final report

Project code: PAS.0269

Prepared by: Mr Jim Shovelton, Dr Lewis Kahn, Mr Geoff Thomas, Emeritus Professor Jim Pratley, Mr Charles de Fegely
Mike Stephens & Associates, ,
Agricultural Information & Monitoring Services
Thomas Project Services
Charles Stuart University

Date published: November 2011

ISBN: 9781741916911

PUBLISHED BY
Meat & Livestock Australia Limited
Locked Bag 991
NORTH SYDNEY NSW 2059

R, D & E Priorities for the Southern Australian Feedbase

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Project: Developing R, D & E priorities and Investment Plan for the Southern Australian feedbase	
Report: Feedbase Investment Plan	Report Date: 14th November 2010 Edited Report Date: 24th November 2010 Edited Report Date: 12th December 2010 Final report Date: 14th January 2011
Report prepared for: Cameron Allan Project Manager, Pastures & Resource Management Meat & Livestock Australia North Sydney NSW 2060	Report prepared by Project Team of: Mr Jim Shovelton, Mike Stephens & Associates Dr Lewis Kahn, Agricultural Information & Monitoring Services Mr Geoff Thomas, Thomas Project Services Emeritus Professor Jim Pratley, Charles Sturt University Mr Charles de Fegely, Mike Stephens & Associates
	Contributions to the report from: Mr David Hudson, SGA Solutions Pty Ltd (Sections 4.1 – 4.5, Appendix 1) Dr David Lloyd (interviews QLD)
Contact details: Tel. (02) 63611204 Email. callan@mla.com.au	Contact details of Project Leader: Jim Shovelton Tel. (03) 57953445 Email. jshovelton@msanda.com.au

Executive Summary

Meat and Livestock Australia (MLA) has taken a lead role within the red meat co-investment partners and commissioned the development of an Investment Plan for the research, development and extension that underpins the Southern Australian feedbase. The Southern Australian feedbase is defined as herbage provided by pastures, grazing crops and shrubs from sown, naturalised and native plant species within the area south of the 26° line of latitude. The objectives of the Feedbase Investment Plan were to:

- Document feedbase priorities and industry deliverables that increase meat profitability and sustainability for the 6 southern agro-ecological regions that underpin the national beef and sheepmeat RD&E strategies
- Develop a Feedbase Investment Plan (FIP), addressing strategic and applied research and delivery priorities and opportunities covering Southern Australia for at least the period from 2010 to 2020, for consideration by the Red Meat Co-investment Committee (RMCiC).
- Provide recommendations for management and coordination of such investment across the national RD&E framework, supported by the public and private sectors in the pasture industry supply chain.

Strategic fit

The feedbase industry requires a national focus and has "slipped between the cracks" of the national PISC process. It is an industry that makes its contribution indirectly through meat, fibre, dairy and grain and this accounts for its lack of recognition on a national scale. The contribution of the feedbase, and pastures in particular, to farm production and sustainable natural resource management deserves focused attention in a farm systems context. A similar conclusion emerged from the recent review of Pastures Australia which identified better industry collaboration leading to a more coordinated and efficient use of RD&E resources and capacity as key objectives.

A structure for delivery of RD&E has been proposed in this FIP that will establish the national focus and provide clear linkages throughout the industry. The recommendations are aligned with national and industry priorities as developed by MLA and the PISC process. The RD&E objectives have emerged from widespread industry consultation and establish an industry direction for the period until 2020.

Consultation

The approach taken to develop the Plan involved an industry survey followed by extensive consultation with key people representative of sectors and agro-ecological regions within the Feedbase industry. Consultation activities were supported by a comprehensive review of relevant documents, reports and existing activities, a situation analysis of livestock demographics, value and underpinning practices and orientation of the Investment Plan within the strategic policy environment.

The consultation process collected 576 responses from within the Feedbase industry. The scale of the consultation process and its stratification across industry sectors and agro-ecological regions provides a very sound justification for the recommendations contained within this report. The consultation used industry knowledge and many of the participants had experience from other RD&E programs. This knowledge provided a context and a filter about the state of the industry and informed responses about prioritising existing technologies likely to have the largest impact on the productivity and sustainability of red meat production. The value of consultation was also

brought to bear when industry-experienced participants nominated research areas and projects to further improve the feedbase industry. There were other benefits from the consultation such as identifying major barriers to adoption and capturing preferred and perhaps novel methods of extension and communication.

The Project Team used their industry experience and knowledge gained from the review process to build the consultation responses into a workable, strategic and innovative Feedbase Investment Plan (FIP). The short and long –term goals for the feedbase industry put forward in this FIP will be achieved by increasing the margin between cost of production and price received per unit product.

GOALS FOR THE FEEDBASE INDUSTRY

- Increase by 30% the productivity and profitability of red meat production by 50% of producers by **2015**, through the adoption of existing information and practices. These changes will also lead to improvements in the sustainability of natural resources and quality of life of industry participants.
- Increase by a further 30% (i.e. 60% increase from year 2010 position) the productivity and profitability of red meat production by 50% of producers by **2025**, through the adoption of information and practices to emerge from research programs. These changes will also lead to further improvements in the sustainability of natural resources and quality of life of industry participants.

In the first instance, responses were partitioned according to a decision tree with segmentation on the basis of **current** (i.e. existing technologies) and **future** (i.e. research programs) industry needs. A clear outcome from the consultation was the recognition that existing knowledge/practices/technologies are adequate to support a 30% improvement in the productivity and profitability of red meat production while also improving the sustainability of natural resources. Using the outcome from the consultation we have proposed a delivery structure that integrates local, regional and national issues which will lead to improved rates of adoption and penetration to non-traditional market segments.

Existing technologies for adoption

Industry responses indicated considerable improvements to the profitability (22 – 55%) and sustainability of red meat production from adoption of existing technologies and further gains to be generated from research activity. With only some exceptions, there was substantial consistency among the agro-ecological regions as to the **current** issues regarded as of top priority for adoption. Ranking of existing technologies indicated emphasis should be given to adoption pathways that address the following:

1. Better pasture utilisation
2. Improved grazing management
3. Improved soil fertility
4. Increased legume content
5. Increased sown perennial grass content
6. Better integration of crops with pastures
7. Improved control of weeds
8. Correct soil pH
9. Increased use of fodder crops
10. Increased subdivisional fencing

Delivery structure

Many of these technologies have and continue to be the subject of extension programs and the review indicated that extension programs have had some success in increasing adoption. Importantly, the results of this consultation clearly indicate that a new approach that builds on

previous programs is required to address the nominated barriers to adoption. The key reasons that technologies are not adopted include concerns about:

1. Seasonal variation
2. Cash flow
3. Lack of confidence that adoption will yield profit
4. Risk of failure
5. Lack of technical and farm business skills (as opposed to information)
6. Labour and infrastructure issues

MLA market research and review documents generated by Pastures Australia highlighted inadequacies in the pasture industry supply chain both in terms of services to producers and information sharing. Our conclusion from the consultation process was that extension methods needed to facilitate a higher level of producer engagement in a whole-farm and business context which accounted for peer group, risk and labour. Achieving change will require a substantial shift from the technology driven "one size fits all" approaches of the past. The approaches recommended for effective extension to drive rates of adoption and market penetration should be formed to satisfy the demand for:

Approaches where producers learn with other producers, see adoption of practices in a whole-farm context in their locality and have access to financial information of the benefits and risks.

Lead Farms

The approach recommended in this FIP is to address the known barriers to adoption and preferred extension methods through the development of a network of Lead Farms. Briefly, Lead Farms are commercial properties which will be used as the basis of establishing facilitated action learning groups of producers, be used as the location for adoption of current technologies and, in some circumstances, be used to identify research projects and house networked research sites. Focus paddocks may be located on the Lead Farm or on farms of producer group members where technologies of interest will be investigated. The choice of Lead Farms will provide the opportunity to engage with various traditional and non-traditional market segments. Lead Farms offer the opportunity for linkage with existing programs such as More Beef from Pastures and across other MLA Program areas. *Allocated budget is $4.6M over a 5-year period*.

It is recommended that the focus for the delivery of feedbase technologies be based on a network of 100 commercial Lead Farms. This approach will address many of the barriers to adoption, place extension in a local context and better integrate the sectors in the feedbase industry.

Feedbase Development Managers

Lead Farms will be linked nationally through professional Feedbase Development Managers who will be responsible to Agro-Ecological Teams. In addition to their management role of the Lead Farm program, their role will include liaison between the sectors of the feedbase, facilitate the transfer of information and technology up, down and within the feedbase sectors as well as ensuring that the information/training needs of providers and producers are met. *Allocated budget is $6.0M over a 5-year period*.

It is recommended that eight Feedbase Development Managers based on agro-ecological regions be appointed to lead and facilitate regional teams, manage the Lead Farm program and take responsibility for development, delivery and evaluation of RD&E activities.

Agro-Ecological Teams

The consultation highlighted the broad similarity of issues within the agro-ecological regions and this provides the basis for bringing together the wide range of expertise from within and outside of that region, including producers, producer groups, private and public consultants, the retail sector, input suppliers and researchers to form Agro-Ecological Teams. The key benefits from this approach include better allocation of resources to priority issues, increased cross-sectoral communication and better integration of activities. The Agro-Ecological Teams will form a network that links Lead Farms with the national body of Feedbase Oz. *Allocated budget is $1.4M over a 5-year period*.

It is recommended to establish eight Agro-Ecological Teams to develop a whole farm business strategic framework relevant for their agro-ecological region which will guide investment and on-ground activity.

Feedbase Oz

Whilst opinions of the effectiveness of Pastures Australia varied among respondents, it is important that there be a national focus on the feedbase (and particularly pasture) industry. The recommendations in this FIP support those of the recent review of Pastures Australia but importantly also provide the linkage to regional and local issues and the capacity through Feedbase Development Managers.

It is recommended that a new national body (called Feedbase Oz) be formed consisting of key people from the existing RDCs and with inclusion of representatives from industry sectors and agro-ecological regional groups. The body would be the peak group for the feedbase industry, and be a forum to co-ordinate activity and optimise collaboration for project support. This structure ensures a funding base directly through the RDCs and indirectly through government and interconnects the various elements and proposals of this FIP. The national body would not just deal with technical issues but those of industry importance, including capacity building, and work closely with groups such as the RMCiC, RMAC and PISC.

Research programs addressing future needs

The clear message from the consultation process was that importance should be given to:

Research programs that address improving the utilisation and management of the existing feedbase, provide greater integration with farming systems and the whole farm business, and then improve pasture choices through evaluation and selection programs.

Successful adoption of the research outcomes is estimated to eventually increase the profitability of red meat production by an average of 29% with moderate improvements to the sustainability of natural resources. Five research program areas were developed from the consultation, which are:

Plant improvement

It is expected that there will be greater public benefit from public sector investment in germplasm enhancement and platform technologies such as genome sequencing with private sector engagement in cultivar development. The species targeted for public investment should be those which are unlikely to attract stand alone private investment.

It is recommended to:

Establish an independent plant evaluation and selection program using appropriate genetic and genomic technologies to improve a range of pasture traits such as increased persistence, lower

nutrient (fertiliser) requirements, higher quality feed and out of season production. The evaluation will be built upon a network of linked sites that provide uniform and independent genetic evaluation of pastures species and investment in germplasm enhancement and platform technologies such as genome sequencing. The keystone species for improvement are legumes (lucerne, medic, sub clover), phalaris and subtropical species. *Allocated budget is $5.9M over a 5-year period*.

Establish a formalised process for collection and analysis of pasture seed sales for Southern Australia.

Pasture production

Research will address improvements in the efficiency of fertilizer use by better testing and application regimes and better harnessing of soil biological processes. The key nutrient is phosphorus but attention to sulphur and potassium is also recommended. *Allocated budget is $2.5M over a 5-year period*.

Pasture harvest

The objective is to develop grazing systems for better utilisation of pastures and shrubs, which encourage perenniality, and which achieve high livestock performance with high labour efficiency. There is a need to develop indicators or trigger points to best determine appropriate rates of utilisation and livestock rotations that fit agro-ecological regions, enterprise mix and risk exposure profiles. *Allocated budget is $5.5M over a 5-year period*.

Production systems

There are market signals that are encouraging a greater integration of crops, pastures and livestock in traditional mixed farming regions and also those with higher rainfall.

The major objective is the need to develop systems to better integrate livestock and the pastures that support them with cropping enterprises, with primary attention to the role of grazing cereals, legume break crops and the strategic use of containment feeding. *Allocated budget is $3.5M over a 5-year period*.

Evaluation

The major themes are further development of farm system models that will assist with climate adaptation, financial performance and system optimization and analysis of farm system options for profit, risk, labour and natural resource management. Models are a basic building block of RD&E programs and this will support greater focus on key areas. In addition to sophisticated models there is a role for simple tools which capture the key performance indicators of farms and are used in the extension process. *Allocated budget is $1.6M over a 5-year period*.

Capacity building

The issue of maintenance and development of research capacity is an issue for the feedbase industry. While the data suggest broadly that there is sufficient research capacity in most feedbase components in the short to medium term, there is a notable issue that the skill base is thin and in decline. It is also evident that expertise in pasture agronomy has been diverted to other disciplines as agencies seek to adjust to budget cuts. The industry is also suffering from a low level of interaction by the non-commercial sector with the commercial sector and there is a general feeling of dysfunction in the feedbase supply chain. A number of recommendations were formed about industry human capacity which are:

- Greater farmer involvement in the design and delivery of research and extension
- Better information transfer between sectors and capacity building within the feedbase
- Integrated coordination of feedbase RD&E
- More collaborative projects
- Better collaboration between public and research sectors and private industry

The Project team recommends:

- A detailed assessment be carried out as the age structure and succession of existing staff in the feedbase industry and how this might be impacted by changes in government support for RD&E.
- Further develop the MLA mentoring program to target particular needs and to broaden beyond research to include advisory services.
- Annual regional interactive forums based on agro-ecological regions.
- Recognise the need for whole farm business skills and provide these to the various sectors (private and public), but particularly those engaged in extension and those from aligned industries such as crop agronomists.

Extension program activities, objectives, deliverables, time frame and regional relevance for investment in the feedbase of Southern Australia.

Extension activity	Adoption objectives	Deliverables	Time frame (years)	Agro-ecological significance (1,2,3)[A]
Feedbase Oz	National coordination of feedbase industry activities and linkages	• National Feedbase strategies at the agro-ecological regional level • Coordination across RDCs for project delivery • Linkage of Feedbase industry with national priorities	On-going	All
Agro-ecological teams	Co-ordination of feedbase extension activities on an agro-ecological basis	• Formation of 8 regionally based networks for the adoption of relevant technologies	10	All
		• Appointment of 8 Feedbase Development Managers	On-going	All
		• Regional RD&E priority setting and delivery	On-going	All
Capacity building	Improve the skill base of public and private providers of advice to producers	• Annual updates based on agro-ecological regions	Annually	All
		• Improved feedbase management skills in Advisors, particularly in the mixed cropping grazing zones with livestock management	3	(1) Temperate Slopes and Plains (1) Arid Interior (2) Semi arid Sub Tropical Plains (2) Sub Tropical Slopes and Plains (3) Temperate Highlands (3) Wet Temperate Coast
		• Improved financial management skills in Advisors and Producers	3	All
Lead Farm	On-farm implementation of technologies in a whole farm context	• The phased establishment of a network of lead farms in southern Australia and associated Focus Paddocks	3	All
		• Active engagement of appropriate feedbase sectors in lead farm activities	10	All
		• Adoption of relevant technologies which demonstrate improved profitability and sustainability of red meat production	10	All
		• Identification of component research issues	10	All

[A]Agro-ecological relevance (1) top priority; (2) moderate priority; (3) low priority

Research program areas, themes, objectives, deliverables, time frame and agro-ecological relevance for investment in the feedbase of Southern Australia.

Research Program	Major themes	Research objectives	Deliverables	Time frame (years)	Agro-ecological relevance (1,2,3)[A]
Plant Improvement	Evaluation and selection programs	• Implement an independent plant evaluation and selection program using appropriate quantitative genetic and genomic technologies to improve the persistence, quality and productivity of existing keystone species and evaluation of new species.	• A network of linked sites that provide uniform and independent genetic evaluation of pastures species. • Investment in germplasm enhancement and platform technologies such as genome sequencing.	6 - 9	(1) Temperate Slopes and Plains (1) Temperate Highlands (1) Wet Temperate Coast (2) Sub Tropical Slopes and Plains
		• Selection to provide the base pasture traits identified through the consultation process. These traits are required for all the pasture species which are listed below. Species specific traits, in addition to the deliverables for this objective, are provided below.	Base general pasture traits: • better persistence under grazing and moisture stress • lower phosphorus requirements and/or higher nutrient extraction efficiency • higher feed quality and production • out of season production • better seedling vigour • lower animal health toxicity		All
	Legumes	• Selection to increase the tolerance to low soil pH and mixed-sward compatibility of **lucerne** • Selection of shorter-season **medics** with better seed production and **sub clovers** with greater consistency across variable seasons	• Lucerne cultivars with greater tolerance of low soil pH and better compatibility in a mixed sward (i.e. grass/lucerne) • Medic cultivars with a shorter season and better seed set for recruitment and sub clovers with greater adaptation to climate variability	6 - 9	(1) Temperate Slopes and Plains (1) Temperate Highlands (2) Wet Temperate Coast
	Phalaris	• Selection to reduce phalaris toxicity and increase aluminium tolerance	• Phalaris cultivars with lower toxicity for livestock and better aluminium tolerance	6 - 9	(1) Temperate Slopes and Plains (1) Temperate Highlands (2) Wet Temperate Coast
	Subtropical species	• Selection of legumes for better adaptation to sub-tropical grass pastures • Selection of Subtropical grasses for adaptation to southern Australia	• Legumes better adapted to persist in sub-tropical pastures • Subtropical grasses adapted to southern Australian soil and climate	6 - 9	(1) Sub Tropical Slopes and Plains (2) Temperate Slopes and Plains
Pasture Production	Pasture nutrition	• Improve the efficiency of fertilizer use by better testing and application regimes and better harnessing of soil biological processes.	• Improved precision of nutrient status determination , pasture requirements and application technologies to enhance the marginal return from on-farm fertilizer applications • Greater understanding of soil biology and its role in reducing fertilizer requirements	6 - 9	(1) Temperate Highlands (1) Wet Temperate Coast (2) Temperate Slopes and Plains (2) Sub Tropical Slopes and Plains
Pasture Management and Harvest	Grazing management	• Develop grazing systems for better utilisation of pastures and shrubs, which encourage perenniality, achieve high livestock performance with high labour efficiency.	• Grazing rotation indicators (e.g. stock density, graze and rest periods, pasture residuals) for different feedbase systems, enterprises and agro-ecological regions • Demonstration of the linkages between optimal rates of pasture utilisation (% of pasture growth) and stocking rate decisions (including seasonal variation) • Development of trigger points for matching stocking rate to planned rates of utilisation • Evaluation of the impact of grazing rotation and pasture utilisation strategies on livestock performance, risk exposure, profit and sustainability	3 - 6	(1) Arid Interior (1) Semi arid Sub Tropical Plains (1) Temperate Highlands (1) Wet Temperate Coast (1) Sub Tropical Slopes and Plains (2) Temperate Slopes and Plains
	Pasture management	• Develop information to allow management of pastures to fill feed gaps for increased persistence, quality and productivity in a variable climate.	• Integrated systems that fill feed gaps including the role of forage crops and fodder conservation • Management strategies to increase the consistency of the legume content of pastures	3 - 6	(1) Temperate Slopes and Plains (1) Temperate Highlands (1) Wet Temperate Coast (2) Sub Tropical Slopes and Plains
		• Develop more labour efficient approaches to sheep production	• Evaluation of ways to improve labour efficiency of sheep production	1 - 3	All
Production Systems	Integration of crops, pastures and livestock	• Develop systems for better integration of livestock and the pastures that support them with cropping enterprises. Primary attention to the role of grazing cereals, legume break crops and the strategic use of containment feeding.	• Development of the technical basis for the role of livestock in mixed enterprises for managing crop diseases, risk and impact on profit • Evaluate the strategic role of containment feeding in mixed cropping/livestock feeding	3 - 6	(1) Temperate Slopes and Plains (1) Sub Tropical Slopes and Plains (1) Semi arid Sub Tropical Plains (1) Temperate Highlands

					(1) Wet Temperate Coast (2) Arid Interior
Evaluation	Farm system models and financial benchmarks	• Further develop models that will assist with climate adaptation, financial performance and system optimization.	• Analysis of farm system options on profit, risk, resource management and labour • Analysis of the impact of climate change in models to predict species abundance and feedbase productivity	1 - 3	All

[A]Agro-ecological relevance (1) top priority; (2) moderate priority; (3) low priority.

Table of Contents Page Number

Table of Figures Page Number

Table of Tables

1.0 Introduction

Meat and Livestock Australia (MLA) has taken the lead within the red meat industry and commissioned the development of an Investment Plan for the research, development and extension that underpins the Southern Australian feedbase. Red meat includes beef, sheep and goat meats. The Southern Australian feedbase is defined as herbage provided by pastures, grazing crops and shrubs from sown, naturalised and native plant species within the area south of the 26° line of latitude.

MLA market research and review documents generated by Pastures Australia highlighted inadequacies in the pasture industry information supply chain both in terms of services to producers and information sharing between the various sectors. This commission is to review all aspects and relevant technologies of feedbase production/sustainability that can improve the productivity of red meat production, and develop a comprehensive investment plan for RD&E.

The specific objectives were to:

- Document feedbase priorities and industry deliverables that increase meat profitability and sustainability for the 6 southern agro-ecological regions that underpin the national red meat industries
- Develop a Feedbase Investment Plan, addressing strategic and applied research and delivery priorities and opportunities covering Southern Australia for at least the period from 2010 to 2020, for consideration by the Red Meat Co-investment Committee (RMCiC).
- Provide recommendations for management and coordination of such investment across the national RD&E framework, supported by the public and private sectors across the pasture industry supply chain

2.0 Strategic fit of the Feedbase Investment Plan

2.1 Background

It is important that any planning be within the context of the many policy and strategic initiatives being taken within industry and government.

National RD&E priorities for the beef and sheepmeat industries have been developed through consultation between Federal, State and Territory Governments, industry and research organisations (Fig. 1). National research priorities of the Australian Government complement the National Rural Research and Development priorities (2007) and act to guide research effort (http://www.daff.gov.au/agriculture-food/innovation/priorities). These priorities were established to position the livestock industries to improve long term profitability, competitiveness and sustainability.

Within the direction provided by the National and Rural research priorities, the Primary Industries Ministerial Council (PIMC) has developed a National RD&E Framework to facilitate further cooperation between government agencies and industry for improving the efficiency and effectiveness of the national RD&E capability. Of relevance for the livestock industries has been the development of National Beef Production and Sheepmeat Production RD&E strategies coordinated by the Primary Industries Standing Committee (PISC), which is a subcommittee of PIMC. Development of the Sheepmeat Production strategy was led by Industry and Investment, NSW and MLA and the Beef Production strategy by the Department of Employment, Economic

Development and Innovation, Qld and MLA. These national strategies are serviced by organisations with membership of the Red Meat Co-investment Committee (RMCiC) which include Federal and State agencies, MLA, CSIRO, Co-operative Research Centres and Universities.

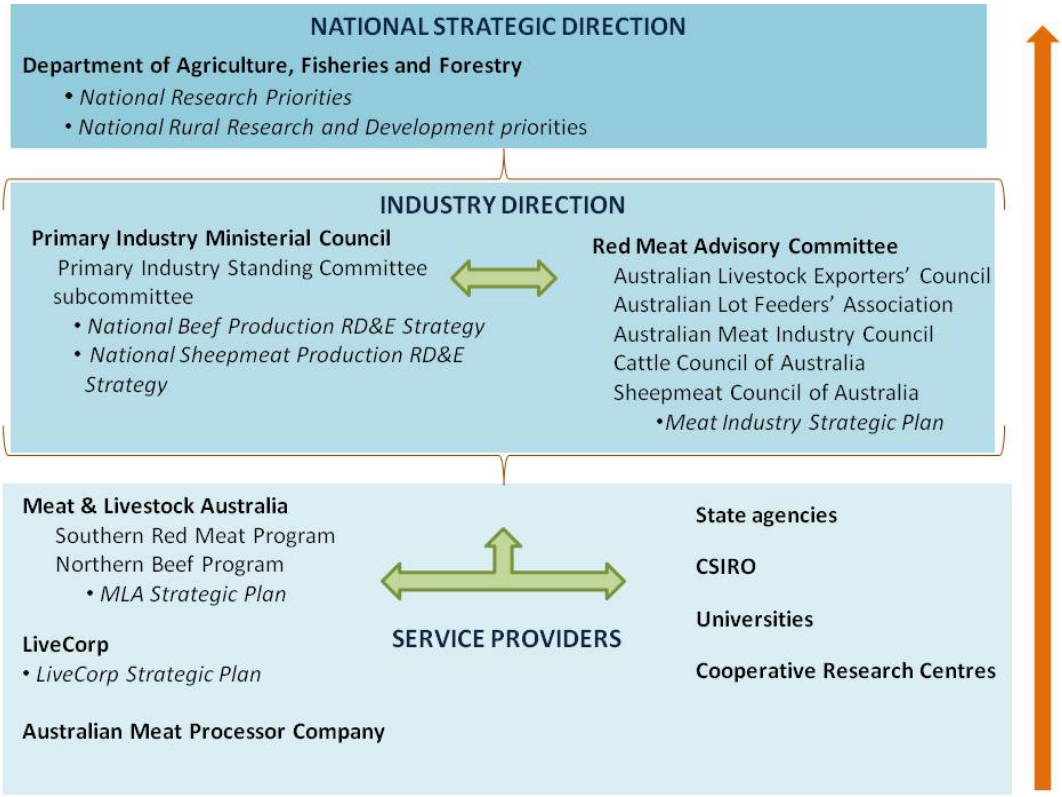


Figure 1: Strategic framework of the red meat industry

Within the red meat industry, the Red Meat Advisory Council (RMAC) developed the third Meat Industry Strategic Plan (MISP; 2010-2015) to guide the red meat and livestock industries in guaranteeing vital food for the nation and the world. Membership of RMAC and input into the MISP was provided by five peak industry councils (Australian Livestock Exporters' Council, Australian Lot Feeders' Association, Australian Meat Industry Council, Cattle Council of Australia and Sheepmeat Council of Australia). The strategic themes identified in the MISP are serviced by the activities of Meat and Livestock Australia (MLA), LiveCorp and the Australian Meat Processor Company (AMPC). The RMCiC through the National Beef Production and Sheepmeat Production RD&E strategies integrates other industry priorities, such as MISP, with agency and research activity.

