25.0%	0.0%

Table A10 – Region 1 (southern Western Australia) ration composition parameters

Parameter	Type	Units	Market Type			
		(DM)	Domestic	Short Fed	Mid-Fed	Long- Fed
Grain	Summer	%	0	0		
	Winter	%	75	75		
Protein	Cottonseed	%	0	0		
	Canola	%	5	5		
	Lupins	%	5	5		
	Other	%	5	5		
Roughage	Straw/Hay	%	9.5	9.5		
	Silage	%	0	0		
Liquids		%	0.5	0.5		
Supplements		%	5	5		

Table A11 – Region 2 (northern Western Australia) ration composition parameters

Parameter	Type	Units	Market Type			
		(DM)	Domestic	Short Fed	Mid-Fed	Long- Fed
Grain	Summer	%	75	75		
	Winter	%	0	0		
Protein	Cottonseed	%	5	5		
	Canola	%	0	0		
	Lupins	%	0	0		
	Other	%	5	5		
Roughage	Straw/Hay	%	2	2		
	Silage	%	4	4		
Liquids		%	4	4		
Supplements		%	5	5		

Table A12 – Region 3 (Northern Territory) ration composition parameters

Parameter	Type	Units	Market Type			
		(DM)	Domestic	Short Fed	Mid-Fed	Long- Fed
Grain	Summer	%	75	75		
	Winter	%	0	0		
Protein	Cottonseed	%	5	5		
	Canola	%	0	0		
	Lupins	%	0	0		
	Other	%	5	5		
Roughage	Straw/Hay	%	2	2		
	Silage	%	4	4		
Liquids		%	4	4		
Supplements		%	5	5		

Table A13 – Region 4 (South Australia) ration composition parameters

Parameter	Type	Units	Market Type			
		(DM)	Domestic	Short Fed	Mid-Fed	Long- Fed
Grain	Summer	%	0	0	0	0
	Winter	%	75	75	75	75
Protein	Cottonseed	%	0	0	0	0
	Canola	%	5	5	5	5
	Lupins	%	4	4	4	4
	Other	%	0	0	0	0
Roughage	Straw/Hay	%	9.5	9.5	9.5	9.5
	Silage	%	9	9	9	9
Liquids		%	1.5	1.5	1.5	1.5
Supplements		%	5	5	5	5

Table A14 – Region 5 (northern Queensland) ration composition parameters

Parameter	Type	Units	Market Type			
		(DM)	Domestic	Short Fed	Mid-Fed	Long- Fed
Grain	Summer	%	50	50	50	50
	Winter	%	25	25	25	25
Protein	Cottonseed	%	10	10	10	10
	Canola	%	0	0	0	0
	Lupins	%	0	0	0	0
	Other	%	0	0	0	0
Roughage	Straw/Hay	%	2	2	2	2
	Silage	%	4	4	4	4
Liquids		%	4	4	4	4
Supplements		%	5	5	5	5

Table A15 – Region 6 (southern Queensland) ration composition parameters

Parameter	Type	Units	Market Type			
		(DM)	Domestic	Short Fed	Mid-Fed	Long- Fed
Grain	Summer	%	32	32	32	32
	Winter	%	43	43	43	43
Protein	Cottonseed	%	10	10	10	10
	Canola	%	0	0	0	0
	Lupins	%	0	0	0	0
	Other	%	0	0	0	0
Roughage	Straw/Hay	%	3.5	3.5	3.5	3.5
	Silage	%	5	5	5	5
Liquids		%	1.5	1.5	1.5	1.5
Supplements		%	5	5	5	5

Table A16 – Region 7 (northern New South Wales) ration composition parameters

Parameter	Type	Units	Market Type			
		(DM)	Domestic	Short Fed	Mid-Fed	Long- Fed
Grain	Summer	%	25	25	25	20
	Winter	%	50	50	50	37
Protein	Cottonseed	%	10	10	10	0
	Canola	%	0	0	0	0
	Lupins	%	0	0	0	0
	Other	%	0	0	0	8
Roughage	Straw/Hay	%	3.5	3.5	3.5	5
	Silage	%	5	5	5	15
Liquids		%	1.5	1.5	1.5	10
Supplements		%	5	5	5	5