The focus of the MLA Strategic Plan (2010-2015; www.mla.com.au/files/8324e581-bd4b.../MLA-Strategic-Plan-2010-15.pdf) is provided from the MISP and is closely aligned with the PISC process and the National and Rural research priorities (Fig. 2). The Strategic Plan supports progress on five imperatives:

1. Improving market access
2. Growing demand
3. Increasing productivity across the supply chain
4. Promoting industry integrity and sustainability
5. Increasing industry and people capability

The MLA Strategic Plan is supported by the Southern Red Meat Program (formerly Southern Beef Program) and the Northern Beef Program. **The MLA Feedbase Investment Plan for Southern Australia detailed in this report, fits into the strategic environment by supporting progress on imperatives 3-5 in the MLA Strategic Plan**.

Whilst these formal industry arrangements are important, there are several components of the strategic and policy environment that warrant discussion in the context of implementing the MLA Feedbase Investment Plan for Southern Australia.

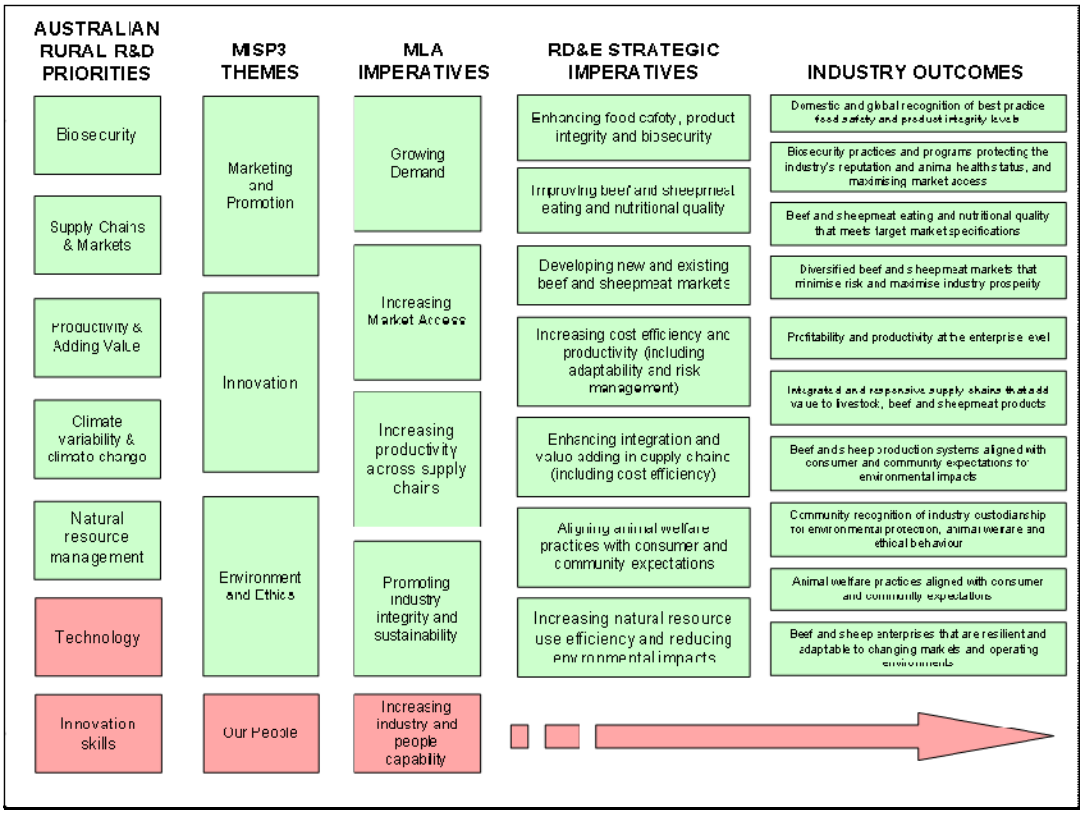


Figure 2: Alignment of MLA Strategic Plan imperatives and outcomes with other industry priorities

2.2 Primary Industry Standing Committee (PISC)

The PISC agenda has been driven largely by the realisation that State agencies, in response to State government budget pressures and priorities, are required to reduce their investment in agricultural services and that there is a need to rationalise the provision of those services at a national level in order to make best use of the increasingly limited resource. The initial agreement by the Ministers (in PIMC) was that research (R) would be led nationally, development (D) regionally and extension (E) locally, with the States maintaining a strong responsibility for D and E.

In practice, the rationalisation of resources to support research, as required under the PISC strategies has not occurred. In the case of D&E, most States, faced with budget constraints, have substantially reduced their commitment to field D&E. This has resulted in a reduction in capacity in the very areas which this report (see Sections 7.0 and 8.0) shows are important, such as the adaptation and proofing of research results to local conditions as a means of facilitating adoption of research. This shortage of field capacity, especially in the livestock industries is an important constraint to progress towards increasing red meat production. Strategies to overcome this constraint are discussed in Sections 7.0, 8.0 and 10.0.

2.3 Productivity Commission

There are several aspects of the Productivity Commission Draft Report (2010) into Rural Research Development Corporations which, if adopted by government may impact on the adoption of the strategies presented in the MLA Feedbase Investment Plan for Southern Australia.

These include such things as:

- The proposed reduction in government funding, given a belief, at least by the Productivity Commission, that most of the benefits to R, D &E are in the private good.
- A concentration on the needs of research rather than the benefits provided by D & E in achieving the gains from adopting known information.
- The lack of appreciation of farmer decision making within the farm system context, and therefore of the need for farm systems adoption research and improved extension capacity in the field.
- Failure to effectively address cross sectoral issues that exist within a whole of farm context.

Feedbase issues are central to these considerations and are covered in Section 3.

2.4 Cross – Sectoral considerations

The major issue when considering the feedbase, and the pasture component in particular, is that the benefits are indirect and difficult to value. For example, take the case of the cropping/livestock enterprise and the interactive but indirect benefits of better pasture to subsequent crops and of crop products to the livestock enterprise. Indirect benefits arising from the pasture feedbase have tended to “fall between the cracks” of livestock and cropping strategies. This is the case with both the PISC and Productivity Commission activities outlined above. The contribution of the feedbase, and pastures in particular, to farm production and sustainable natural resource management deserves focused attention in a farm systems context.

3.0 The approach to developing the Feedbase Investment Plan

The approach taken to developing the Feedbase Investment Plan (FIP) included the following steps:

1. Review existing industry strategic documents of relevance to the structure and governance of the feed base supply chain. A list of these documents is provided as part of the References to this document.
2. Develop the feedbase consultation framework covering the components and sectors of the feedbase supply chain across the agro-ecological regions.
3. Compile a list of key organisations and stakeholders in public and private organisations undertaking pasture RD&E in the identified agro-ecological regions.
4. Conduct a situation analysis covering regional:
    - Livestock demographics, production levels and trends in red meat production
    - Practices underpinning red meat production.
5. Consult with participants in all sectors of the feedbase supply chain to identify priorities for RD&E investment, document current and planned investment in RD&E, and seek additional information on such things as communication networks essential in developing a FIP which can be put into immediate effect.

6. Develop a FIP that supports improvement in the productivity, profitability and sustainability of red meat production, is based on outcomes of the industry consultation, is consistent with the situation analysis, and is positioned to have strategic fit with industry.
7. Provide information to enable a benefit cost assessment of the FIP, conducted by an independent economics team engaged by MLA (outside scope of this commission).
8. Integrate review comments of the draft FIP from an independent group of stakeholders.
9. Submit the final FIP.

3.1 Feedbase supply chain

The feedbase supply chain consists of several core components including improvement of existing and/or selection of new genotypes, establishment and production of herbage, harvest and supplementation (value adding) of that herbage and biological and financial evaluation of the feedbase system (Table1). All components interact to underpin the red meat industry. Within each core component are specific themes which were identified during this review and presented in Section 9.0.

Table 1: Feedbase components that combine and interact to support the feedbase supply chain.

Feedbase Components				
New genotypes	Establishment	Production	Harvest	Evaluation
• Plant improvement	• Pasture establishment	• Pasture nutrition • Pasture management	• Grazing management • Dual enterprise systems • Supplements	• Farm system models • Financial analysis

3.2 Feedbase sectors

The sectors of the feedbase supply chain represent the various interests of producers (End Users), advisors (Next Users), retail, input suppliers and researchers. The consultation sought input from across the public and private sectors.

3.3 Agro-ecological regions

Consultation and development of the FIP sought to accommodate differences among the agro-ecological regions of Southern Australia (Fig. 3). The agro-ecological regions were based on those proposed by Williams et al. (2002) which separates Southern Australia into seven distinct regions based on differences in biophysical characteristics. This consultation did not include the Wet Subtropical Coast. The remaining six regions have a good fit with the known differences in agricultural practices and are therefore a suitable basis for a targeted FIP. That said, some regions such as the Temperate Slopes and Plains still have significant variation within them, requiring further targeting of programs.

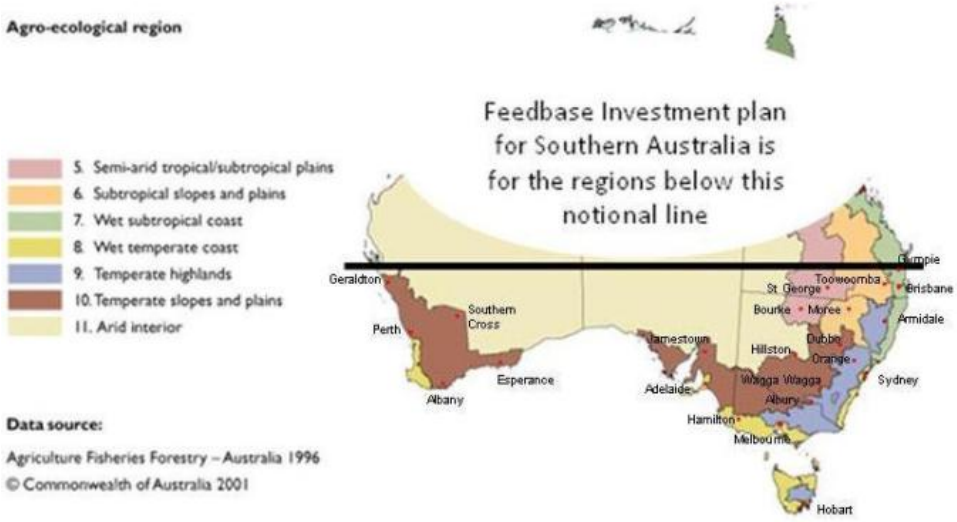


Figure 3: Agro-ecological regions of Southern Australia

3.4 Framework guiding the Feedbase Investment Plan

The framework used to underpin the FIP (Table 2) is based on increasing the production, profitability and sustainability of red meat by **increasing the margin between cost of production and price received per unit product.** The main drivers of cost of production and revenue are in Table 2 and each of the investment recommendations within the FIP address at least one of these drivers.

Table 2: Guiding framework used to develop the Feedbase Investment Plan

Aspiration	Double red meat production from half of the area currently used for grazing
Goals	1. Increase by 30% the productivity and profitability of red meat production by 50% of producers by **2015**, through the adoption of existing information and practices. These changes will also lead to improvements in the sustainability of natural resources and quality of life of industry participants. 2. Increase by a further 30% (i.e. 60% increase from year 2010 position) the productivity and profitability of red meat production by 50% of producers by **2025**, through the adoption of information and practices to emerge from research programs. These changes will also lead to further improvements in the sustainability of natural resources and quality of life of industry participants.
Objective	Increase the margin between cost of production and price received while managing risk and improving the natural resource base
Actions	*Research and extension programs to target at least one of the following actions:* 1. Decrease cost of production • Reduce the contribution of overheads to the unit of production • Match pasture supply and demand • Optimise marginal economic return from variable inputs 2. Increase the unit value of production by meeting market specifications 3. Improve the condition of the natural resource base 4. Manage risk exposure associated with production

4.0 Feedbase situation analysis and underpinning practices

This section provides background information for the red meat industry in the agro-ecological regions of Southern Australia. The data have been derived from Australian Bureau of Statistics (ABS) data for the years 2001, 2005 and 2009. Because of inconsistencies in the data collection methods between years, some assumptions have been necessary to arrive at projected stock numbers and the implications of these changes. A full description of the situation analysis is provided in Appendix 1.

4.1 Area of pasture

In 2001 the area of 'Native & Self Sown' pastures across all agro-ecological regions totaled 28.61 million hectares. The ABS definition of 'Native & Self Sown' refers to 'native and naturalized pasture including all grasses and legumes indigenous to the area or those introduced in the past which are now reproducing naturally'. This grouping includes pasture in low input pastoral areas and some low productivity pastures in higher rainfall regions.

In 2001 the 'Sown' pasture area was 21.88 million hectares. ABS ceased to collect sown pasture data after 2001, but it has been assumed that the total farmed area remained the same for the 2006 and 2009 census data. On mixed cereal/livestock farms, areas of sown or naturally regenerating pasture would have fallen substantially over this period as the area in crop increased.

4.2 Livestock numbers

The size of the beef cattle herd across all six agro-ecological regions declined from 10.17 million head in 2001 to 9.66 million head in 2009 (Fig. 4).

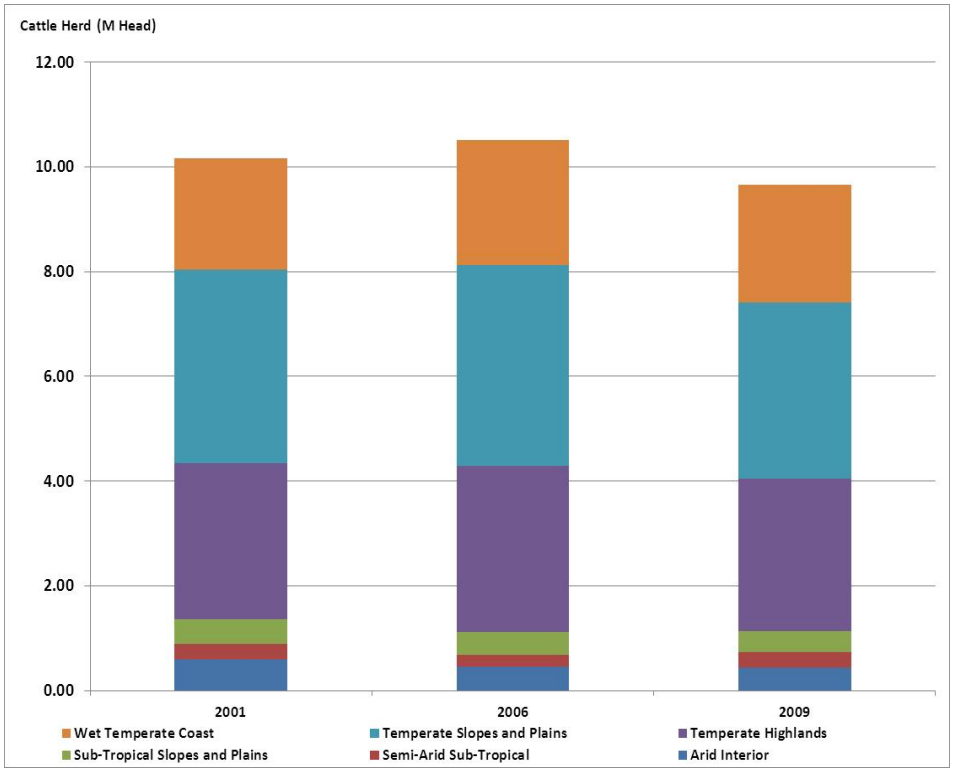


Figure 4: Beef cattle numbers by agro-ecological region in the years 2001, 2006 and 2009.

The reduction in the sheep flock was relatively greater with the total number of sheep and lambs falling from 101.46 million in 2001 to 68.48 million in 2009 (Fig. 5). There are indications that this may be turning because of sustained high prices for lamb and more favorable seasons.

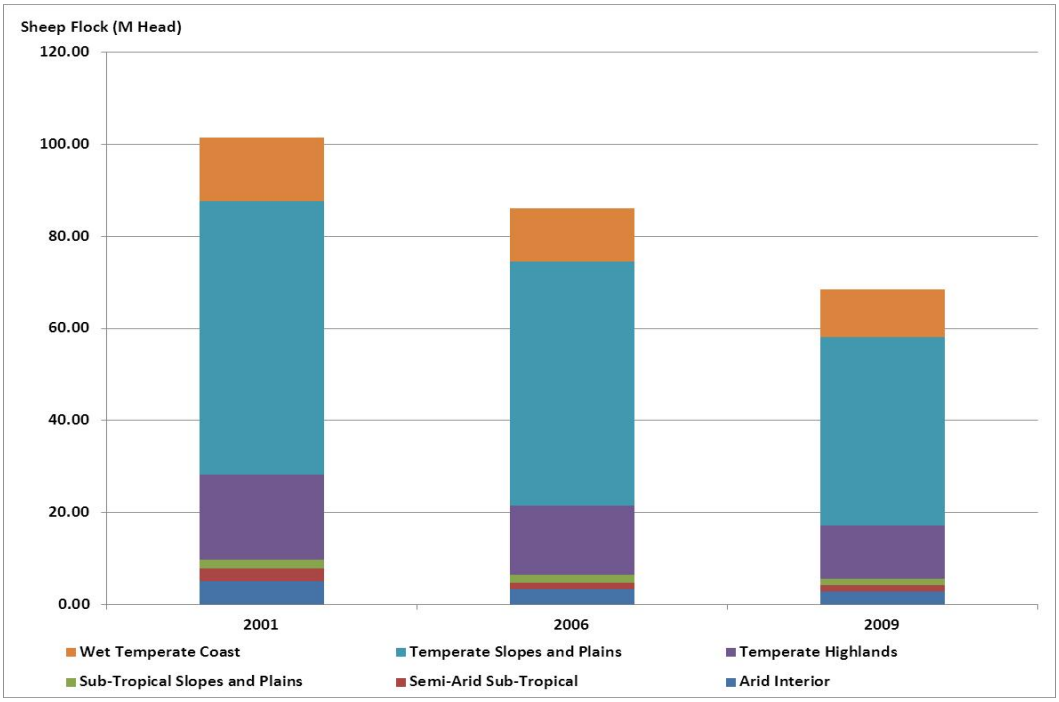


Figure 5: Sheep numbers by agro-ecological region in the years 2001, 2006 and 2009.

These changes, especially in the sheep flock reflect a combination of drought across all six regions, continuing low prices for wool, and a shift to cropping driven by grain prices. Not only was this shift to cropping evident in traditional mixed cropping/livestock areas, but occurred in medium/high rainfall areas where there had previously been little cropping activity. **This shift to cropping has important implications for RD&E priorities and cross sectoral investment in the FIP**.

4.3 Expected trends in livestock numbers

Prospects for the beef, sheep and grains industries within the regions and states of interest have been remarkably transformed due to the improved climatic conditions since the end of 2009. Heavy rains across south eastern Australia have dramatically improved soil moisture and pasture conditions as well as water storage levels. The rainfall has also resulted in improved irrigation water allocations in the short to mid-term for crop and pasture production along the Murray Darling irrigation system.

Over the five years to 2015, the area sown to grains and oilseeds is projected to average around 23.5 million hectares, compared with an average of 22.5 million hectares over the 10 years to 2009. Since the 1990s, there has been an increase in the area of pastures converted to cropping, especially in the Temperate Slopes and Plains and Wet Temperate Coastal regions. Over the next two to three years competition for land use between livestock and winter crop production is expected to increase within these regions. Increased competition will arise because prices for beef cattle and sheep are projected to remain high as livestock producers restrict market supply while they rebuild their beef cattle herds and sheep flocks and re-establish pastures.

The need for "break crops" after continuous cereal will further increase paddock-based and stored fodder supply giving the potential to further increase livestock output on mixed farms. As part of this trend, there continues to be a swing from wool sheep to prime lamb, especially in medium/low rainfall areas. At the same time it is expected that livestock producers having gained experience in cropping practices, especially in the Wet Temperate Coastal region will look to shorten the length of permanent pasture phases prior to the introduction of a cropping phase. As a result of this forecast trend, the contribution of pastures to the value of winter crops is expected to slightly decline.

The Australian Bureau of Agricultural and Resource Economics (ABARE) predicts that the growth in the number of beef cattle and sheep within the regions of interest will be 20.83 million DSE (dry sheep equivalents) by 2015. ABARE's projections are for an increase in beef cattle numbers of, on average 3.0% per year. Considering that in 2009 the beef cattle herd within the agro-ecological regions represented 38.8% of the national herd it is estimated that between 2010 and 2105 the cattle herd within these regions has the potential to increase cumulatively by approximately 717,000 cattle (Fig. 6).

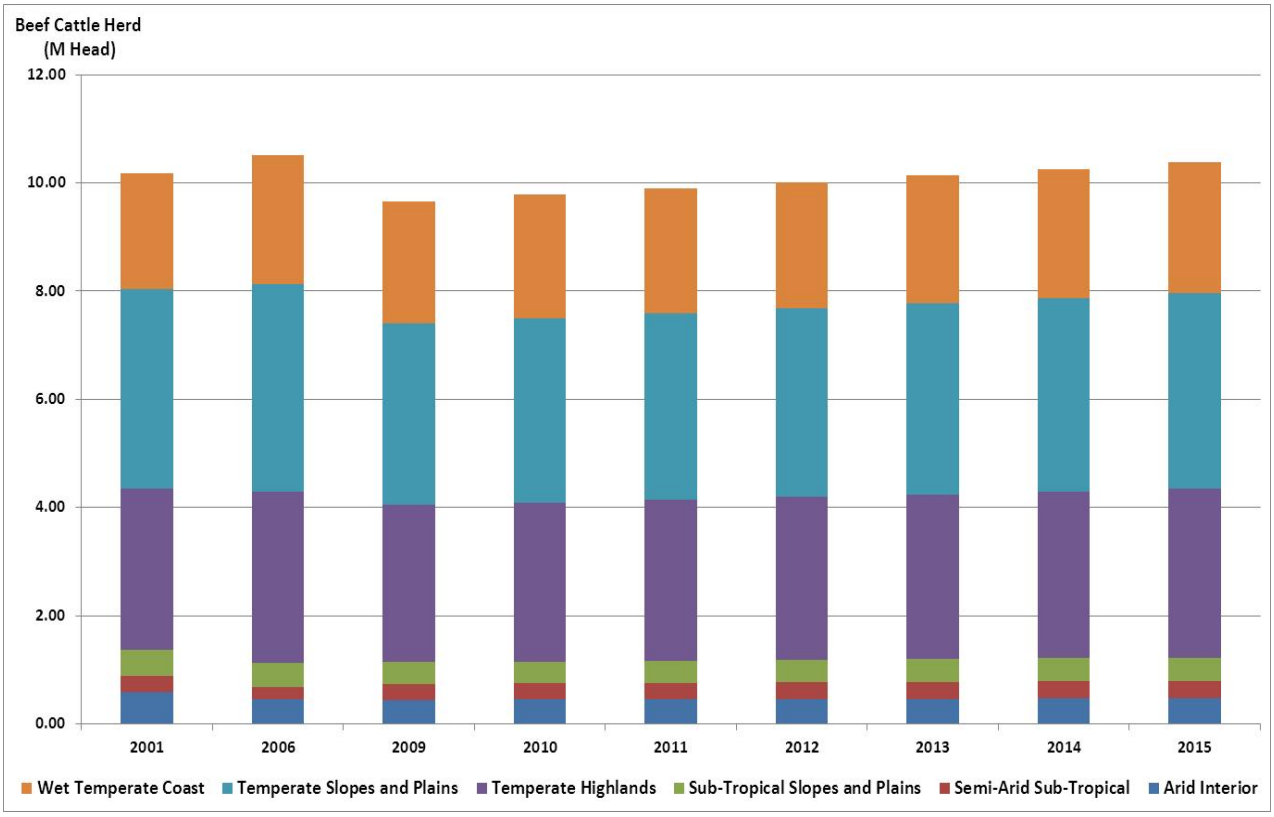


Figure 6: Projected beef cattle herd number within agro-ecological regions for the period 2010 – 2015.

ABARE also predict a moderate increase in the size of the national sheep flock. The sheep numbers within the agro-ecological regions represented 94 % of the national flock and it is estimated that between 2010 and 2015 the sheep flock within the southern agro-ecological regions has the potential to increase cumulatively by approximately 5.08 million head (Fig. 7).

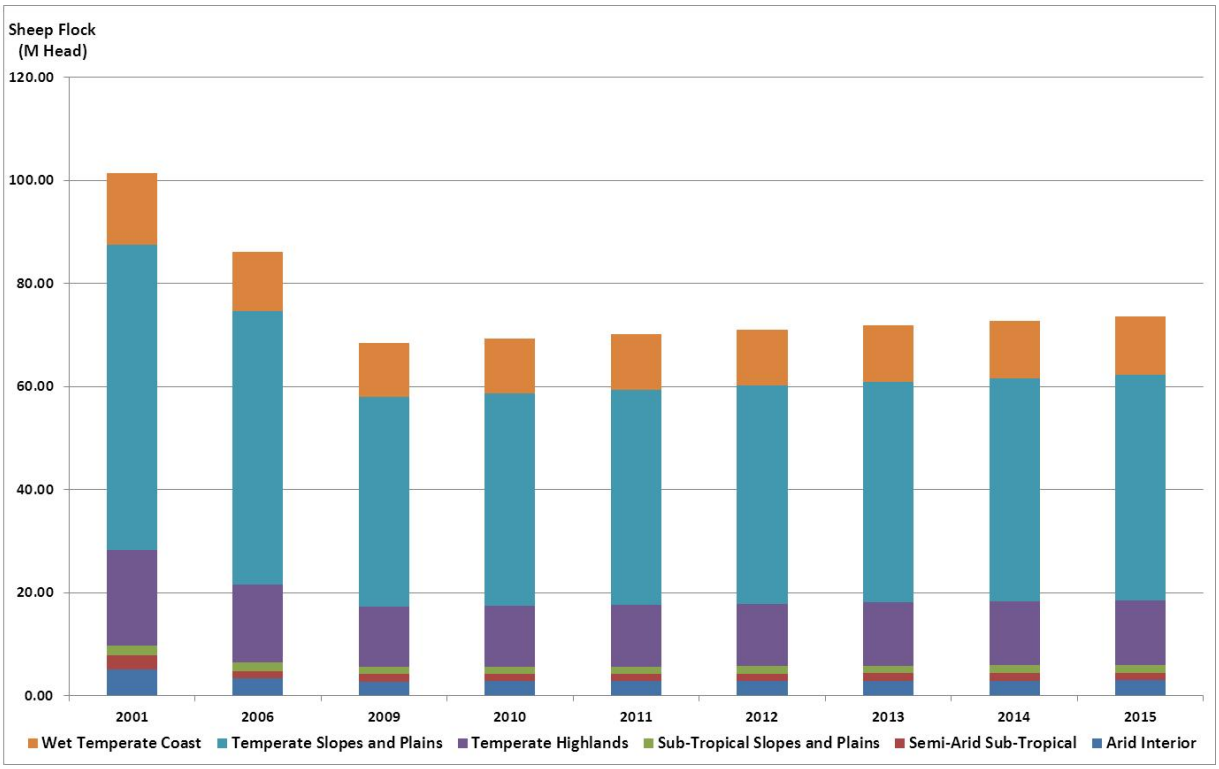


Figure 7: Projected sheep numbers within agro-ecological regions for the period 2010 – 2015.

Based on the estimated areas of land covered by the southern agro-ecological regions, this increase in stock numbers (if applied proportionally across each of the regions) will require an increase in 0.21 DSE/ha. The estimates for the Temperate Slopes and Plains is for an increase of 0.22 DSE/ha while the Temperate Highlands and Wet Temperate Coast regions would require increases of 0.50 DSE/ha and 0.55 DSE/ha respectively. The projected increases in stock numbers on a per hectare basis are small in relation to the existing potential to increase stocking rates. As such the projected increase should be comfortably met through the adoption of existing technologies.

In summary, there is likely to be a recovery in stock numbers over the next five years following significant reductions between 2001 and 2006. Provided seasonal conditions are favorable, a significant increase in stocking rates and productivity is possible. The potential to lift productivity will be influenced to the extent that existing pastures have degraded as a result of adverse seasons and the reductions of pasture inputs such as fertilizer (see Section 4.6.1). The switch to grazing crops as part of more flexible mixed farming systems will also be strongly influenced by relative prices of grains and red meat.

The most significant region in relation to value of livestock produced and the value of pastures is the Temperate Slopes and Plains. The area to cropping is likely to increase so that the ability to integrate crop and grazing systems is likely to become more even important.

4.4 Value of production from pastures

The value ($AUD) generated by pastures directly from livestock production and from the indirect contribution to winter crop production from the southern agro-ecological regions increased from $4.99 billion (B) in 2001, to $6.25B in 2006 and $6.50B in 2009 (Fig. 8). Most of this increased value has occurred because of changes in the price of sheep and lamb meat (Fig. 9).

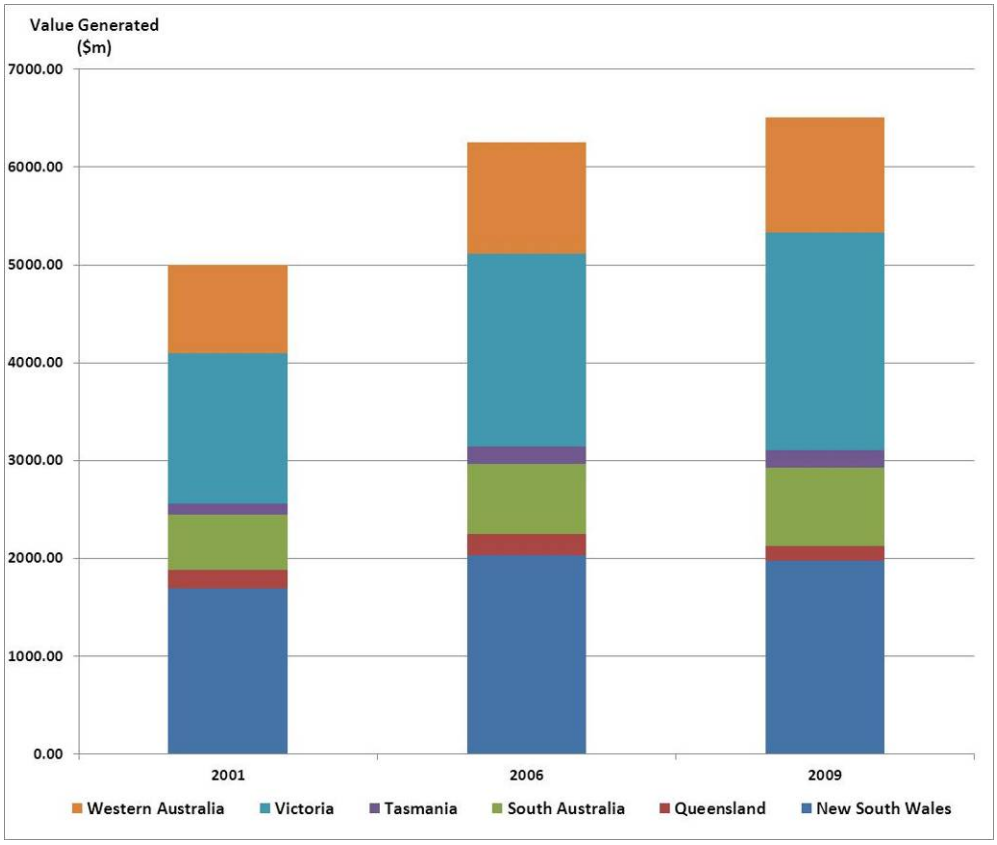


Figure 8: Combined value of pasture and livestock within agro-ecological region for the years 2001, 2006 and 2009.

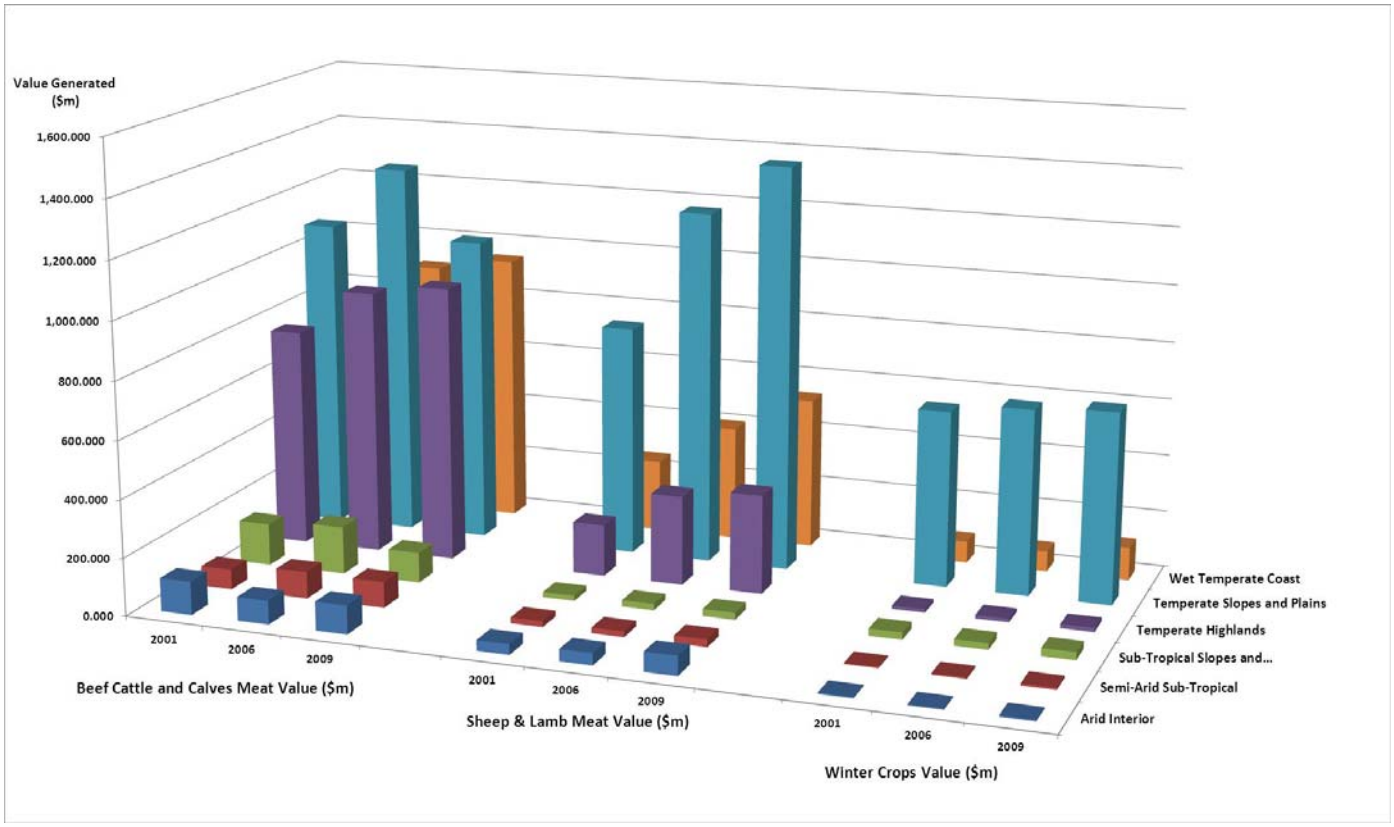


Figure 9: Pasture and livestock value generated by enterprise type within each agro-ecological region for the years 2001, 2006 and 2009.

Despite the reduction in sheep and cattle numbers, the primary drivers for the increase in value were:

- the continued "sell off" of sheep and cattle for slaughter as a result of the declining availability of pastures for grazing due to the drought,
- the increase in the adoption and intensification within traditional pasture of winter crops and the pasture benefit accruing to the crops,
- the shift from wool production to sheep meat production, and
- a significant increase in sheep meat prices in the period between 2001 and 2007.

Of the agro-ecological regions, the primary contributor of total value during the 2001 to 2009 period was the Temperate Slopes and Plains region which contributed about 50% of the value generated from beef, sheep and winter crops in each of the three years of the ABS census. New South Wales and Victoria were the main state contributors with about 30% of the value generated from livestock and winter crops in each state for the years 2001, 2006 and 2009.

In 2001 there was a total of $2.95B in value generated from the sale of cattle and calf meat. This increased to $3.47B in 2009 and declined slightly to $3.27B in 2009. The Temperate Slopes and Plains region generated the majority of the value derived from cattle and calf meat sold contributing $1.09B (36.8%) in 2001, $1.31B (37.6%) in 2006 and $1.07B (32.6%) in 2009. New South Wales and Victoria dominated the supply of beef cattle and calf meat to the market. In 2001, New South Wales contributed $1.16B (39.4%) and Victoria $0.97B (33.0%) of the cattle meat sold. By 2009 this had increased to $1.24B (38.1%) and $1.16B (35.5%) respectively for each state.

The value generated from the sale of sheep and lamb meat in 2001 was $1.31B which increased to $2.02B in 2006 and $2.40B in 2009. The supply of sheep and lambs was dominated by the Temperate Slopes and Plains region which contributed $0.80B (61.3%) in 2001, a further $1.23B (60.8%) in 2006 and $1.41B (58.7%) in 2009.

The dominance of the Temperate Slopes and Plains in both beef and sheep production raises important issues as to the balance of investment between agro-ecological regions. This is a major consideration in determining the FIP and was addressed through the consultation process and is considered in RD&E programs (Sections 7.0 – 9.0).

In 2001, the value generated from winter crops of interest, attributable to pastures (e.g. through nitrogen inputs) was estimated to total $0.73B. By 2006, the value had increased to $0.76B and by 2009 it had further increased to $0.84B. The major winter crop was winter cereals, which represented over 90% of the total value. To provide consistency, the method of Gout and Jones (2006) for Pastures Australia was used to calculate the indirect value of pastures to grain production. It assumed that the first year benefit to crops was as follows:

- High rainfall – 1.0 t/ha for cereals, 0.4 t/ha for oilseeds, 0.3 t/ha for grain legumes
- Medium rainfall – 0.7 t/ha for cereals, 0.3 t/ha for oilseeds, 0.2 t/ha for grain legumes
- Low rainfall – 0.4 t/ha for cereals, 0.2 t/ha for oilseeds, 0.1 t/ha for grain legumes

The length of crop rotation was estimated by region from the GRDC 2004 profit drivers report

- One year in very high rainfall livestock areas
- Four years in high rainfall zones

- Five years in medium rainfall mixed farming zones
- Four years in low rainfall mixed farming and cropping zones.

While the method used provides consistency, it is known rotations have shortened considerably since 2004 with lesser reliance on pastures and greater emphasis on grazing cereals and break crops, which is likely to result in lower benefit to the crop from the pasture.

These figures probably underestimate the importance of feedbase crops and pastures to the cropping system in that they do more than supply nitrogen by providing a disease break and opportunity for grass weed control which have enormous benefits on the following crops. In fact without them, many intensive cropping systems would not be sustainable. On the flip side, grazing cereals and stored cereal grains are playing an increasingly important role in filling feed gaps and improving livestock production.

The integration between farming enterprises is an important consideration in preparing the FIP and highlights the need for a systems approach in order to optimize enterprise profitability, manage risk and capture the natural resource benefits.

4.5 Forecast value of sheep meat and cattle production

The forecast value of Australian sheep meat production and cattle production for the period 2010-11 to 2014-15 is provided in Tables 3 and 4 respectively. ABARE provide data for the number of live exports, but no estimate of the value. For completeness, a nominal value of $80 per head has been used for the live sheep trade and $650/head for the live cattle trade. Note that ABARE projections are national projections and are not provided on an agro-ecological regional basis.

Table 3: Forecast value of the sheep meat market 2010-11 to 2014-15.

		2010-11	2011-12	2012-13	2013-14	2014-15
Mutton	Production (kt dw[A])	187	182	186	194	200
	Nominal (¢/kg dw)	300	315	315	310	305
	Value ($B)	0.56	0.57	0.59	0.60	0.61
Lamb	Production (kt dw)	405	404	410	420	430
	Nominal (¢/kg dw)	450	465	475	480	485
	Value ($B)	1.82	1.88	1.95	2.02	2.09
Total slaughtered value ($B)		2.38	2.45	2.53	2.62	2.70
Live sheep export	Number ('000)	3400	3400	3450	3500	3500
	Value @ $80/head ($B)	0.27	0.27	0.28	0.28	0.28

[A] Dressed weight

Table 4: Forecast value of cattle meat market 2010-11 to 2014-15.

		2010-11	2011-12	2012-13	2013-14	2014-15
Cattle	Production (kt dw[A])	2108	2120	2139	2157	2165
	Nominal (¢/kg dw)	272	277	285	295	305
	Value ($B)	5.80	5.90	6.10	6.36	6.60
Live cattle export	Number ('000)	953	973	994	1017	1041
	Value @ $650/head ($B)	0.62	0.63	0.65	0.66	0.68

[A] Dressed weight

The value of sheep meat production (excluding live sheep exports) is forecast to increase by 12% in nominal value during the period 2010-11 to 2014-15. At the same time the value of beef production (again excluding live exports) is forecast to increase by 15%.

4.6 Practices underpinning red meat production

The key drivers of productivity are production per hectare and product quality, as reflected in price for the unit of production, and there are many practices which combine to influence the profitability of red meat production.

The feedbase factors which have the greatest influence on productivity include:

- Sustained high levels of quality feed.
- Efficient and sustainable use of feed produced so as to maintain the feedbase and meet animal demand.

These factors are commonly accepted by farmers and are described below. "*Improvements in productivity …… start with those changes that are cheap and provide large returns e.g. manipulating lambing time and turnoff times in order to improve pasture utilisation. The next step is to grow more pasture and ensure it is utilised with more animals. Initially this should be done by improving soil fertility. Sowing new pastures and improving paddock subdivision follows these earlier actions*." (McEachern *et al*, 2005).

This approach to red meat production is supported by the outcomes of the consultation and matches with the experience of the Project Team. It makes sense that farmers, especially given a period of low profitability due to poor seasons or prices, will adopt strategies which generate the ready income first, before they make what are in effect capital investments in things like pasture establishment; especially perennial pastures. This has important implications especially for the balance between RD&E in the FIP.

There is a lack of data on which to assess most feedbase practices, which constrains the capacity to assess their adoption and value. Broad data (i.e. regional or industry) exist for fertilizer use, pasture sowing and grazing management/feed utilisation, but otherwise there is a dearth of information.

4.6.1 Soil fertility

Soil fertility is a major driver of red meat production through its influence of pasture productivity and quality. A more detailed description of fertiliser practices and usage is provided in Appendix 2. The results of a number of studies (such as Grassland's Productivity Program and the Triple P Program) confirm that fertilizer programs, which address key plant nutrients, accompanied with appropriate rates of feed utilisation, lead to significant increases in productivity and profitability of broad acre grazing systems.

Despite the evidence in favour of increasing and managing soil fertility, it appears that fertilizer use on pastures has been decreasing at an alarming rate. An accurate estimate of fertilizer use for non-cropping purposes is obscured by lack of distinction between pasture and cropping applications, while application rates also fluctuate with the price of fertilizer and commodities and seasonal conditions.

There is potential to significantly increase red meat production through the correction of soil nutritional deficiencies and, because inputs of fertilizer to pasture soils have declined dramatically, this potential has been increasing. Strategies to improve soil fertility provide an important opportunity to increase red meat production in most regions.

4.6.2 Pasture renovation

There is no formalised collation and collection of pasture seed sales for southern Australia. This section draws on information from data collected by the Rural Industries Research and Development Corporation (RIRDC) for the 2003 growing season, Gout and Jones (2006) for the 2005/06 growing season, and MLA (H Robinson, pers. comm.) for the 2009/2010 season. It is not clear if standardised methodology was used but the data does provide broad guidelines about trends in pasture renovation. A more detailed description of pasture renovation practices is provided in Appendix 3. Data sourced from the Australian Seeds Authority for certified seed produced annually in Australia for the years 2004-05 to 2008-09 has been compared to the above data. There is a very poor correlation between the data collected by the two methods. In a number of cases the estimated seed sales greatly exceed the certified seed produced and in other cases the opposite is the case. These two scenarios would be expected if for the first situation there were significant imports of seed or there were significant sowings of uncertified seed or in the second situation there were considerable exports of certified seed.

It is considered that the certified seed figures are likely to be less indicative of the level of pasture improvement than the estimates of seed sales; however, the discrepancy between the two sets of data highlights the poor state of knowledge about the Australian Feedbase and the need for more accurate baseline data.

It is recommended that a formalised process for collection and analysis of pasture seed sales be initiated for Southern Australia.

Estimates of temperate seed sales for each of the three data sets are provided (Table 5). For the purpose of this study the seed sales have been averaged to provide an average annual seed sale quantity. The annual estimated pasture renovation rate has been calculated from the total pasture area identified in the 2003 ABS census data for the Temperate Slopes and Plains, Wet Temperate Coast and Temperate Highlands agro-ecological regions and from assumed sowing rates of the various species.

Table 5: Seed sales of major temperate pasture species and estimated pasture renovation rates.

	Seed sold (t)			Average seed sales (t)	Assumed sowing rate (kg/ha)[A]	Estimated area sown since 2003 (ha/year)	Pasture renovation rate (%/year)[B]
	2003	2005	2009				
Sub clover	2,300	1,700	1,902	1,967	6	327,889	0.55%
White clover	800	600	684	695	2	326,902	0.54%
Perennial Ryegrass	6,200	2,400	3,528	4,043	10	404,267	0.67%
Phalaris		180	156	112	3	44,800	0.07%
Cocksfoot		210	222	144	3	48,000	0.08%
Lucerne	2,500	2,100	2,838	2,479	5	550,963	0.92%
Tall fescue	450	650	846	649	9	76,314	0.13%

[A] Assumed sowing rate is an unweighted average between single species and mixed species sowing rates.

[B] Pasture renovation rate calculated from estimated area sown each year and total pasture area from 2003 ABS census data.

The clear indication is that there is a very low rate of pasture renewal. The percentage pasture sowing rate values for each species are not likely to be additive. Phalaris, cocksfoot and ryegrass are likely to be sown with a legume so the estimate of total area sown is probably better reflected by the addition of the resowing rates for the legumes. Annual medics were not included in the latest study. This is important given that mixed farming systems rely more on medic or on sown feed such as vetch, peas, lupins, oats and other grazing crops. Medic use has declined substantially under more intensive cropping systems but may recover now that farmers are using more break crops after extended cereal phases. Even if these are included, the resowing rate is unlikely to exceed 2.5% of pastures each year. The data do not account for failed sowings or the resowing of pastures that have failed to persist.

Sowing of pastures represents an opportunity for increasing red meat production but the low rates of renewal suggest important barriers exist to the on-farm adoption of this practice. We suggest that the low pasture renovation rates are likely to result from a combination of lack of perceived benefit from pasture renovation and cultivars and species which do not have the desirable traits required by producers and identified from the on-line survey (see Table 16, Section 5.0). These are key issues that need to be addressed in future research and extension programs.

4.6.3 Grazing management and feed utilisation

Grazing practices of livestock producers were documented in Southern Australia for the year 2003 (IPM survey, 2005). At that time, some 48% of producers practised set stocking and 38% practised some form of rotational grazing. While this describes broad practices, the data on the

financial and natural resource benefits of different grazing practices is inconclusive, despite extensive projects such as Sustainable Grazing Systems and EverGraze.

The term grazing management is often used interchangeably with that of managing feed utilisation but these are distinct feedbase components. Both relate to the harvesting of the feedbase but where grazing management reflects the pattern (set stock, rotation, etc.) of harvest, utilisation describes the proportion of pasture growth that is consumed by livestock. There has long been an opinion within the feedbase industry that rates of utilisation are too low and should be increased by 10% points, allowing an increase in stocking rate. This may be a simplistic perspective based on favourable seasons and a more appropriate objective is to manage to achieve appropriate rates of feed utilisation which need to be considered in a risk management context rather than just a level of production. Rates of feed utilisation are not static and increase with herbage production because it is the residual herbage (i.e. not consumed by livestock) that is the key variable.

There is an opportunity for improvement of grazing management and feed utilisation across all agro-ecological regions to improve red meat profitability and to better manage seasonal risk. However, capital requirements for infrastructure may act as a barrier for on-farm adoption.

5.0 Industry consultation

5.1 Approach and methods

The approach used as the basis for the industry consultation was rigorous in the breadth and depth of the contacts from sectors and agro-ecological regions. The extensive consultation provided justification for the identified current and future priorities, highlighted later in this FIP, that require adoption and/or research. The approach is analogous to simulations of a model – the greater the simulation number the more likely the output will approach the “truth”.

In the same manner, we consider that the analysis of data collected from the consultation provides much of the justification for the actions recommended in this FIP.