Table A17 – Region 8 (southern New South Wales) ration composition parameters

Parameter	Type	Units	Market Type				
		(DM)	Domestic	Short Fed	Mid-Fed		Long- Fed
Grain	Summer	%	0	0	0	0	0
	Winter	%	75	75	75	75	65
Protein	Cottonseed	%	10	10	10	10	0
	Canola	%	0	0	0	0	4
	Lupins	%	0	0	0	0	3
	Other	%	0	0	0	0	0
Roughage	Straw/Hay	%	3.5	3.5	3.5	3.5	8
	Silage	%	5	5	5	5	10
Liquids		%	1.5	1.5	1.5	1.5	5
Supplements		%	5	5	5	5	5

Table A18 – Region 9 (VIC/TAS) ration composition parameters

Parameter	Type	Units	Market Type				
		(DM)	Domestic	Short Fed	Mid-Fed		Long- Fed
Grain	Summer	%	0	0	0	0	
	Winter	%	75	75	75	75	
Protein	Cottonseed	%	0	0	0	0	
	Canola	%	6	6	6	6	
	Lupins	%	4	4	4	4	
	Other	%	0	0	0	0	
Roughage	Straw/Hay	%	3.5	3.5	3.5	3.5	
	Silage	%	5	5	5	5	
Liquids		%	1.5	1.5	1.5	1.5	
Supplements		%	5	5	5	5	

Appendix 2 Input-output methodology

Overview of input-output analysis

Input-output analysis provides a comprehensive economic framework that is extremely useful in the resource planning process. Broadly, there are two ways in which the input-output method can be used.

First, the input-output table provides a numerical picture of the size and shape of the economy and its essential features. The input-output transactions table can be used to describe some of the important features of an economy, the interrelationships between sectors, and the relative importance of the individual sectors.

Second, input-output analysis provides a standard approach for the estimation of the economic impact of a particular activity. The input-output model is used to calculate industry multipliers that can then be applied to various development scenarios.

Linkages between sectors

The standard approach for the estimation of the regional economic impact of a particular activity, such as wine production, is to employ *input-output analysis*. The input-output model conceives the economy of the region as being divided up into a number of sectors, and this allows the analyst to trace expenditure flows.

To illustrate this, consider the example of a winery that, in the course of its operation, purchases goods and services from other sectors. These goods and services would include grapes, bottles, and corks and, of course, labour. The direct employment created is regarded in the model as an expenditure flow into the household sector, which is one of several non-industrial sectors recognised in the input-output model.

Upon receiving expenditure by the winery, the other sectors in the state economy engage in their own expenditures. For example, as a consequence of winning a contract for work with a winery, a bottle manufacturer buys materials from its suppliers and labour from its own employees. Suppliers and employees in turn engage in further expenditure, and so on. These *indirect effects*, as they are called, are part of the impact of the winery on the regional or state economy. They must be added to the *direct effects* (which are expenditures made in immediate support of the winery itself) in order to arrive at a measure of the total impact of the winery.

It may be thought that these indirect effects go on indefinitely, and that their amount adds up without limit, the presence of *leakages*, however, prevents this from occurring. In the context of the impact on a *regional or state* economy, an important leakage is expenditure on imports, that is, products or services that originate from *outside the region, state or country* (e.g. French oak barrels).

Thus some of the expenditure for imports to the region is lost to the local economy. Consequently, the indirect effects get smaller and smaller in successive expenditure rounds, due to this and other leakages. Hence the total expenditure created in the local economy is limited in amount, and so (in principle) it can be measured.

The performance of the input-output analysis calculations requires a great deal of information. The analyst needs to know the magnitude of various expenditures and where they occur. Also needed is information on how the sectors that receiving this expenditure share *their* expenditures among the various sectors from whom they buy, and so on for the further expenditure rounds.

In applying the input-output model, the standard procedure is to determine the direct or first-round expenditures only. No attempt is made to pursue such inquiries on expenditure in subsequent rounds, not even (for example) to trace the effects in the local economy on household expenditures by winery employees on food, clothing, entertainment, and so on, as it is impracticable to measure these effects for an individual case, here the winery.

The input-output model is instead based on a set of assumptions about constant and uniform proportions of expenditure. If households in general in the local economy spend (say) 13.3 per cent of their income on food and non-alcoholic beverages, it is assumed that those working in wineries do likewise. Indeed, the effects of all expenditure rounds after the first are calculated by using such standard proportions (*multiplier* calculations).