Furthermore, the consultation included industry knowledge and participants from many of the previous industry-funded programs (as interviewees) to provide information on both the existing situation and on future directions. These people provided an important filter from which existing investment was considered as part of identifying gaps in research and extension.

Consultation with industry was designed to sample all industry sectors, States and agro-ecological regions. The consultation process with industry took four forms.

1. An online (internet) Feed Base Priority Survey open to interested participants in the Southern Australian feedbase.
2. A telephone survey (interview) of producers and advisers.
3. A telephone survey (interview) of Researchers.
4. Consultation with RD&E providers.

Focus groups or workshops were not used in order to better record equal weighting to the opinions of individuals involved in the industry, rather than the vocal minority as often happens in groups.

The multiple surveys were able to be linked by similar questions being asked of different industry sectors in the different surveys. This provided sectoral and regional perceptions of industry priorities in a way that could be aligned with what producers, advisers and research providers believed were the research needs.

In total, comprehensive inputs were provided by 576 people from across all sectors of the industry and the six agro-ecological regions. This was a very good outcome and provided a robust information base for the recommended FIP.

5.1.1 Feed Base Priority Survey

An online survey (Appendix 4) was open for 50 days (9th August – 28th September 2010) and completed by 444 respondents who provided information and priorities on:

- On-farm actions related to the feedbase to increase red meat production.
- Barriers to the adoption of on-farm actions.
- Investment in extension, development and research.
- Priorities for MLA investment in feedbase research.
- Priorities for MLA investment in feedbase extension.
- Required characteristics for plant breeding programs.
- Priorities for development and packaging of research outputs.
- Preferred approaches to extension, training and advice.
- The likely impact of some possible future (2020) feedbase scenarios on red meat production.

A survey was pre-tested and then circulated initially to over 800 individuals sourced through the Pastures Australia database, consultant contacts, the Grassland Society of Southern Australia, the Grassland Society of NSW, Bestwool/Bestlamb network in Victoria, the Western Australian Farmers Association, Australian Association of Agricultural Consultants, Australian Institute of Agricultural Science and Technology, the Australian Society of Agronomy and the Australian Society of Animal Production. All those contacted were requested to forward the link to potentially interested people. The link was also publicised on the MLA home page.

5.1.2 Producer – Adviser interviews

Participants were key industry informants who were understood to have a broad perspective of feedbase issues (see survey at Appendix 5 and a list of respondents at Appendix 8). Most surveys were conducted by telephone with a few conducted face to face. Eighty two Producers and Advisers were surveyed.

Respondents were asked to:

- Nominate the three most important opportunities for increasing red meat production that could be addressed with **existing** technology and/or information.
- Indicate the expected **benefit** from the adoption of these existing technologies for the productivity/profitability and sustainability of red meat production.
- Prioritise **extension methods** and information to gain greater adoption of these existing technologies.
- Nominate the top three feedbase **research priorities** to increase the profitability and sustainability of red meat production.
- Indicate their level of **professional interaction** with the sectors of the feedbase industry and ways to improve collaboration.

Because adoption in existing programs (e.g. More Beef from Pastures, Making More from Sheep, etc) appeared to have stalled, particular emphasis was placed on understanding the barriers to adoption and preferred extension methods. In other words it was likely that there was not a lack of technical information *per se* but the barriers and drivers had not been addressed in a way preferred by farmers (see Section 5.3.4).

5.1.3 Researcher interviews

Researchers were selected from universities, state departments, CSIRO and several commercial organizations. Fifty interviews (mix of telephone and face to face) were conducted (see survey at Appendix 6 and a list of respondents at Appendix 8).

Participants were asked to:

- Nominate their top three **research priorities** for increasing red meat production and to provide the expected outputs arising from this research.
- Indicate the likely impact on **productivity/profitability** and **sustainability** arising from these research priorities. For each research priority, the time frame for successful completion, total funding requirements and residual funding requirement was noted.
- Identify whether their organisation had the **expertise** to undertake the nominated research or whether expertise existed elsewhere in Australia or internationally.
- Indicate their level of **professional interaction** with the sectors of the feedbase industry and ways that could improve collaboration.

5.1.4 RD&E Provider consultations

This survey was designed to identify current activities and capacity in feedbase RD&E, its agro-ecological regional relevance, and the likely future priorities for investment. Whereas the other surveys were designed to capture an individuals' response, this survey was designed to capture the corporate or organisational response. Twenty three interviews were conducted (see survey at Appendix 7 and a list of the participants at Appendix 8).

The following data were requested:

- Current feedbase research and extension programs.
- Numbers of research and support staff in feedbase research and the number providing feedbase advice.
- The organisation's budget for each of the research areas.
- The feedbase research expertise in the organisation – those currently engaged in feedbase research and those with feedbase expertise currently engaged in non-feedbase research.
- The likely change in emphasis of feedbase research and extension over the next ten years.
- The organisation's priority subjects for extension and research and the likely impact on productivity/profitability and sustainability, should these activities be successful.
- The level of interaction with other sectors of the feedbase industry and suggestions to achieve greater industry integration and coordination

5.1.5 Linkage of consultation responses to inform the Feedbase Investment Plan

The responses from the four forms of consultation provided a comprehensive basis for the development of the FIP. Responses were partitioned according to a decision tree (Fig. 10), initially on the basis of current and future industry opportunities.

Current needs relate to existing technologies and information that could be adopted now to increase the profitability and sustainability of red meat production. The respondents not only

identified these **extension** opportunities, but made an assessment of the expected impact of adopting the technologies, the likely barriers to adoption, and the forms that extension, training and advice should take to maximise rates of adoption. Hence the first step of the FIP is to improve the flow, and therefore leverage, of existing technologies.

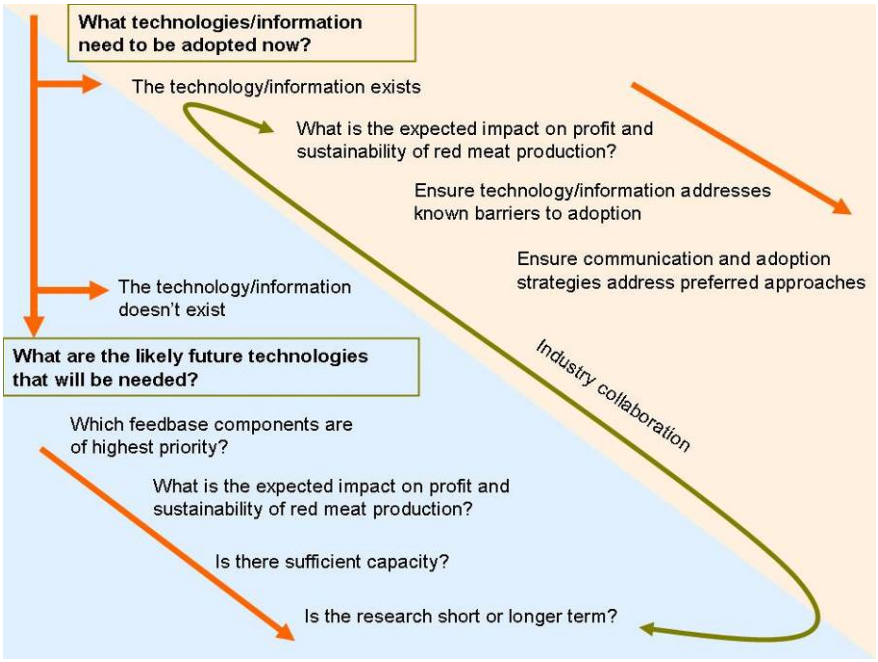


Figure 10: Decision tree approach to linking survey and interview responses to development of the Feedbase Investment plan.

Future needs relate to technologies that are likely to be needed to further increase the profitability and sustainability of red meat production. The respondents not only identified these **research** opportunities but also made assessment of the likely cost and duration of the research, expected impact of adopting the end technology, once the research was successfully completed, as well as the capacity to conduct the research. This research arm of the FIP is connected with communication and adoption strategies through regional teams and industry governance leading to collaboration.

The information collected on the linkages between researchers and others in the feedbase industry clearly pointed to the need for a greater team approach. The proposed mechanisms for structuring the RD&E components of the FIP are provided later in this document (see Sections 7.0-9.0).

5.2 Overview of respondents

5.2.1 Feedbase Priority Survey overview

There were a total of 444 respondents to the Feedbase Priority survey. It is important to explain aspects of the data. Respondents were able to select multiple sectors, States and agro-ecological regions in which they operated. In this way, the data presented in this section relate to the number of people who identified with a particular sector, State or agro-ecological region. The sum of the number of people identifying with each sector exceeds the total of responses because many respondents identified with multiple categories. In the same manner the percentage values provided in the following Tables of data sum to more than 100%. Adjustment to constrain the sum of the percentages to 100% (as is convention) would underestimate the representation of each

category. For example, (Table 6) a total of 236 respondents identified as a Producer. Of these, 21 also identified as a Private Consultant, 17 as a Public Advisor and so forth. Similarly, 70 respondents identified as a Private Consultant and of those respondents, 2 identified with the Retail sector.

In summary:

- Allowing for the selection of multiple categories, 53.2% of respondents identified as a Producer, 15.8% as a Private Consultant, 12.2% as a State Researcher and 11.5% as Public Advisory.
- The majority of respondents had activity in Victoria (40.8%) or NSW (37.6%) (Table 7).
- The most commonly identified agro-ecological regions were the Temperate Slopes and Plains (59.8%), Temperate Highlands (35.9%) and Wet Temperate Coast (31.8%) (Table 8).
- Beef cattle was the most common enterprise (69.8%), followed by meat sheep (66.1%), wool sheep (59.7%), cropping (50.8%), dual purpose sheep (47.6%) and smaller contributions from dairy (17.8%) and goats (7.3%).

Table 6: Number of respondents identifying with each Feedbase sector[A].

Sector	Producer	Private Consultant	Public Advisory	Retail	Plant Breeder	CSIRO Scientist	State Researcher	University	Input Supplier Company	Other	Identified with sector (%)[B]
Producer	236	21	17	8	2	1	6	4	6	11	53.2
Private Consultant	21	70	2	2	1	1	0	2	1	3	15.8
Public Advisory	17	2	51	0	1	0	5	0	0	0	11.5
Retail	8	2	0	15	1	0	0	0	5	1	3.4
Plant Breeder	2	1	1	1	16	1	6	1	3	2	3.6
CSIRO	1	1	0	0	1	18	0	1	0	0	4.1
State Researcher	6	0	5	0	6	0	54	1	0	1	12.2
University	4	2	0	0	1	1	1	18	0	0	4.1
Input Supplier Company	6	1	0	5	3	0	0	0	23	2	5.2
Other	11	3	0	1	2	0	1	0	2	46	10.4

[A] The sum of the number of people identifying with each sector exceeds the total of responses (n=444) because some respondents identified with multiple categories. Those values bolded indicate the total number who identified with the sector. Other values within a row indicate nomination of multiple sectors. For example, 236 respondents nominated as a Producer of which 21 also identified as a Private consultant and so forth. [B] Percentage values calculated from the total number of respondents identifying with each sector and the number of respondents (n=444). The sum of all percentage values exceeds 100 because of the nomination of multiple sectors.

Table 7: Number of respondents[A] identifying with each State.

State	Producer	Private Consultant	Public Advisory	Retail	Plant Breeder	CSIRO Scientist	State Researcher	University	Input Supplier Company	Other	Identified with state (%)
South Australia	32	19	6	7	7	4	12	1	10	16	19.1
New South Wales	73	27	23	8	10	10	25	11	8	23	37.6
Queensland	10	6	8	3	3	2	4	2	5	14	9.7
Tasmania	14	9	1	5	7	1	1	2	6	11	8.1
Victoria	100	32	15	8	8	5	15	7	17	21	40.8
Western Australia	54	15	6	6	6	9	11	2	7	14	23.4

[A] See footnote to Table 6

Table 8: Number of respondents[A] identifying with each agro-ecological region.

Agro-ecological region	Producer	Private Consultant	Public Advisory	Retail	Plant Breeder	CSIRO Scientist	State Researcher	University	Input Supplier Company	Other	Identified with region (%)
Arid Interior	6	8	5	1	1	1	5	2	2	9	7.0%
Temperate Slopes and Plains	118	54	29	9	14	15	34	8	13	31	59.8%
Temperate Highlands	72	29	15	7	9	9	14	10	12	22	35.9%
Wet Temperate Coast	62	26	16	6	13	4	17	5	14	20	31.8%
Sub Tropical Slopes and Plains	15	7	13	3	5	2	10	3	3	14	14.1%
Semi Arid Sub Tropical Plains	1	5	5	3	2	1	5	2	3	13	7.5%

[A] See footnote to Table 6

5.2.2 Producer – Adviser interviews

Eighty two key informants were interviewed and the opinions of five producer groups were obtained as part of the Producer - Adviser survey.

In summary:

- The majority of respondents were in the Producer and Private Consultant and Public Advisory sectors.
- South Australia (45.6%), Victoria (44.3%) and NSW (36.7%) were the States most commonly identified as being the location for business operations among respondents, with lesser representation from Western Australia (22.8%), Tasmania (15.2%) and Queensland (10.1%).
- The most commonly identified agro-ecological regions were, in decreasing order, the Temperate Slopes and Plains, Temperate Highlands, Wet Temperate Coast, Sub Tropical Slopes and Plains, Semi Arid Sub Tropical Plains and Arid Interior.
- Meat sheep enterprises (89.5%) were the most commonly identified enterprise followed by wool sheep (81.6%), cropping (69.7%), beef cattle (67.1%), dual purpose sheep (60.5%) and smaller contributions from dairy (11.8%) and goats (6.6%).

5.2.3 Researcher interviews

In total, 50 key informants were interviewed as part of the Researcher interviews. As was the case with the Feedbase Priority survey, respondents were able to select multiple sectors, states and agro-ecological regions in which they operated. The applicability of research was well distributed across agro-ecological region and State with a greater emphasis in the Temperate Slopes and Plains and NSW (Table 9).

Table 9: Representation of informants (n) by agro-ecological regions and State in the Researcher interviews.

	Arid interior	Temperate slopes and plains	Temperate highlands	Wet temperate coast	Subtropical slopes and plains	Semi-arid tropical plains
South Australia	2	21	N/A	4	N/A	0
New South Wales	2	28	19	3	12	4
Queensland	1	N/A	N/A	N/A	11	5
Tasmania	N/A	8	9	4	N/A	0
Victoria	N/A	24	13	7	N/A	0
Western Australia	1	16	N/A	5	N/A	0

N/A not applicable as agro-ecological region is not present in the State.

Producers, advisers and researchers were asked to nominate research priorities and a breakdown of the relative contribution from each sector is provided. The data from the Producer, Adviser and Researcher surveys were combined and 41.5% of informants were directly involved with research. Private and public advisory represented 30.3% and producers 15.5% with the remaining 12.7% from retail industry.

5.3 Existing opportunities for increased red meat production, barriers and preferred forms of extension

5.3.1 Priority of on-farm actions to increase red meat production (current needs)

Overall ranking of on-farm actions to increase red meat production (Table 10) is summarised as indicating a need for:

Better management of the existing pasture base while improving pasture production and quality with enhanced legume and perennial grass content

From the Feedbase Priority Survey there were **14** key areas identified as needing on farm action (Table 10). Figure 11 provides the responses by sector and Figure 12 by agro-ecological region. With some exceptions, **there was substantial consistency between the sectors and between agro-ecological regions as to what was regarded as important**. The ranking of on-farm actions was consistent with the responses from the interviews with producers and advisors (Fig. 13). All of the 14 areas of existing on-farm opportunity are important in developing the FIP, but given the limited resources the top five have been selected for discussion.

The five most important existing opportunities are:

- *Better Management and Use of Existing Pasture/Improved Grazing Management*.

All sectors and agro-ecological regions regarded this as the most important way in which early gains could be made not just in production but in increasing profitability with low risk. A common response was that while the information was known, there was an inadequate understanding amongst producers and advisers of the feedbase (both amount and quality) during the season, the demand of the animal, and how the two could be best matched. Some of the other major on-farm actions, whilst not in the top five, had a strong pasture/grazing management component. For example increased use of fodder crops, sub divisional fencing, and use of grazing management. Many of these actions have additional benefits for the sustainability of natural resources, especially soil.

- *Improved soil fertility*.

Improved soil fertility as an on-farm action to increase red meat production was ranked highest by Producers and the Advisor sectors but lowest by the Research sector. As for the previous on-farm action, it was felt that the information, by and large is available, but soil fertility has likely declined as rates of fertilizer applications have decreased in response to the tough seasons and price spikes.

- *Increased legume content of pastures*.

Increasing the legume content of pastures was seen as important by most sectors, but particularly the Research sector. In the case of mixed farming systems, the use of legumes was seen as an important part of the break crop phase, and as a source of nitrogen for the following crops. In livestock systems, the species are available but suffer from issues of persistence and declining soil fertility.

- *Increased sown perennial grass content*.

Support for this action was uniform across all sectors and most agro-ecological regions and reflects recent industry project messages concerning the value of perennial pastures for managing soil water recharge and out of season production.

- *Better integration of crops with pastures*.

Mixed farming systems were ranked highly by Advisor and Researcher sectors. This is a rapidly emerging area of importance and opportunity as traditional livestock producers increase the area

under crop. The Arid Interior and Temperate Slopes and Plains regarded integration highly, probably because of the mixed farming component. It does open up a large range of options for feed production/utilisation with early and large gains in production with potentially lower risk.

Of the remaining responses, it is interesting, but hardly surprising, that the Retail sector with their commercial product sales orientation ranked weed control, improving soil pH, use of fodder crops and short term pastures and insect pest control higher than all other sectors.

Increased native perennial grass content leading to increased red meat production had greatest support from the Research sector and from the Arid Interior and Semi Arid Sub Tropical Plains and lowest from Retail and Producer sectors. The high ranking in the more arid regions is not surprising and indicates that adaptation to a tough climate is a highly ranked characteristic.

Table 10: Priority ranking of on-farm actions to increase red meat production.

On-farm actions	Not a priority	Low priority	Moderate priority	High priority	Essential	Average Priority Rank[A]
Better pasture utilisation	1	14	63	172	182	4.20
Improved grazing management	3	22	64	166	176	4.14
Improved soil fertility	2	26	104	163	138	3.94
Increased legume content of pastures	8	31	108	165	117	3.82
Increased sown perennial grass content	14	53	112	141	110	3.65
Better integration of crops with pastures	34	48	113	151	83	3.47
Improved control of weeds	16	72	150	136	56	3.33
Correct soil pH	23	76	154	123	57	3.27
Increased use of fodder crops	25	86	153	122	41	3.16
Increased subdivisional fencing	22	97	157	107	46	3.14
Increased use of grazing cereals, canola, etc.	41	84	132	124	39	3.09
Increased use of short term pastures	40	120	146	94	25	2.87
Improved control of insect pests	40	139	150	77	18	2.75
Increased native perennial grass content	84	134	103	62	35	2.59

Values in table for priority ranks are number of responses. [A]The average priority rank is a weighted average of all responses: Not a priority = 1; Low priority = 2; Moderate priority = 3; High priority = 4; Essential = 5. Standard error of the difference ($p<0.05$) in average priority ranking between actions is *approx*. 0.10.

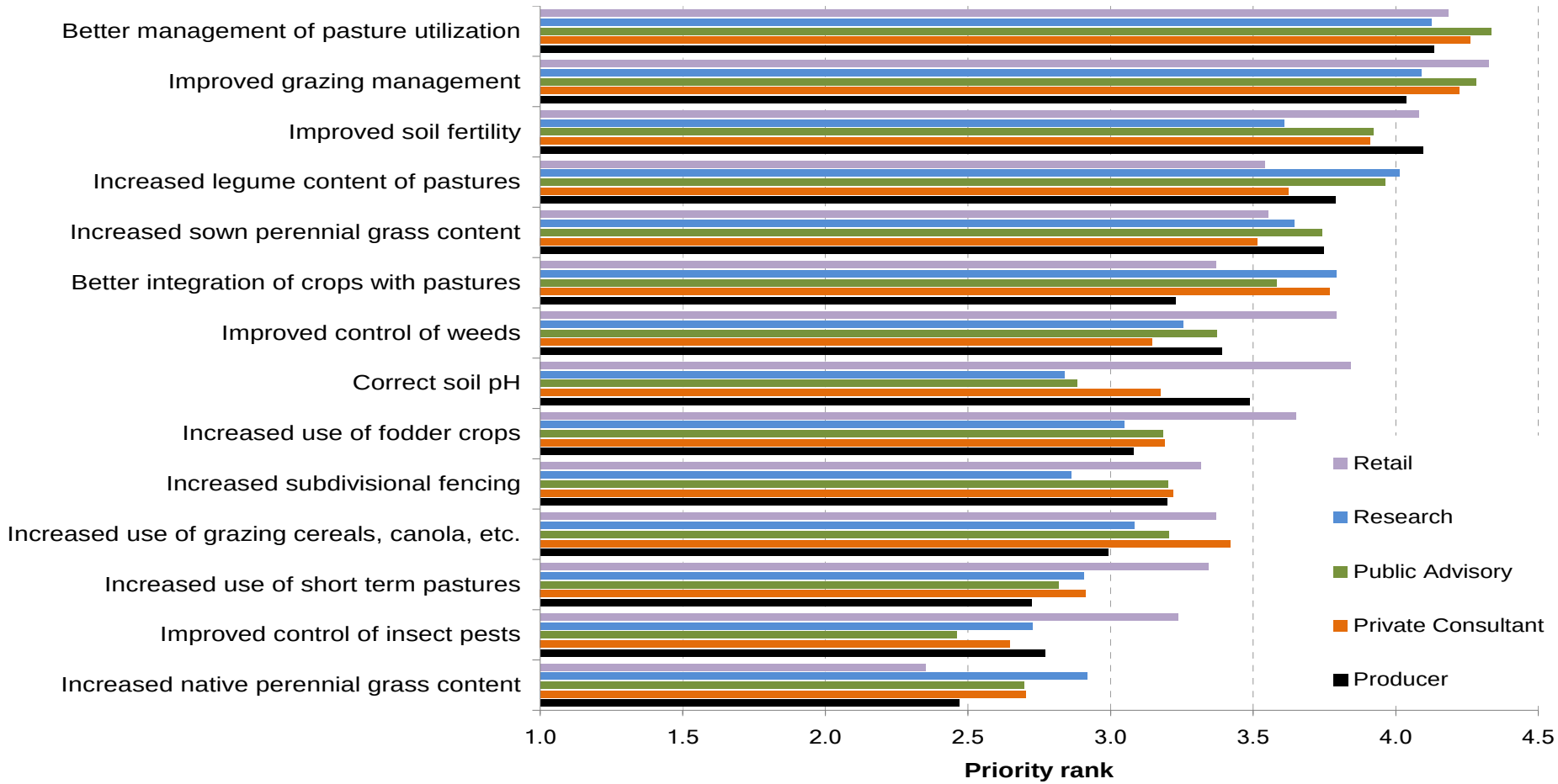


Figure 11: Priority of on-farm actions related to the feedbase that could be undertaken to increase red meat production as nominated by each sector. Priority rank 1 = Not a priority; rank 2 = Low priority; rank 3 = Moderate priority; rank 4 = High priority; rank 5 = Essential. Standard error of the difference between sectors within priorities is *approx*. 0.25 and between priorities averaged over sectors is *approx*. 0.10.

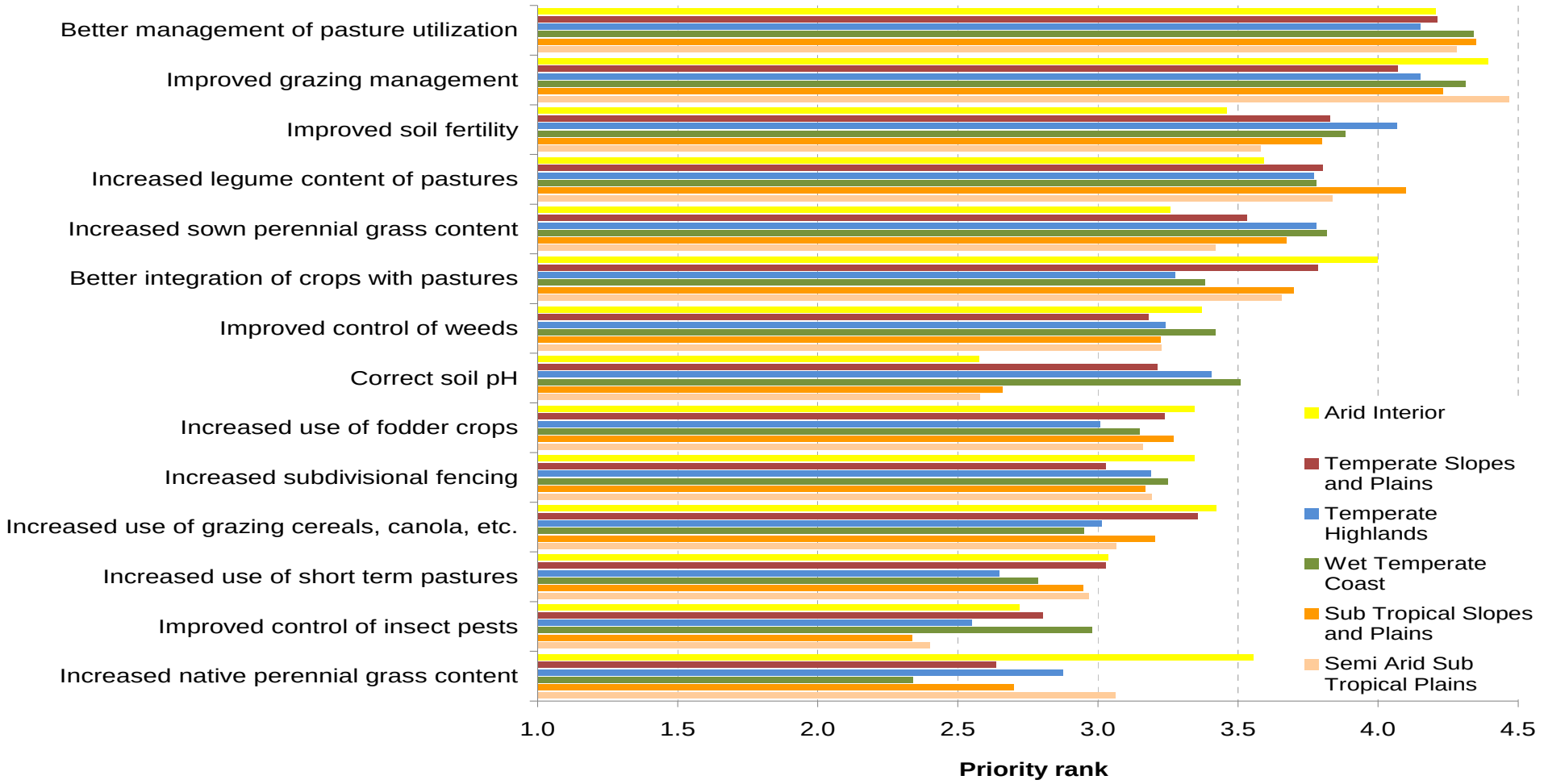


Figure 12: Priority of on-farm actions related to the feedbase that could be undertaken to increase red meat production as nominated by respondents from each agro-ecological region.

See Fig. 11 for explanation of Priority ranks. Standard error of the difference between regions within priorities is *approx*. 0.30 and between priorities averaged over regions is *approx*. 0.10.

Responses from the Producer and Advisor interviews as to the importance of, and likely benefits from, adoption of existing on-farm opportunities (Fig. 13), largely supported the priorities collected through the Feedbase Priority Survey. The agreement between sectors in identifying the priority of current needs provides greater justification for the recommendations in this FIP.

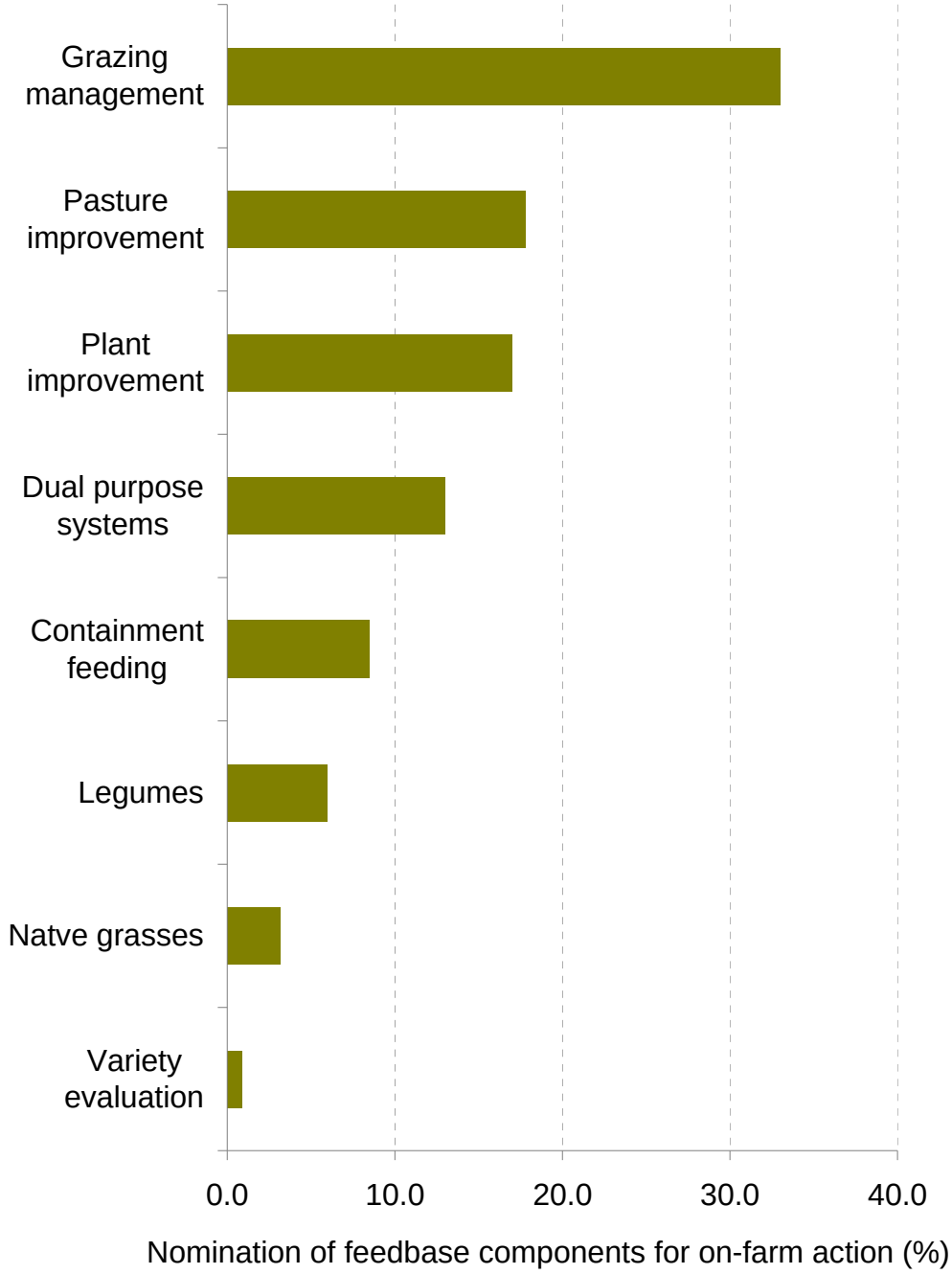


Figure 13: Frequency of nomination of feedbase components for on-farm action with existing technology and/or information to increase red meat production. Data from Producer and Advisor interviews.

5.3.2 Expected benefits from adoption of existing technologies

Interviewees (from Producer and Advisor interviews) were also asked to indicate the expected benefit from the adoption of these existing technologies for the productivity/profitability and sustainability of red meat production (Table 11). These assessments were subjective and assumed successful adoption by producers. While the implementation of “improved/appropriate” grazing systems was the component most commonly identified as a priority action to increase red

meat production, there was a lower perceived financial benefit from this practice than in addressing either pasture nutrition, pasture improvement or improving the legume content of pastures. This may partly be due to the fact that the benefits of improved grazing are more difficult to measure. In any case, all actions are linked to effectively increase red meat production. Later sections highlight the need to address these existing opportunities in a farm systems manner, rather than individual components. Greatest impact on improving the sustainability of red meat production was considered to be gained from pasture nutrition and pasture improvement. While there are common themes across the agro-ecological regions the solutions will be based on the adoption of technologies applicable to the local situation.

Table 11: Expected benefit from the adoption of proposed on-farm actions for the profitability and sustainability of red meat production. Values for impact on sustainability are number of responses.

		Impact on Sustainability				
	Improvement in Profitability (%)	No change	Minor change	Major change	Don't know	Average impact on sustainability[B]
Pasture nutrition	55	2	4	17	1	1.6
Pasture improvement	47	0	7	11		1.6
Legumes	40	3	2	3		1.0
Grazing systems	37	4	12	21	4	1.3
Dual purpose systems	23	8	7	5	2	0.8
Confinement feeding	22	0	5	10		1.7
Variety evaluation[A]	-					
Native grasses[A]	-					

[A]Insufficient responses collected in interviews. [B]Average impact was calculated from the weighted average where, No change in sustainability was rated as a value of 0; Minor change rated as a value of 1, Major change rated as a value of 2.

5.3.3 Barriers to adoption of on-farm actions

The barriers to adoption of these on-farm actions (Table 12) indicated highest ranking to be:

Seasonal variation, concerns about the financial consequence of the action, and risk of failure as the main barriers to adoption.

What the information in Table 12 confirms is that adoption is influenced not just by the availability of technical information but a number of non-technical drivers. In fact the lack of technical information received a much lower ranking. What ranked highly were:

- Seasonal variation.
- Cash flow.
- Lack of confidence that adoption will yield profit.
- Risk of failure.
- Lack of technical and farm business skills (as opposed to information).
- Labour and infrastructure issues.

In general, Producers ranked the priority of nominated barriers lower than other sectors, especially Advisors (Fig. 14). This may be because Producers better understand the barriers and have developed coping strategies. Alternatively, it may be because Advisors better appreciate the potential to improve production by better managing the barriers. Whatever the reason, the need

for a team approach between Producers, Advisers and Research in the planning and conduct of extension programs is obvious.

There was consistency among agro-ecological regions, (Fig. 15) in what were believed to be the barriers to adoption. The exception was that the Arid Interior ranked most barriers highly, possibly reflecting the more uncertain seasons, and their isolation from information sources. Respondents active in the Temperate Slopes and Plains ranked the higher ranked barriers lower than other regions, possibly because the region has a larger proportion of mixed cropping/livestock enterprises that allows for better risk management.

Table 12: Priority ranking of barriers to adoption on-farm actions to increase red meat production.

Barriers to adoption	No impediment	Some impediment	Moderate impediment	Significant impediment	Major impediment	Average Priority Rank[A]
Seasonal variability	7	49	105	150	123	3.77
Cash flow considerations	11	48	116	178	85	3.63
Don't believe returns will cover costs	37	81	108	149	48	3.21
Risk of failure	34	105	114	125	57	3.15
Don't have the right technical skills	41	96	142	100	53	3.06
Don't have the appropriate farm business skills	51	116	118	87	52	2.94
Lack of confidence in the local applicability of information	48	114	115	130	24	2.93
Availability of labour to manage increased livestock numbers	70	128	117	90	26	2.71
Infrastructure to manage increased livestock numbers	66	126	131	86	19	2.69
Lack of information	65	150	114	82	22	2.64
Concerns about environmental effects from increased productivity	104	182	82	53	8	2.25
Don't have access to contractors	132	170	92	31	1	2.06

Values in table for priority ranks are number of responses. [A]The average priority rank is a weighted average of all responses: No impediment = 1; Some impediment = 2; Moderate impediment = 3; Significant impediment = 4; Major impediment = 5. Standard error of the difference ($p<0.05$) in average priority ranking between barriers is *approx*. 0.10.

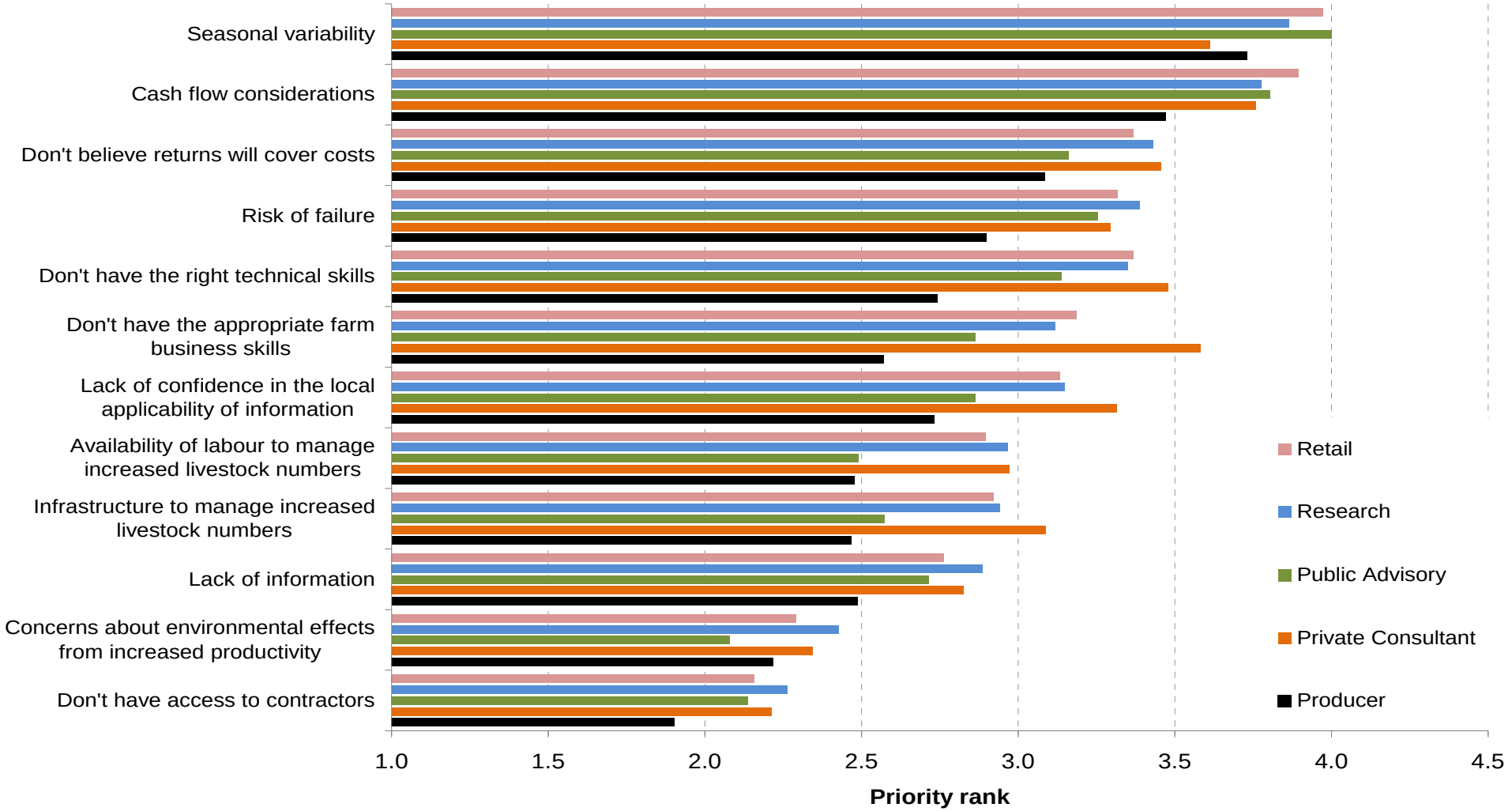


Figure 14: Priority of barriers to adoption of on-farm actions related to the feedbase that could be undertaken to increase red meat production as nominated by each sector.

See legend to Fig 11. for explanation of priority ranks and estimates for standard error of the difference.

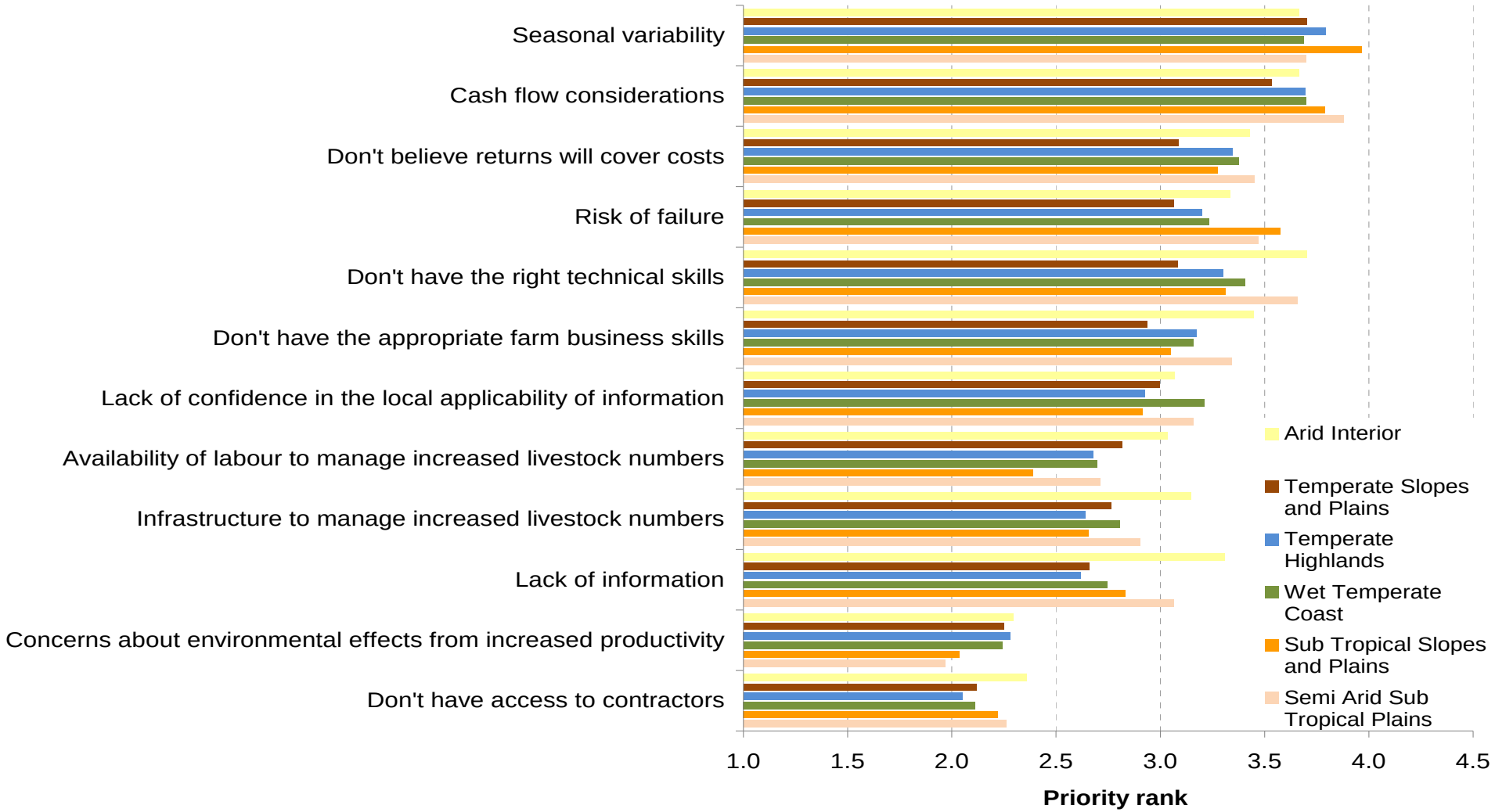


Figure 15: Priority of barriers to adoption of on-farm actions related to the feedbase that could be undertaken to increase red meat production as nominated by respondents from each region.

See legend to Figs. 11 and 12 for explanation of Priority ranks and estimates for standard error of the difference.

5.3.4 Approaches to extension

Extension activities to facilitate greater adoption of on-farm actions that increase red meat production (Table 13) indicated:

Demand for approaches where producers learn with other producers, see adoption of practices in a whole-farm context in their locality and have access to financial information of the benefits and risks.

The preferred approaches from the Feedbase Survey (Table 13 and Fig. 16) and the interviews with Producers and Advisers (Table 14) were consistent among agro-ecological regions and sectors.

Those approaches are:

- The importance of farmer group activity using a whole-farm business approach.
- Practical demonstrations of on-farm actions using local demonstration farm(s) with a whole farm context.
- Provision of detailed financial information of the benefits from adoption of the technology.
- In addition to group activities, individual support either through reference to peers or private /public consultants.
- Training activities for producers and advisers, and for more advisers in the pasture management/grazing management area.
- Traditional “information transfer” methods such as field days, brochures and even web based methods were ranked low in terms of use and impact. Email and SMS alerts were useful in things like pest control.
- Linkage of training and local demonstration in a proposed extension framework for producers and advisers (and with researchers’ involvement) is discussed later in this report.

Table 13: Priority ranking for approaches to extension, training and advice to increase red meat production.

Extension, training and advice priorities	Not a priority	Low priority	Moderate priority	High priority	Essential	Average Priority Rank[A]
Training opportunities for producers	6	8	71	205	112	4.02
Access to a local farm demonstrating adoption of priority actions to increase red meat production	3	23	68	189	120	3.99
More group activities with other producers	4	21	89	176	112	3.92
Field days	7	25	131	167	70	3.67
More trained advisors	14	44	116	142	84	3.60
Decision support tools	7	53	140	142	58	3.48
Publications	6	35	189	130	42	3.42
Training opportunities for service providers	14	53	140	132	51	3.39
Web sites	11	43	172	127	45	3.38
Email alerts	21	60	164	121	26	3.18
Conferences	19	82	165	103	18	3.05
Commercial opportunities for delivery of services	27	89	162	88	18	2.95
Webinars	29	135	162	54	11	2.70
Web forums	33	149	158	47	4	2.59

Values in table for priority ranks are number of responses. [A]The average priority rank is a weighted average of all responses: Not a priority = 1; Low priority = 2; Moderate priority = 3; High priority = 4; Essential = 5. Standard error of the difference ($p<0.05$) in average priority ranking between priorities is *approx*. 0.10.

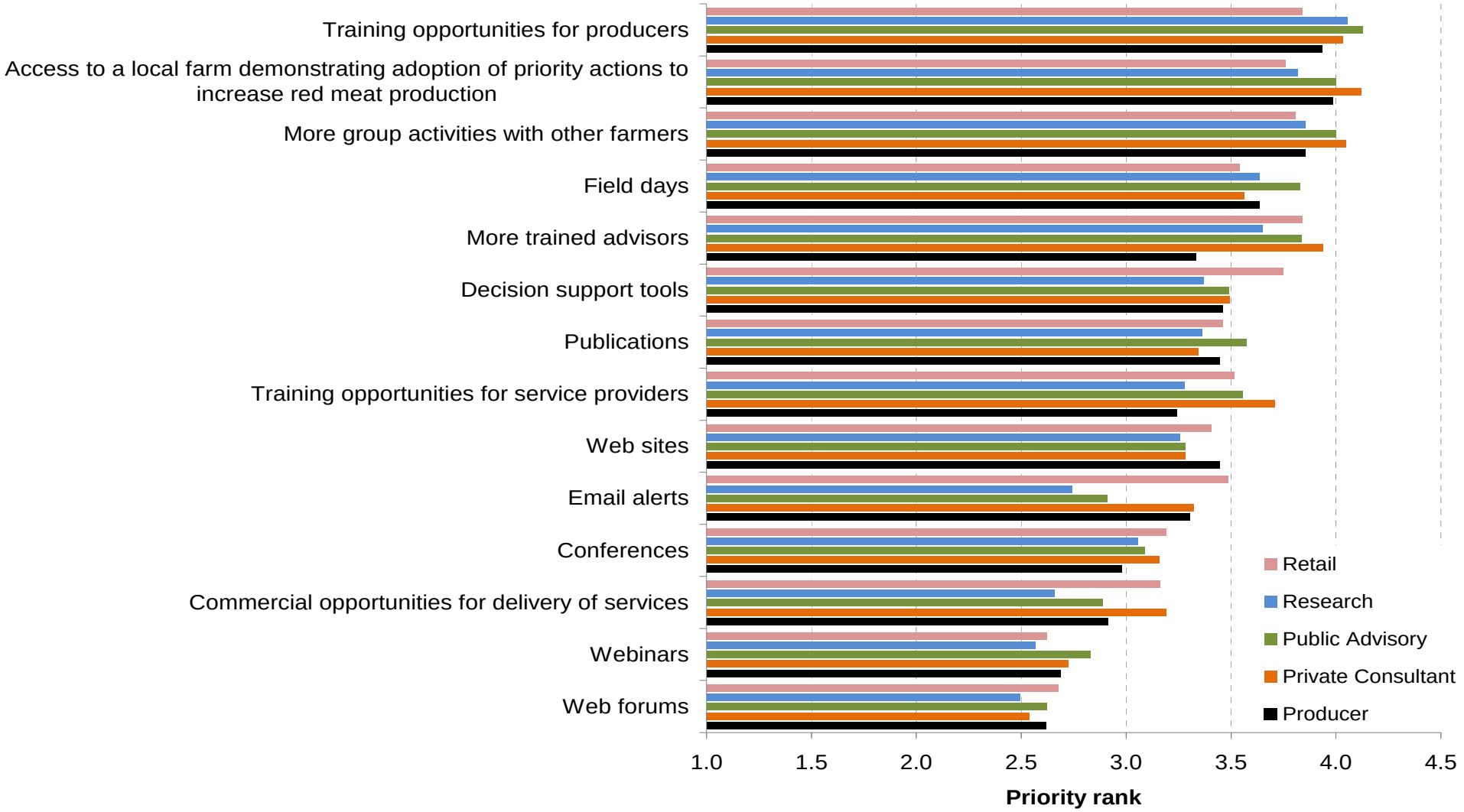


Figure 16: Priority areas for extension, training and advice to increase red meat production as nominated by each sector.
See legend to Fig. 11 for explanation of Priority ranks and estimates for standard error of the difference.

Table 14: Priority ranking for the likely impact of approaches to extension, training and advice to increase adoption of actions within feedbase components. Higher values in table indicate greater impact on adoption. Data from Producer and Advisor interviews.