Multipliers

Multipliers are an indication of the strength of the linkages between a particular sector and the rest of the regional economy. As well, they can be used to estimate the impact of a change in that particular sector on the rest of the economy. As noted above, detailed explanations on calculating input-output multipliers (and the underlying assumptions) are provided in any regional economics or input-output analysis textbook (see for example Hewings (1985), Jensen and West (1986), Midmore and Harrison-Mayfield (1996), Powell et al. (1985), and West (1993)). Suffice to note that they are calculated through a routine set of mathematical operations based on coefficients derived from the input-output transactions table.

Input-output transactions table

The structure and linkages of a local economy can be described with the aid of input-output analysis. Input-output analysis, as an accounting system of inter-industry transactions, is based on the notion that no industry exists in isolation.

This assumes, within any economy, each firm depends on the existence of other firms to purchase inputs from, or sell products to, for further processing. The firms also depend on final consumers of the product and labour inputs to production. An input-output transactions table is a convenient way to illustrate the purchases and sales of goods and services taking place in an economy at a given time.

Input-output tables provide a numerical picture of the size and shape of the economy and its essential features. Products produced in the economy are aggregated into a number of groups of industries and the transactions between them recorded in the transactions table. The rows and columns of the input-output table can be interpreted in the following way:

- The rows of the input-output table illustrate sales for intermediate usage (to other firms) and for final demand (consumers, exports, capital formation).
- The columns show the origin of the inputs and hence the purchases made at that time (labour, capital and intermediate inputs).
- Each item is shown as a purchase by one sector and a sale by another, thus constructing two sides of a double accounting schedule.

In summary, the input-output transactions table can be used to describe some of the important features of a regional economy, the interrelationships between sectors, and the relative importance of the individual sectors. The table is also used for the calculation of sector multipliers and the estimation of economic impacts arising from some change in the local economy.

Appendix 3 Glossary of input-output terminology

Consumption-induced effects are additional output, employment and income resulting from re-spending by households that receive income from employment in direct and indirect activities. Consumption-induced effects are sometimes referred to as "induced effects".

Direct effects are the initial round of output, employment and income generated by an economic activity.

Employment is the number of working proprietors, managers, directors and other employees, in terms of the number of full-time equivalent jobs.

Flow-on effects are the sum of the production-induced effects and the consumption-induced effects.

Gross regional (or state) product is a measure of value added on a regional basis. It can be calculated using two methods. The income method calculates GRP as household income plus other value added. The expenditure method calculates GRP as household expenditure plus other final demand, that is, in total, gross regional expenditure, plus exports less imports.

Household income is wages and salaries and other payments to labour including overtime payments and income tax, but excluding payroll tax.

Input-output analysis is an accounting system of inter-industry transactions based on the notion that no industry exists in isolation.

Input-output table is a transactions table that illustrates and quantifies the purchases and sales of goods and services taking place in an economy at a given point in time. It provides a numerical picture of the size and shape of the economy and its essential features. Each item is shown as a purchase by one sector and a sale by another, thus constructing two sides of a double accounting schedule.

Multiplier is an index (ratio) indicating the overall change in the level of activity that results from an initial change in economic activity. They are an indication of the strength of the linkages between a particular sector and the rest of the regional economy. They can be used to estimate the impact of a change in that particular sector on the rest of the economy.

Other final demand includes government expenditure, private and public sector investment (gross fixed capital formation) and change in stocks (inventories).

Other value added includes gross operating surplus and all taxes, less subsidies.

Output is gross revenue of goods and services produced by commercial organisations plus gross expenditure by government agencies.

Production-induced effects are additional output, employment and income resulting from re-spending by firms that receive income from the sale of goods and services to firms undertaking, for example, agricultural activities. Production-induced effects are sometimes referred to as "indirect effects".

Total impact is the sum of the direct effects and the flow-on effects.

Type I multiplier is calculated as (direct effects + production induced effects)/direct effects.

Type II multiplier is calculated as (direct effects + production induced effects + consumption induced effects)/direct effects.

Value added is calculated as the value of output less the cost of goods and services (including imports) used in producing the output. It represents payments to the primary inputs of production (labour, capital and land). Value added is consistent with standard measures of economic activity, such as gross domestic, state or regional product and it provides an assessment of the net contribution to regional economic growth of a particular enterprise or activity.