	Pasture improvement	Legumes	Plant nutrition	Grazing systems	Dual purpose systems	Confinement feeding
Demonstration farms	2.6	2.8	2.7	2.7	2.6	2.6
Whole farm context	2.7	2.5	2.4	2.5	2.8	2.5
Detailed financial information	2.3	2.1	2.2	2.5	2.6	2.5
1 to 1 Private consultants	2.4	2.1	2.5	2.5	2.5	2.1
Peer support	2.3	2.1	2.3	2.4	2.0	2.1
Field days	2.1	2.2	1.9	2.2	2.3	2.1
1 to 1 Public Advisory	1.7	1.5	1.9	2.0	2.0	1.6
Decision support tools	1.5	1.5	1.5	1.8	1.6	1.6
1 to 1 Retail advice	1.6	1.4	1.8	1.6	1.5	1.2
Press releases	1.2	1.3	1.1	1.3	1.3	1.1
Brochures	1.2	1.1	1.4	1.2	1.2	1.1
Web based information	1.3	1.1	1.3	1.3	1.0	1.2

Limited impact =1; Moderate impact =2; Major impact =3.

5.4 Future opportunities for research to meet industry needs

5.4.1 Components of the feedbase requiring research

Research to increase red meat production was highlighted as being most important for feedbase components that will lead to:

> Increased pasture production, better management of existing pasture and farming systems, while improving pasture quality

An overview of the Feedbase Priority Survey (Table 15, Figs. 17 and 18) indicates a high degree of consistency of views between sectors and between agro-ecological regions as to what were the important issues that require research.

In all, 15 areas for research were named, the five most important were:

- Pasture utilisation/grazing management.
- Farming systems.
- Soil fertility.
- Improvement of legumes.
- Improvement of introduced perennial grasses.

It is significant that these are similar to the top five priorities listed as existing opportunities for on-farm actions (see Section 5.3.1) that will increase red meat production. Furthermore, the responses from consultation with Researchers, Research Providers, Advisors and Producers (Figs. 19, 20 and 21) indicated plant improvement, pasture management, grazing systems, pasture nutrition, dual purpose systems and legumes as highest research priorities. These six areas comprised 78% of all nominated research areas. Unlike the situation with the Feedbase Priority

Survey (mostly Producers and Advisors), there were occasional but substantial differences between sectors and agro-ecological regions in the nominated research areas.

Plant improvement was nominated most frequently by the retail sector (see Fig. 20) and least frequently by Producers. In contrast, Producers, Private consultants and Researchers frequently nominated pasture management, whereas the Retail sector and Public Advisory did not. Grazing systems research was most frequently nominated by Researchers and least frequently by the Retail sector. These responses indicate a major difference between Retail and Producer/Advisory/Research sectors in the model used to improve the feedbase. A commitment to plant improvement is linked to a sales benefit, whereas better management of the existing feedbase is not. Further research on pasture nutrition was not frequently nominated by Producers (presumably the high ranking this received from Producers for existing on-farm opportunities suggests that Producers consider there is sufficient, but not adopted, information already available) who rated research into dual purpose systems more highly. Research into various livestock issues and extension was most frequently nominated by Public Advisors, whereas labour efficiency was of greater interest to Private consultants and Producers.

Plant improvement was nominated most frequently by informants with activity in the Wet Temperate Coast and the Temperate Highlands and least frequently from the Arid Interior and Semi Arid Tropical Plains (Fig. 21). In contrast, informants with activity in the Arid Interior and Semi Arid Tropical Plains more frequently nominated research into pasture management and grazing systems. Pasture nutrition was most frequently nominated for research by informants with activity in the Semi Arid Tropical Plains. Dual purpose systems research was of greatest interest for informants from Temperate Slopes and Plains and research into livestock issues from the Arid Interior.

Despite these differences, the overall research priorities are broadly consistent. In other words, not only was it recognized that there was already a lot of existing information in these areas as the basis for extension, but that they were the main areas of opportunity through the development of new information from research. This provides a very robust basis for the FIP and for a team approach between Research, Advisers and Producer sectors given that they are in agreement as to what is important in increasing red meat production both in the short and the long term.

Table 15: Priority ranking of the feedbase components requiring research to increase red meat production.

Research priorities	Not a priority	Low priority	Moderate priority	High priority	Essential	Average Priority Rank[A]
Pasture utilisation	4	31	87	159	147	3.97
Grazing management	6	39	97	140	147	3.89
Farming systems	9	36	86	163	132	3.88
Soil fertility	8	61	99	148	112	3.69
Improvement of legumes	11	41	126	148	88	3.63
Improvement of introduced perennial grasses	16	64	121	140	83	3.50
New species	21	62	119	152	68	3.44
Soil biology	14	78	126	118	82	3.42
Decision support systems	8	72	148	128	66	3.41
Pasture establishment techniques	19	101	133	116	57	3.21
Improvement of fodder crops	29	99	134	115	35	3.07
Weed control	24	113	157	82	46	3.03
Improvement of annual / biennial grasses	35	123	135	89	31	2.90
Improvement of native species	67	116	121	85	35	2.78
Insect pest control	41	149	143	69	16	2.69

Values in table for priority ranks are number of responses. [A]The average priority rank is a weighted average of all responses: Not a priority = 1; Low priority = 2; Moderate priority = 3; High priority = 4; Essential = 5. Standard error of the difference ($p<0.05$) in average priority ranking between research priorities is *approx*. 0.10.

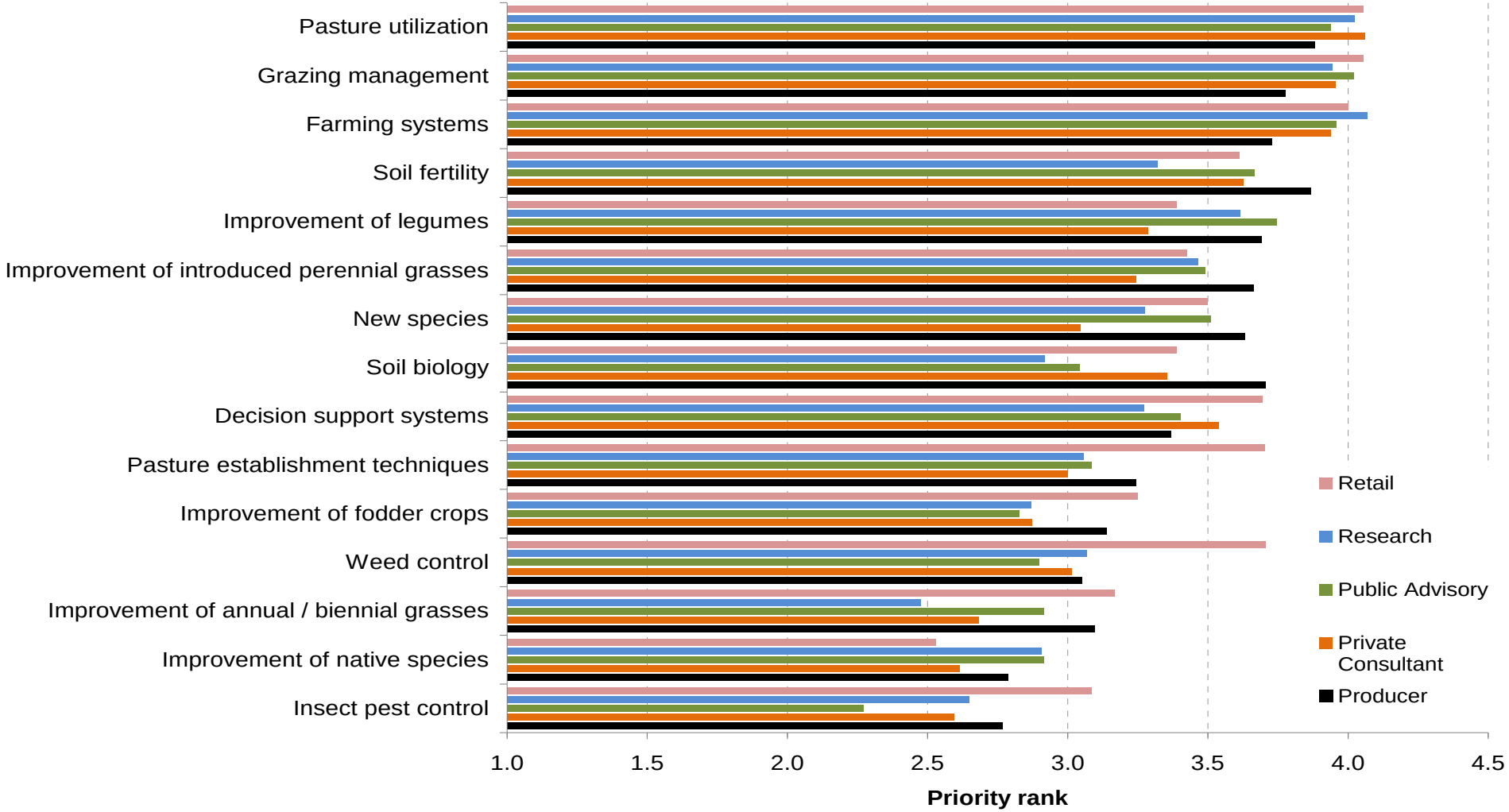


Figure 17: Priority components of the feedbase requiring research to increase red meat production as nominated by each sector. See legend to Fig. 11 for explanation of Priority ranks and estimates for standard error of the difference.

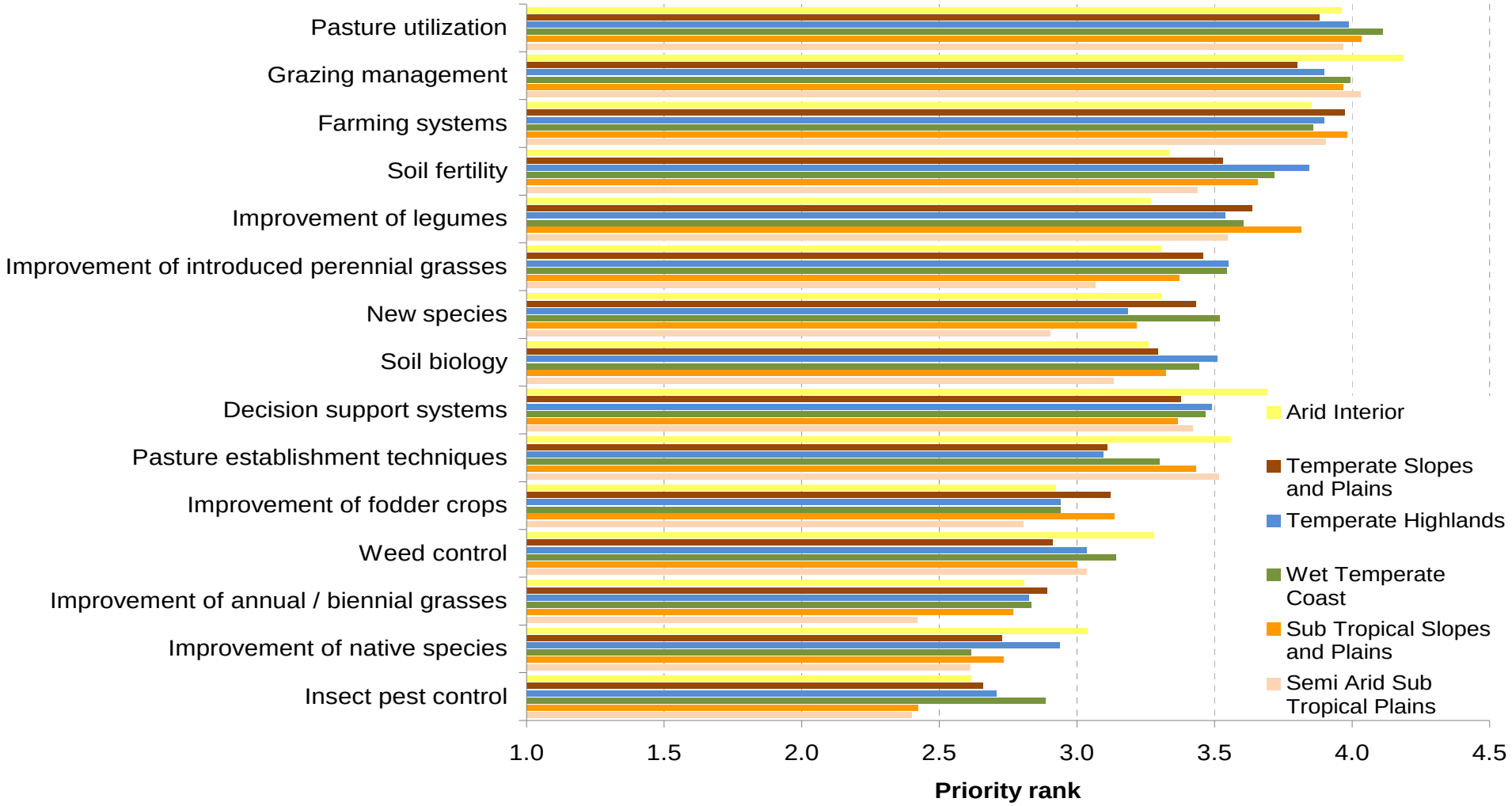


Figure 18: Priority components of the feedbase requiring research to increase red meat production as nominated by respondents from each region. See legend to Figs. 11 and 12 for explanation of Priority ranks and estimates for standard error of the difference.

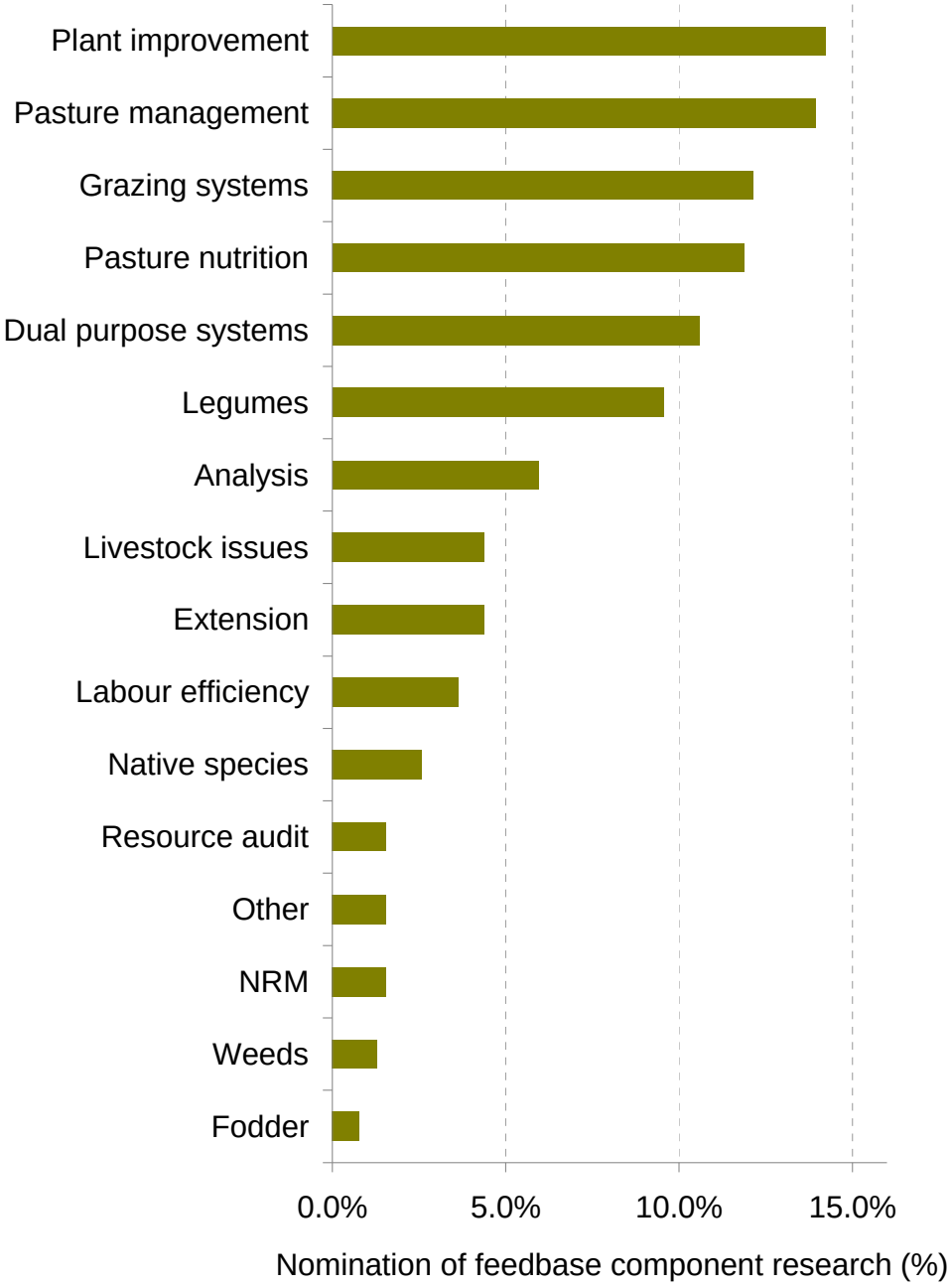


Figure 19: Frequency of nomination of feedbase components for further research.

Data amalgamated from the Researcher interviews, RD&E Provider consultations and Producer and Advisor interviews.

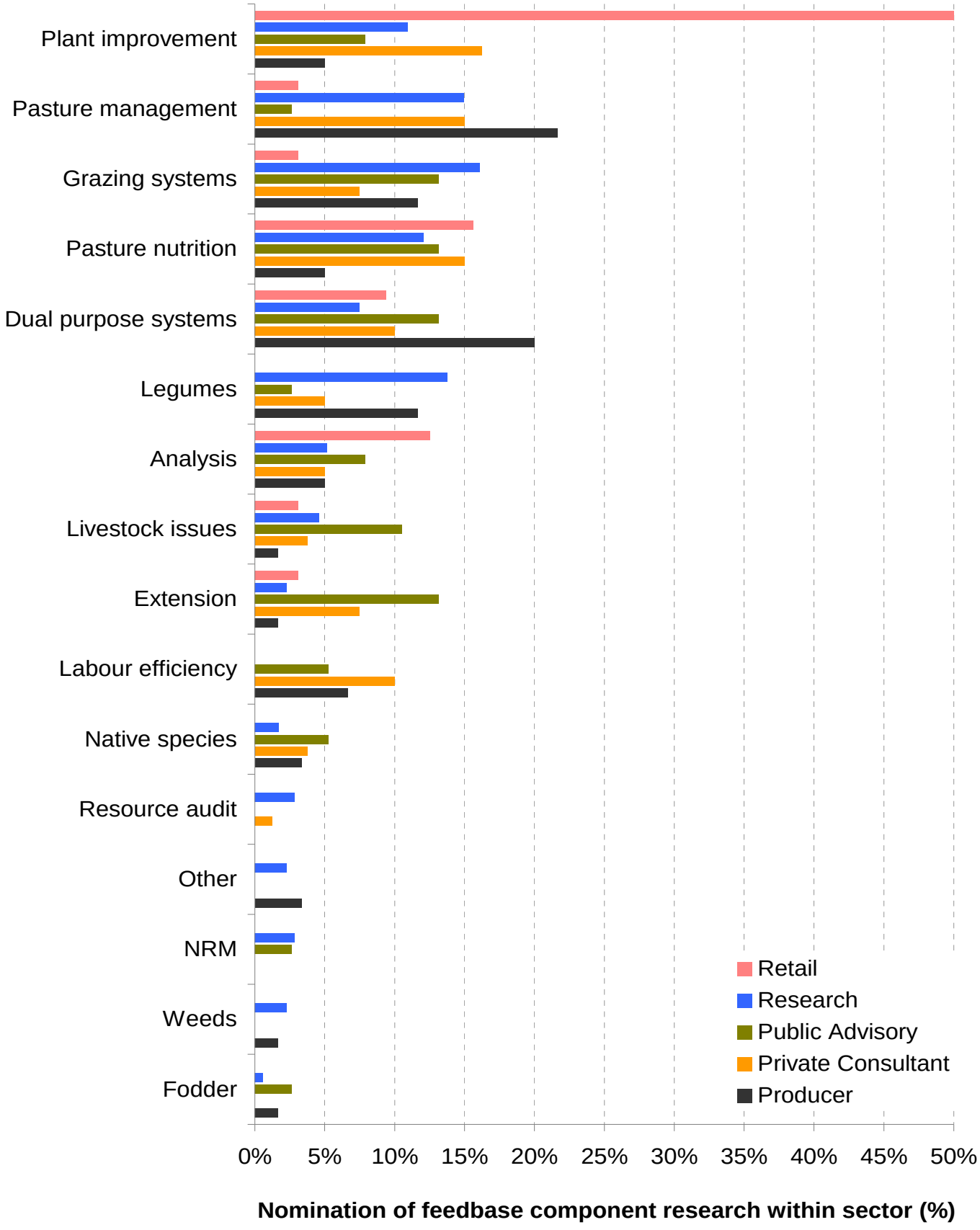


Figure 20: Frequency of nomination of feedbase components for further research within sector. Data amalgamated from the Researcher interviews, RD&E Provider consultations and Producer and Advisor interviews.

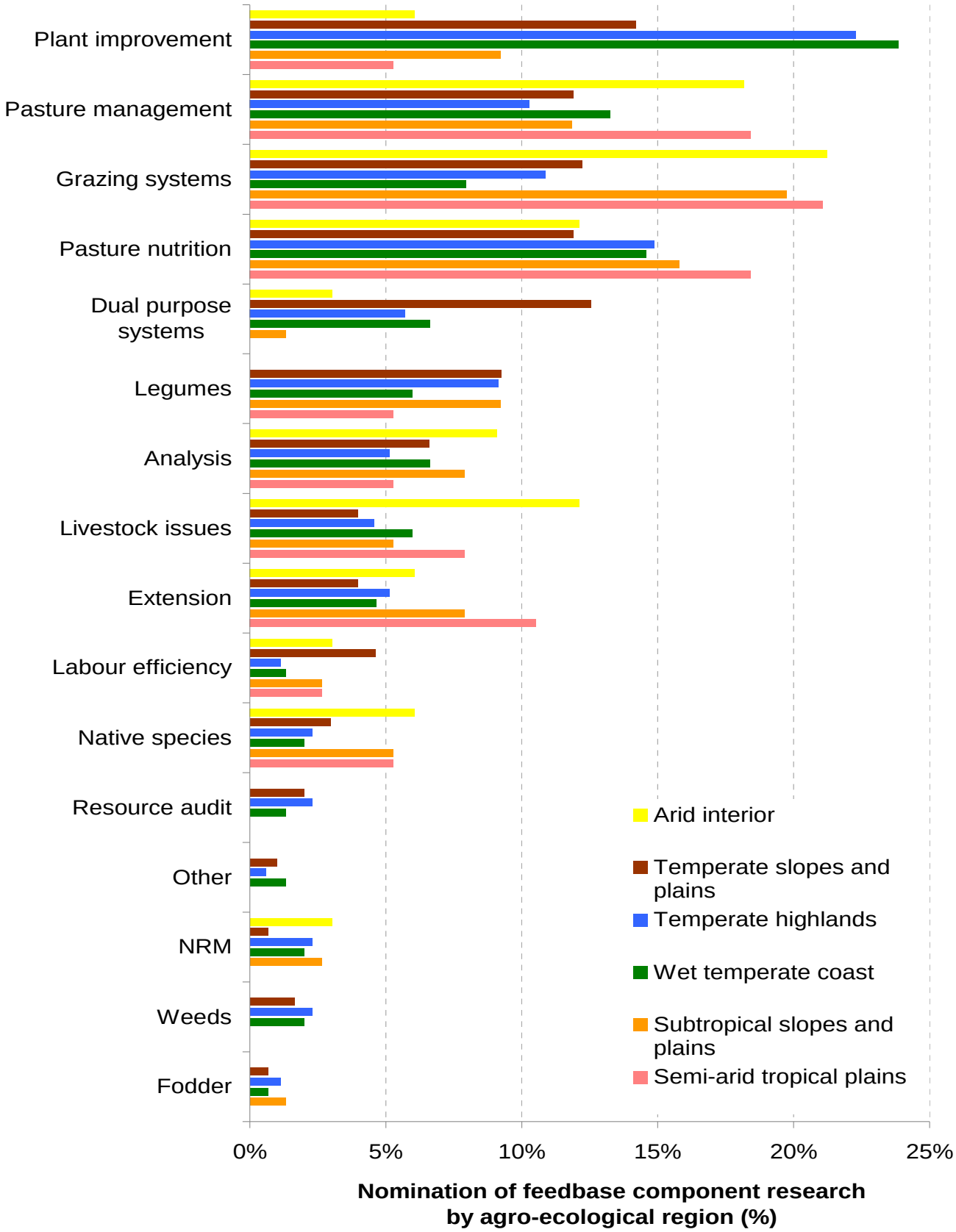


Figure 21: Frequency of nomination of feedbase components for further research within agro-ecological region.

Data amalgamated from the Researcher interviews, RD&E Provider consultations and Producer and Advisor interviews.

5.4.1.1 Plant improvement research

There was a high level of consistency between agro-ecological regions in the prioritisation of plant traits required to increase red meat production. The notable exception was the higher ranking for acid tolerance in the Temperate Slopes and Plains, Temperate Highlands and Wet Temperate Coast. The highest priority across all regions (Table 16) was identified as the need to breed for persistence under grazing.

Table 16: Priority ranking of plant traits to increase red meat production.

	Arid Interior	Temperate Slopes and Plains	Temperate Highlands	Wet Temperate Coast	Sub Tropical Slopes and Plains	Semi Arid Sub Tropical Plains	Average Priority Rank[A]
Persistence under grazing	4.04	4.18	4.21	4.22	4.28	4.03	4.20
Herbage quality	3.85	3.84	3.85	3.93	3.97	3.72	3.87
Extended growing season	3.54	3.77	3.76	3.83	3.68	3.45	3.76
Increased total herbage production	3.80	3.76	3.65	3.74	3.73	3.40	3.71
Low risk of establishment failure	3.48	3.60	3.64	3.53	3.83	3.62	3.62
Out of season production	3.46	3.62	3.53	3.61	3.53	3.45	3.58
Low requirement for applied nutrients	3.31	3.32	3.46	3.33	3.31	3.17	3.34
Tolerance of plant diseases	3.28	3.25	3.27	3.37	3.21	2.97	3.26
Acid tolerance	2.85	3.14	3.48	3.24	2.83	2.71	3.19
Contain compounds with benefits for stock health	2.84	3.13	3.16	3.37	2.97	2.86	3.16
Tolerance of insect pests	3.04	3.16	3.10	3.40	2.91	2.83	3.16
Better grazing tolerance of dual purpose crops	3.12	3.17	3.07	3.02	3.16	2.86	3.10
Salt tolerance	2.85	2.76	2.60	2.83	2.64	2.59	2.72
Contain compounds with benefits for human health	2.52	2.59	2.69	2.85	2.60	2.34	2.66

[A]Values in table for priority ranks are number of responses. [A]The average priority rank is a weighted average of all responses: Not a priority = 1; Low priority = 2; Moderate priority = 3; High priority = 4; Essential = 5.

The most recent comprehensive assessment of the distribution of pasture species in Australia was undertaken by Hill and Donald (1995). This study identified the potential area for adaptation of the

major species in each of the states (Table 17) and the estimated area containing the major pasture species (Table 18). There was no breakdown by agro-ecological region supplied in the report which is somewhat dated, but it has value in identifying the relative importance of pasture species, both in adaptability and likely current use. All pasture species were estimated to have an actual distribution considerably less than their potential with no species exceeding 50% (Table 18).

Table 17: Estimated potential area (ha) of adaptation for major pasture species for each State as assessed in 1998.

	NSW	QLD	SA	VIC	WA	TAS	Total potential area
Sub clover	278680	11429	95701	125362	179525	19973	710670
Balansa clover	95892	8397	37582	55773	42874	6373	246891
Persian clover	137736	11388	42522	65731	48457	5736	311570
Barrel medic	126614	109	67664	49767	151342		395496
Serradella	270329	11435	92473	92931	168953	9911	646032
White clover	79772	28832	3763	31363	1756	14116	159602
Lucerne	313109	199814	78239	122803	77468	20078	811511
Phalaris	154982	23297	15688	74326	21921	17498	307712
Perennial ryegrass	52990	26115	6	43420	31	21106	143668
Cocksfoot	99135	29486	2245	42451	4791	24510	202618
Tall fescue	85955	10663	961	50513	282	20363	168737

Table 18: Estimated area (ha) of pasture containing major pasture species for each State as assessed in 1998.

	NSW	QLD	SA	VIC	WA	TAS	Total area	Percent of potential area[A]
Sub clover	83997	14	18346	61718	99710	29128	292913	41
Balansa clover	2526	-	3768	582	6032	-	12908	5
Persian clover	522	158	960	345	-	-	1985	1
Barrel medic	12320	1862	22416	4242	5602	-	46442	12
Serradella	1935	-	-	-	7605	-	9560	1
White clover	40516	596	1078	16471	388	19082	78131	49
Lucerne	25841	1218	4957	2901	503	-	35420	4
Phalaris	21817	0	6807	7922	556	10258	47360	15
Perennial ryegrass	12227	31	2928	22749	1154	20411	59500	41
Cocksfoot	14741	0	5101	9981	535	10970	41328	20
Tall fescue	9396	8	864	372	313	39	10992	7

[A]Percent of potential area calculated by dividing total area (Table 18) by total potential area (Table 17) for each pasture species.

The species targeted for further development by RDCs should be those which are unlikely to attract stand alone private investment in the traits identified from the Feedbase Priority Survey.

White clover, lucerne, perennial ryegrass and fescue are the focus of major and existing investments by plant breeders. On this basis the targeted species should include phalaris, cocksfoot and sub clover for the medium/high rainfall areas and medics and grazing crops for low rainfall areas. These species have wide adaptability and applicability to the agro-ecological regions in this study. What was absent from the report of Hill and Donald (1998) were estimates for tropical pasture species, the need for which was identified during this consultation.

5.4.2 Duration and cost of proposed research

Key informants indicated that, on average, research projects would take 5.2 years to complete and have a total (not per annum) cash cost of $1.11M (AUD). Successful adoption of the proposed research was estimated by informants to increase the profitability of red meat production by an average of 29% (calculated from Table 19). The feedbase components most frequently nominated as a research priority were not those with the highest estimated impact on profitability, possibly reflecting the difficulty in determining the value of systems and management initiatives and problems in attribution of costs and returns. The most frequently nominated research components tended to have the highest cash cost requirement. There was also no relationship between the frequency with which a research priority was nominated and the likely impact on the sustainability of red meat production (Table 20).

Table 19: Expected improvement in profitability of red meat production arising from the adoption of proposed research with expected duration and cash cost.

	Improvement in Profitability (%)	Duration of research (years)	Cash required ($M)
Pasture improvement	20 (22)	4.0 (5.8)	0.6 (1.4)
Pasture management	20 (22)	6.0 (6.6)	1.3 (1.6)
Grazing systems	20 (36)	4.0 (5.2)	0.8 (1.8)
Pasture nutrition	20 (25)	4.0 (5.1)	0.4 (0.9)
Dual purpose systems	20 (23)	5.0 (4.8)	1.4 (1.6)
Legumes	20 (34)	6.0 (6.5)	0.7 (0.8)
Analysis	20 (28)	2.0 (3.6)	0.4 (0.8)

Values in table are means, followed by (medians). Both statistics are provided because of the distribution of responses.

Table 20: Expected benefit from the adoption of proposed research for the sustainability of red meat production.

	Impact on Sustainability				
	No change	Minor change	Major change	Don't know	Average impact on sustainability[A]
Pasture improvement	0	6	13	3	1.7
Pasture management	0	8	16	1	1.7
Grazing systems	1	7	17	1	1.6
Pasture nutrition	1	6	14	0	1.6
Dual purpose systems	1	7	3	0	1.2
Legumes	1	5	17	0	1.7
Analysis	0	3	6	0	1.7

Values for impact on sustainability are number of responses. [A] Average impact was calculated from the weighted average where No change in sustainability was rated as a value of 0; Minor change rated as a value of 1, Major change rated as a value of 2.

5.5 Existing research capacity and financial investment

Organisational capacity for research (Table 21) indicates the total number of research and support staff currently engaged in research of various feedbase components (Fig. 22) with the main focus on:

- Grazing management.
- Legume improvement.
- Soil fertility (i.e. soil acidity, fertility and biology).
- Farming systems.

Summation of staff numbers across the components provides 248 full-time equivalent research and 147 technical and support staff.

Table 21: Organisations (number[A]) with research expertise located within research organisations with relevance to agro-ecological region.

Feedbase component	Arid interior	Temperate slopes and plains	Temperate highlands	Wet temperate coast	Subtropical slopes and plains	Semi-arid tropical plains
Legume improvement	0	9	10	7	2	1
Grass improvement	1	7	9	6	2	1
Dual purpose crops	0	7	6	4	2	1
New species introduction	1	9	8	4	2	1
Weeds	5	10	8	5	5	6
Soil biology	1	7	6	3	4	2
Soil fertility	1	9	8	3	4	3
Soil acidity	1	8	5	3	2	1
Pasture establishment	1	6	8	3	3	2
Diseases	0	5	4	2	3	2
Pests	1	6	6	2	3	2
Grazing management	5	9	10	7	4	2
Decision support systems	2	4	4	3	3	3
Farm systems	3	8	6	4	5	4
Retail product development	0	0	2	0	1	1

[A]The sum of people within rows may over estimate the total number of people with the relevant expertise in each component because expertise may be relevant to multiple regions.

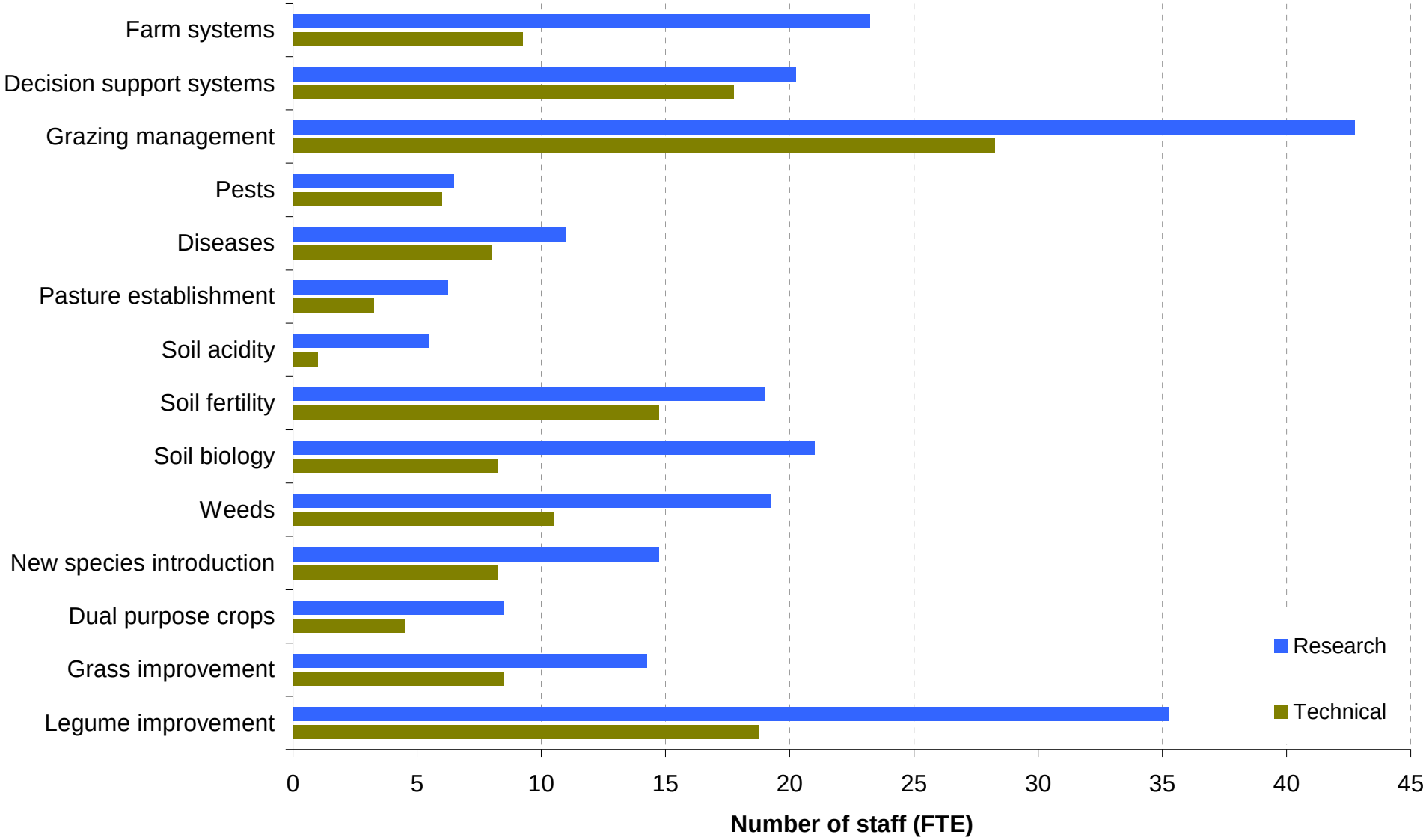


Figure 22: Number (full time equivalent) of research and technical or support staff engaged in feedbase component research.

The issue of maintenance and development of research capacity was an issue that invoked strong responses from many scientists. While the data suggest broadly that there is sufficient research capacity in most feedbase components, in many cases, respondents commented that the skill base is thin and in decline. The decline is being driven by staff who are near retirement and there is no depth in the replacement pipeline. It is also evident (other survey responses not shown) that expertise in pasture agronomy has been diverted to other disciplines as agencies seek to adjust to budget cuts. The comment was also made that the current deployment of expertise within the industry is volatile and strongly influenced by government and industry policy.

Comments from informants included:
There are few job opportunities for young scientists in the field of pasture RD&E. There is a clear need to retain plant improvement capability and skills. For example, CSIRO CPI and CLI have very few pasture scientists. Most of the State agencies are also in need of agronomists but finding agronomists with high level computing skills in areas such as GIS/SIS/RS is difficult.

There was concern that GM capability in pasture species has not been supported which demonstrates a misunderstanding of its value and leaves the industry unprepared for future changes in policy, or in response to such things as climate change. A modest effort at least, linked to conventional plant improvement programs and agronomic research is required.

Plant pathology for pastures is particularly poorly addressed in Australia. The main group of pasture specialists is in WA where they are isolated from interacting with the eastern states by plant quarantine restrictions. This reflects a lack of strategic investment in this area.

The rural research capacity of Australia has been built on a system of levies and shared investment in research by RDC-Govt (other industries' bodies contribute but to a minor degree). An important function of this uniquely Australian and very successful system has been to ensure research meets the needs and objectives of industry. However, if the RDCs fail to invest (eg AWI) or cherry pick in recently popular topics of research, the system and its capabilities can quickly fall below a productive critical mass.. As a direct consequence we are presently in the middle of a substantial loss of skill across Australia as it applies to pasture based industries. Research organisation (federal and state research agencies and universities) budgets are all predicated on the existence of the shared investment model. They can carry areas of research without external investment for relatively short periods of time but inevitably sensible succession planning for research capacity is the first hit, then unplanned loss of skills by attrition, followed by redundancies. Some specific "expertise" issues for pasture research in Australia include, conventional breeding of key species has been decimated by the advent of Pastures Australia and by the apparent belief that the "market" will take care of pasture improvement. I think that demonstrates a fundamental misunderstanding of how pasture genetics are accessed and used by the industry and the implications of this for inevitable 'market failure'.

Organisational budgets for research (Table 22) indicate a spread of support across the main feedbase components with a total annual commitment of $43.9M (AUD). These figures do not include the research commitment by private companies but for public sectors probably include all sources of funding, including from RDCs. The likely direction of investment over the next ten years (Fig. 23) indicates some movement away from pasture establishment and weeds and greater support for grazing management, farm systems, soil fertility and legume improvement.

Table 22: Current annual budget ($k) allocated by State agencies, Universities, CSIRO and non-MLA RDCs (excluding Dairy Australia) in feedbase research areas.

	Plant Imp legumes	Plant Imp grasses/ forages	Pasture Establish-ment	Weeds	Feedbase manage-ment	Grazing systems	Soil & water manag-ement	Total budget
SARDI	1200	100	150	0	850	250	200	2750
DPI Vic	700	567	125	0	1354	406	1277	4429
DAFWA	360	220	0	0	500	480	290	1850
DEEDI	20	0	15	10	250	100	0	395
NSW I&I	1540	924	154	770	462	924	924	5698
TIAR/Uni Tas	180	180	0	230	0	150	0	740
UNE	0	0	30	70	20	20	80	220
Uni Qld	0	0	0	0	0	0	0	0
LaTrobe Uni	0	0	0	0	0	0	25	25
Curtin Uni	10	10	0	0	0	20	50	90
Uni Adelaide	0	0	0	100	0	0	100	200
Murdoch Uni	170	1000	0	0	0	20	125	1315
UWA	550	3338	0	1060	1644	1660	2394	10646
CSU	0	0	0	400	1100	600	200	2300
TIAR/Uni Tas	180	180	0	230	0	150	0	740
RIRDC	100	100	0	0	50	50	0	300
AWI	0	48.4	0	30	0	455	0	533
GRDC	0	798	0	0	2038	1155	0	3991
CSIRO	608	64	75	650	3762	969	1590	7718
Total	**5618**	**7529**	**549**	**3550**	**12030**	**7409**	**7255**	**43940**

Imp = Improvement.

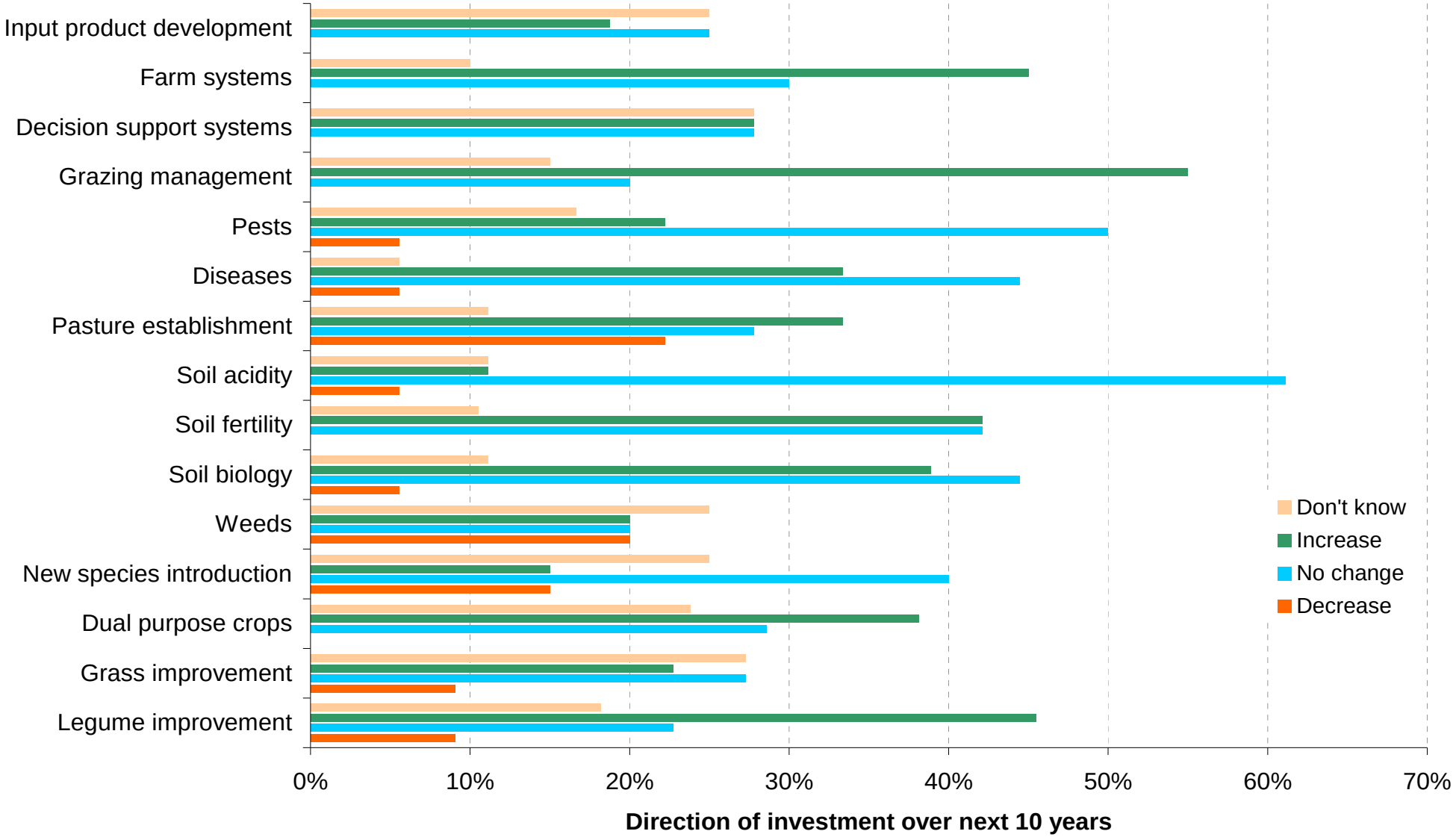


Figure 23: Direction of research investment over the next ten years (start year 2010) for various feedbase components.

Note that the sum of all columns within a component may not equal 100% because data for “no comment” are not provided.

5.6 Potential threats to red meat production by 2020

The most important likely impacts on red meat production to 2020 (Table 23) can be summarized as:

Higher farm costs, seasonal uncertainty, a lower quality feedbase and restricted farming practices.

Table 23: Priority ranking for likely impact of various scenarios (assuming they eventuate) on red meat production in 2020.

Scenarios by 2020	Nil	Minor	Major	Average Priority Rank[A]
Increased input costs	3	73	359	4.66
Increased fertilizer costs	3	79	355	4.60
Reduced annual rainfall	6	78	349	4.55
Increased rainfall variability	10	86	342	4.54
Lower quality feedbase	14	139	273	4.11
Restriction of farming practices	9	165	256	4.10
Increased demands for 'clean and green' products	12	196	229	4.00
Higher energy costs	11	203	222	4.00
Increased temperatures	22	198	216	3.93
Increased pests	20	245	167	3.73
Increased weed pressure	33	242	157	3.59
Restriction of GM technologies	100	230	97	2.99

Values in table for priority ranks are number of responses. [A]The average priority rank is a weighted average of all responses: Nil impact = 1; Minor impact = 3; Major impact = 5. Standard error of the difference ($p<0.05$) in average priority ranking between scenarios is *approx*. 0.10.

It is clear that the greatest concerns relate to increases in costs and seasonal variability. To a degree these factors are “givens” and some farmers in particular would say that there is little that they can do in response. On the other hand, these changes represent management challenges in which all sectors have an important part to play in making the whole farm business more resilient to adverse events. This will mean greater emphasis in programs that deal with profitability and risk management rather than just production *per se*. These adaptations to the threats posed by future scenarios apply equally to research as they do to Advisers and Producers.

Results of the consultation confirm the desire by Producers and Advisers for greater emphasis by extension and research programs on the whole farm, including the business aspects. It is relevant that the Commonwealth Government is moving away from Exceptional Circumstances Assistance to programs which improve financial management and resilience. In fact, this change in policy approach provides both the need and the basis for on-farm programs which address the whole farm business.

5.7 Industry collaboration

Respondents in the Producer - Adviser and Researcher interviews were asked to list their level of professional interaction with the various feedbase sectors (Table 24). An average ranking below 2.0 reflects less than a moderate level of interaction.

Overall the results show a disappointing but not altogether unexpected lack of contact between many sectors of the industry.

Table 24: Professional interaction among sectors in the feedbase industry.

	Interaction with:											
Interaction by:	Producers	Producer Groups	MLA	Industry Organisations	Private Consultants	Public Advisory	Public Research	University	CSIRO	Retail Sales & Advice	Private Plant Breeders	Input Supply Companies
Producers	3.0	2.7	1.7	1.8	2.2	1.8	2.1	1.6	1.7	1.5	1.3	1.7
Private Consultants	2.8	2.7	1.9	1.8	2.7	1.8	1.9	1.7	1.7	1.8	1.4	2.0
Public Advisory	2.9	2.8	1.7	1.7	2.1	2.9	2.6	1.8	1.5	1.7	1.6	1.8
Public Research	2.2	2.0	1.8	1.7	1.6	2.6	2.8	2.3	1.9	1.5	1.2	1.5
University	2.4	1.8	1.8	1.6	1.5	2.5	2.7	2.6	2.0	1.1	1.6	1.2
CSIRO	2.4	2.4	1.8	2.2	2.2	2.3	2.7	2.7	3.0	1.8	1.0	1.8
Retail Sales & Advice	3.0	2.3	1.3	2.0	2.3	1.7	2.4	1.7	1.8	3.0	2.2	2.8
Private Plant Breeder	3.0	2.5	2.0	2.0	2.0	2.0	2.0	3.0	1.0	3.0	3.0	1.0
Input Supply Companies	3.0	2.5	1.5	2.0	2.0	2.0	2.5	2.0	2.0	3.0	2.0	2.5

No interaction = 0, low level = 1; moderate level =2; high level =3.

The key issues of collaboration identified through the consultation were:

- There is a low level of interaction by the non-commercial sector with the commercial (product supply) sector.
- All sectors believed that they interacted at a high level with producers, while the producers indicated that high level interaction was restricted to other producers, producer groups, and private consultants. The implication from this result is that the non-producer sectors access only a limited number of producers
- Producers indicated below moderate levels of interaction with most research sectors.
- In general, researchers only interacted strongly with other researchers and the public advisory sector but generally at a low level with private consultants.

There was a general feeling by interviewees of dysfunction in the feedbase supply chain. In large part, this stems from the feedbase not being recognised as an industry and not served by an organisation which acts as a focal point. As consequence of this, there is a lack of interaction

between the various sectors of the feedbase chain which the Project Team felt contributed to the less than expected number of innovative ideas for future research, coming from all sectors, but particularly from the research sector itself.

The suggestions from the interviews to improve the integration of, and flow of information between the feedbase sectors, can be summarized as:

Greater farmer involvement in the design and delivery of research and extension.
Approximately 30% of responses identified greater involvement by producers in the design and conduct of pasture RD&E as a key activity to improve feedbase integration. Producers represented 40% of the respondents in this category with private consultants, researchers and public advisory officers also rating this outcome highly.

Better information transfer between sectors and capacity building within the feedbase.
This was the second most highly rated group of suggestions. There was a strongly expressed need for greater flow of information between the various sectors in the feedbase in the belief that the skills within the feedbase were not being effectively harnessed. To be effective these information exchanges would need to be seen as genuinely collaborative and managed so as to avoid the linear or unidirectional patterns of communication which often occur. Researchers called for the development of research capacity through post graduate studies in pasture technology.

Integrated coordination of feedbase RD&E.
Respondents in this grouping wanted greater coordination between the investors in feedbase RD&E. The spread of feedbase issues across a number of RDCs was seen as a limitation – particularly in the cropping/grazing areas where a combined approach between GRDC and MLA, at least, was seen to be essential.

More collaborative projects.
These referred mainly to cooperative research projects. A major barrier to better collaboration was the lack of a funding structure that facilitated cooperative bidding rather than competitive bidding.

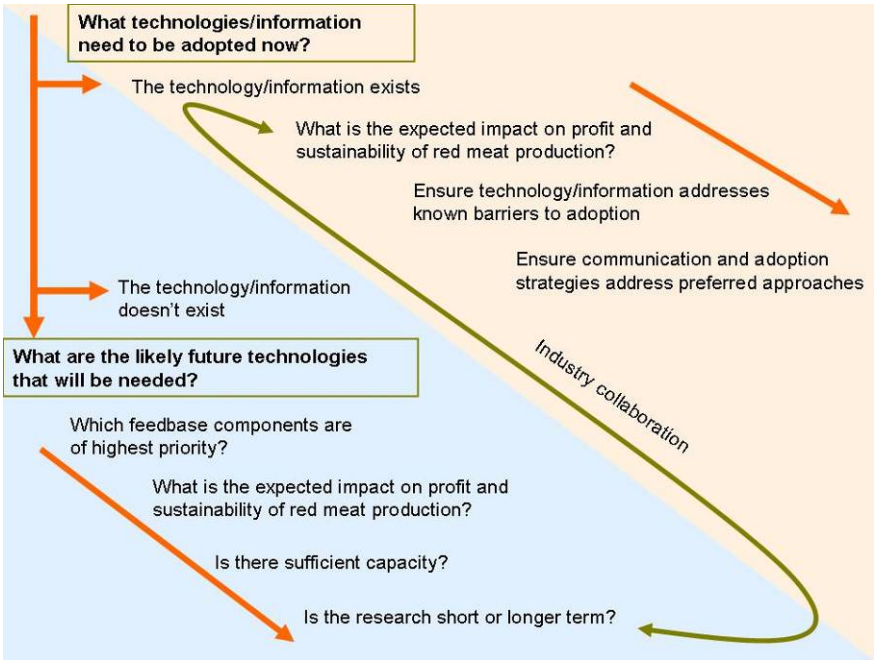
Better collaboration between public and research sectors and private industry.
The need for better cooperation between the public and research sectors with the retail sector was identified, particularly in relation to the transfer of commercial technologies on to farm. The low level of contact by the research, extension and consultant sectors with the retail and input sectors is a barrier to the better integration of the feedbase chain. This issue has special significance for plant improvement programs.

These suggestions, supported by other data collected from the surveys, highlight the need for a two level approach to planning, conduct and evaluation of pasture work in future. One level is to accommodate the variation within agro-ecological regions and the other level is to develop a national approach to feedbase RD&E.

6.0 Summary of consultation

The consultation process provided 576 responses from across the feedbase industry. Respondents provided good coverage of industry sectors, agro-ecological regions and States. The consultation was conducted to accord with the information requirements as described previously (see Fig. 10) but which is provided below for reference. A summary of the priority outcomes is provided in Table 25.

The first element of the consultation was to identify the **existing opportunities for on-farm action** through the adaptation, validation and adoption of existing technologies and information to increase the profitability and sustainability of red meat production. Respondents also made assessment of the expected impact of adopting the technology, the likely barriers to adoption and the forms that extension, training and advice should take to maximise advantage of the opportunities.



Existing technologies that should form the basis of on-farm actions were ranked and the top ten were:

1. Better pasture utilisation	6. Better integration of crops with pastures
2. Improved grazing management	7. Improved control of weeds
3. Improved soil fertility	8. Correction of soil acidity
4. Increased legume content	9. Increased use of fodder crops
5. Increased sown perennial grass content	10. Increased subdivisional fencing

There were very few notable regional differences, with lower importance placed on soil fertility and legume content and higher importance on increased native perennial grass content in regions with a more arid environment. In general, there was a strong overlap between sectors and regions in the ranking of on-farm actions. There was also consistency and strong support from the interviews with researchers, RD&E providers, advisors and producers with high priority given to grazing systems (encompassing pasture utilisation), pasture improvement and pasture nutrition. The role of containment feeding in the Temperate Slopes and Plains agro-ecological region rated highly.

On-farm actions with existing technologies to improve pasture nutrition were expected to increase red meat profitability to the greatest extent (55%) with moderate improvements to sustainability. Improved grazing systems were expected to increase profitability by 37% with smaller benefits for sustainability than improved pasture nutrition.

The major (top five) **barriers to adoption** of on-farm actions were identified as:

1. Seasonal variability
2. Cash flow considerations
3. Lack of confidence that returns will cover costs
4. Risk of failure
5. Not having the right technical skills

Producers ranked these barriers to adoption lower than the other sectors indicating a different perspective. It is important to note the importance placed on seasonal/profitability/risk issues. Whilst this is in part a reflection of the poor seasons and the current financial position of many producers, it highlights again the fact that farmer decisions are usually driven by factors other than technical information and unless a whole farm business approach is taken, programs are unlikely to succeed in the long-term.

The preferred approaches for providing training opportunities for producers and consultants were:

1. Demonstration of the technology in a local setting
2. Involvement with group training activities with other producers
3. Support with field days
4. Trained advisors
5. Detailed financial information

Having addressed the existing technologies, the consultation process sought to determine the **future opportunities mainly through research** to further increase the profitability and sustainability of red meat production. The top ten feedbase components for research were:

1. Pasture utilisation
2. Grazing management
3. Farming systems
4. Soil fertility
5. Improvement of legumes
6. Improvement of introduced perennial grasses
7. New species
8. Soil biology
9. Decision support systems
10. Pasture establishment techniques

There were some notable sectoral and regional differences but in general there was strong industry agreement on the research priorities.

While these research priorities were nominated from the broader on-line survey of industry (Feedbase Priority Survey), the consultation also sought the ideas of researchers. This group nominated **plant improvement, pasture management, grazing systems, pasture nutrition, dual purpose systems and legumes as the highest priorities,** accounting for 78.3% of nominated research priorities. Research conducted on grazing systems (feed utilisation, pasture persistence, risk management) was estimated to have the largest likely impact on red meat profitability, followed by work with legumes (management, selection, break crops, feed quality). Research in legumes and grazing was considered to offer moderate improvements to the sustainability of red meat production.

There is clearly the opportunity for better collaboration within the feedbase industry, an issue which is of critical importance in the FIP, and particularly its adoption and management. Approaches to improve collaboration were detailed in Section 5.7 and the extension framework proposed in this FIP is described in Sections 7.0 and 8.0. In summary, strategies need to be enacted to encourage greater sectoral interactions, deal with the variation within agro-ecological regions and establish a nationally recognised feedbase industry.

Table 25: Summary of consultation with the feedbase industry and conceptual framework.

Aspiration	Double red meat production from half of the area currently used for grazing				
Goals	1. Increase by 30% the productivity and profitability of red meat production by 50% of producers by **2015**, through the adoption of existing information and practices. These changes will also lead to improvements in the sustainability of natural resources and quality of life of industry participants. 2. Increase by a further 30% (i.e. 60% increase from year 2010 position) the productivity and profitability of red meat production by 50% of producers by **2025**, through the adoption of information and practices to emerge from research programs. These changes will also lead to further improvements in the sustainability of natural resources and quality of life of industry participants.				
Objective	Increase the margin between cost of production and price received while managing risk and improving the natural resource base				
Industry Framework	1. Decrease cost of production • Reduce the contribution of overheads to the unit of production • Match and align pasture supply and demand • Optimise marginal economic return from variable inputs 2. Increase the unit value of production by meeting market specifications 3. Improve the condition of the natural resource base 4. Manage risk exposure associated with production				
ACTIONS, BARRIERS AND EXTENSION APPROACHES TO INCREASE THE PROFITABILITY & SUSTAINABILITY OF RED MEAT PRODUCTION WITH EXISTING TECHNOLOGY AND INFORMATION					
	HIGH PRIORITIES				LOW
On-farm actions	Grazing systems • Pasture utilisation • Pasture persistence • Pasture composition • Enterprise structure	Pasture management • Establish pastures • Increase feed supply • Timing of feed supply • Match species to landscape • Increase legume content • Increase sown perennial grass content	Pasture nutrition • Match fertilizer to requirement • Increase soil fertility	Dual enterprise systems • Grazing cereals • Integration of crops, pastures and livestock	Containment feeding • Part of the grazing system • Feeding for production
Barriers to adoption	Seasonal variability	Cash flow considerations	Don't believe returns will cover costs	Risk of failure	Lack of the right technical skills
Preferred approaches for communication and adoption	Training for producers and activities with peers	Access to a local farm demonstrating adoption	Detailed financial information	One to one support from Private Consultants	Field days
RESEARCH PRIORITIES TO INCREASE THE FUTURE PROFITABILITY & SUSTAINABILITY OF RED MEAT PRODUCTION					
	HIGH PRIORITIES				LOW
Research	Pasture management • Pasture persistence • Manage feed gaps • Manage risk (climate, season, resilience) • Adapt to low land capability	Grazing systems • Pasture utilisation • Systems (pastures, livestock, etc) • Livestock performance • Pasture persistence and risk management	Pasture nutrition • Efficiency of fertilizer use • Greater extraction of soil P • Pastures with lower nutrient demand • Regulate legume content	Dual enterprise systems • Integration of multiple enterprises • Inclusion of livestock with crops • Grazing cereals • Break crops (legumes)	Legumes • Selection for adaptation, persistence, seed set • Lucerne management • Persistent and consistent frequency and abundance • Use as break crops

6.1 What will be the FIP outcomes?

Up to this stage of the FIP the outcomes of industry consultation have been provided and discussed. The key focus has been on consulting with industry to understand opportunities, approaches, barriers and existing activity to improve the productivity, profitability and sustainability of red meat production in Southern Australia. The remainder of the FIP deals with recommended approaches to support greater rates of adoption, strategically-focused research and industry governance.

Based on previous MLA programs and the information collected as part of this project, the anticipated outcome of the FIP is an 30% increase in red meat productivity and profitability by 50% of producers through the **adoption of existing information and practices** by **2015**. These changes will extend beyond 2015 and will also lead improvements in the sustainability of natural resources and risk management contributing to a better quality of life for industry participants.

A further 30% increase in red meat production will be achieved by **2025 through the adoption of information and practices to emerge from current and new research activities.** There will be similar positive changes for natural resource and risk management as outlined above.

In terms of the **farmer audience,** these improvements will be achieved by greater penetration of the farmer market based on better understanding the opportunities, barriers and drivers through the Agro-Ecological Team approach with targeted extension using the methods preferred by farmers including, but not constrained to, the Lead Farm approach. This overall approach allows the targeting of traditional and non-traditional market segments by matching recognized needs with the appropriate practice change technology and delivery method. In reality, this will mean market penetration into the late majority segment, at least in the early years.

The FIP also achieves **other goals and requirements** which will impinge increasingly on feedbase research and extension in coming years. This includes addressing:

- The imperatives highlighted in the **MLA Strategic Plan**, especially in relation to increasing productivity across the supply chain and increasing industry and people capability.
- The requirements of the **Primary Industry Standing Committee (PISC)** agenda for a joint national/regional/local approach (see Section 2). In fact adopting the FIP could fill the feedbase/pastures gap in the PISC program.
- The anticipated outcomes from the **Productivity Commission enquiry into RIRCS** including the proposed reduction in government funding, concentration of government funding more on the needs of research, the lack of appreciation of farmer decision making within the farm system context, (and therefore of the need for farm systems/adoption research and improved extension capacity in the field),and the failure to effectively address cross sectoral issues that exist within a whole of farm context.
- The many **Cross Sectoral Issues** between private and public; research, development and extension, various technical sectors; and agencies; and doing so across the

national/regional and local level. In this regard alone, but also because of the extensive consultation that supports the recommendations, this FIP makes a contribution to industry improvement that few, if any, other strategic documents have made.

7.0 Feedbase Investment Plan - an integrated national – regional – local structure

7.1 Rationale for the FIP approach

The FIP proposes three levels which require co-ordination and governance:

1. National
2. Agro- ecological regional
3. Local

The focus of the recommendations contained in this FIP are to:

- Achieve greater relevance of information and better rates of adoption amongst more farmers (and their advisers), and
- Ensure that the setting of priorities and management of research and extension projects at local, regional (agro-ecological region) and national levels occurs in an integrated manner which makes best use of the limited resources available, regardless of source.

7.1.1 Achieving greater relevance of information and better rates of adoption amongst more producers and their advisers

Many projects have been reviewed in terms of their impact on changing farm practices (for example Barnett 2007). In summary, these programs appear to have had some success in achieving practice change. As a general comment, programs which have a high level of direct on-farm involvement have resulted in a higher level of practice change than those which present information in passive forums, such as seminars.

However, what is not known from these project reviews is:

- Were the changes localised or industry wide?
- Were the programs based on market research which gave an understanding of farmer drivers, or were they based largely around the availability of technology?
- What were the practices that changed – were they simple or complex?
- Was it mainly single practice change or a combination of changes in a more systems approach?
- Which types of farmers changed – were the programs targeted to particular groups and did they fail to engage with some farmers market segments. Were those who adopted the more innovative farmers who were able to fit the change into their system?
- What methods were used – was it mainly information transfer, what was the level of farmer involvement, and how?
- Have the practices been sustained by those who have adopted and have there been "trickle down" effects to other farmers who have adopted?
- What might have been the results had different approaches been used?

Above all, how readily can the results of these programs be used to inform the most appropriate approaches in achieving improvements in the feedbase? There are obvious

concerns in the industry about the current state and utilisation of the feedbase for red meat production and these were included as part of the Terms of Reference for this project.

MLA market research and review documents generated by Pastures Australia highlighted inadequacies in the pasture industry supply chain both in terms of services to producers and information sharing. The commission to develop the FIP was charged with the task of reviewing all aspects and relevant technologies of feedbase production/sustainability that can improve the productivity of red meat production, and develop a comprehensive investment plan for RD&E.

The consultation was conducted against the background that pasture improvement and effective utilisation are complex practices which are likely to impinge on the whole farm business and quality of life. Adoption is likely to be quite different to simple practices where the provision of relevant information is itself often sufficient to achieve significant adoption.

Our conclusion from the consultation process was that extension methods needed to facilitate a higher level of producer engagement in a whole-farm and business context which accounted for peer group, risk and labour.

The provision of technical information alone is not likely to achieve the required rate of industry adoption and practice change. The importance of experiencing technologies in a whole-farm context is illustrated by the results from the Grassland's Productivity Program (GPP) which sought to sustainably and profitably increase stocking rates through the correction of soil fertility. The base technology was simple and well documented and demonstrated in the past. However adoption had faltered because of a poor understanding of the management requirements to obtain a financial benefit.

After 3 years of involvement in the GPP, where participants were required to implement the technology in the context of their own farm operation, there was a whole-farm increase in phosphorus fertiliser use by 6.3 kg P/ha, stocking rates by 2.6 dse/ha and annual pasture resowing by 0.9% of the farm, when averaged across the 146 participants. The participants were applying the productive pasture technology to almost a third of their properties in 1997 and the intention was to increase this to over half of their properties by 2000. The participants also changed farm management practices as the program effectively developed management skills. There were increases in the ability to assess pasture quality and quantity, livestock by weighing or physical assessment, and the ability to calculate per hectare production and per hectare gross margins. A high proportion of GPP participants were soil testing (92%) and spring lambing (72%) at the completion of the program (Trompf and Sale, 2000). In contrast there was no change in the practices of a Control group of farmers over the same time (Trompf, et al 1998) despite the availability of the same information in a passive form. This highlights the importance of direct farmer involvement.

Achieving change requires a substantial shift from the technology driven "one size fits all" approaches of the past.

The clear message from the Feedbase Priority Survey was that the major changes to red meat production require them to be demonstrated in a whole-farm system. The more

complex the practice and its integration into a farming system, the more necessary it is to demonstrate the practice or product in a whole-farm context.

This is the basis behind the proposed LEAD FARM (and associated) approaches (see following) whereby the program is developed around a commercial situation, augmented by such things as simple decision support tools, focus paddocks etc. Different Lead Farms may be required to address the needs of different parts of the market. External funding may not be required in each case. This approach requires a greater appreciation of barriers and drivers and an identification of which segments of the farmer market will give the best outcomes not just in terms of red meat production but in terms of financial and natural resource sustainability.

It is likely that much of the current information will still be relevant. Some of the current initiatives (such as focus farms, training packages, forums, manuals, and demonstrations; without naming specific programs) will also be relevant. What is proposed are different processes of delivery which will provide the opportunity (and need) to value-add to them as part of the mix.

In other words the proposed process retains the best of the current and adds new things in an integrated suite of opportunities to learn and change, catering for different, defined segments of the market and different learning styles. Programs are driven not by preconceived notions of what will be good for farmers but a thorough identification of the issues, barriers and drivers for change. It is a team approach involving all of the stakeholders.

This is not just about producers but those who advise and influence their decisions, be they private, public or sales consultants, accountants and banks. In fact the engagement and training of these groups will be crucial. The process also needs to involve the key technical and farm business information sources, some of whom will be outside the region or locality.

This is one of the bases behind the AGRO-ECOLOGICAL ZONE approach (see following) under which, given the similarities in the overall farming environment, teams of producers, advisors, and technical/farm business experts can be brought together to set the priorities and develop and manage the approaches appropriate to each of the localities and defined segments of the farmer market, including the use of Lead Farms.

The programs from the agro-ecological regions, with other inputs, are brought together to form the basis of the NATIONAL PROGRAM.

This leads to the second important goal of the proposed FIP.

7.1.2 The setting of priorities and management of research and extension projects at local, regional (agro-ecological zone) and national levels

One thing which emerged clearly from the various consultation approaches was the need for an approach by which projects have greater input from the bottom up, a system which encourages collaboration of other sectors of the feedbase supply chain, and a process which aggregates projects at the regional level to match national priorities.

Such an approach needs to be built on several requirements:

- Is responsive to changes in the operating environment be they due to costs, returns, seasonal variation, government policies (such as might relate to greenhouse gas abatement for example) etc.
- Ensures relevance of activities at each level, for each of the research, development and extension functions.
- Utilises and coordinates the expertise and knowledge of research, consultants and farmers in the planning, conduct and evaluation of activities. It provides continuous and constructive feedback loops.
- Provides for integration of feedbase initiatives with other associated improvement opportunities such as animal improvement, use of grazing crops, livestock management etc. It also does so within the context of the full range of drivers of change, rather than just the technical considerations. It focuses on whole farm practice integration and business outcomes at all levels.
- It accepts that “one size does not fit all” and that programs (especially of extension) need to be flexible and based on the characteristics of the farmer audience.
- Increases efficiencies by avoiding duplication and utilizing teams of the best available resources, regardless of how and where they are employed.
- It provides for the involvement of the full range of relevant players and funding sources be they government, industry or private sector.
- It provides for contributions from related industries and funding bodies as part of an integrated approach – good examples are the inclusion of AWI, GRDC, Dairy Aust, RIRDC and natural resource interests and funding. The engagement of related CRCs is also important.
- It is consistent with the PISC process which is meant to work at these three levels – in fact this FIP could become the Feedbase (pasture) component of PISC – something which has not been addressed adequately by PISC to date.
- This requires an integrated local-regional-national approach. Figure 24 depicts the players and the relationships.

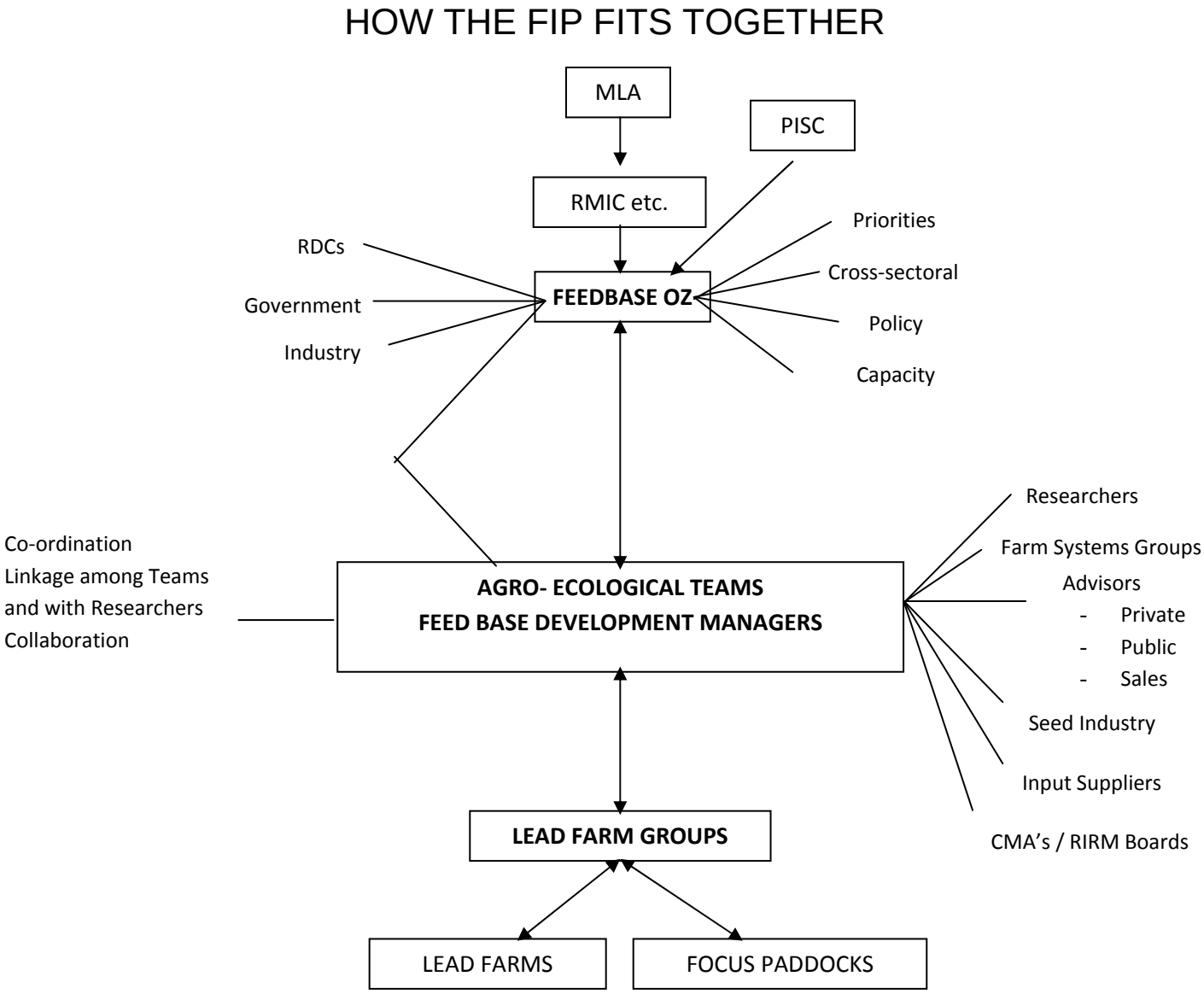


Figure 24: Feedbase extension delivery model indicating how the different components fit together to provide an integrated approach to foster adoption and identify research priorities.

7.2 National level - Feedbase Oz

Whilst opinions of the effectiveness of Pastures Australia varied among respondents, it is important that there be a national focus on the feedbase (and particularly pasture) industry. This is simply because, apart from seed sales, it is an industry which makes its contribution indirectly through meat, fibre, dairy and grain. But even these larger industry groupings often underestimate the importance of the feedbase, leading to feedbase issues (especially pastures) often "falling between the cracks". This has certainly been the case with the PISC agenda which recognizes most industries, and a lot of areas of generic importance, but not pastures (or other components of the feedbase). Adoption of this FIP and delivery model will correct this and lead where the PISC has had difficulty.

The recent review of Pastures Australia (SGA Solutions, 2009) recommended, among other things, that Pastures Australia evolve to fulfill the following objectives:

- Increase across supply chain collaboration in the generation of pasture improvement RD&E and the flow-on commitment to the promotion and adoption of these outcomes.
- Facilitate a process for the effective planning and prioritisation of RD&E required for pasture improvement.
- Coordinate an across industry approach to industry investment in pasture improvement RD&E.
- Provide a mechanism to deliver increased efficiency in the use of industry RD&E resources and capacity through the integration of across sector RD&E priorities.
- Facilitate the systematic consolidation of information from isolated silos into a centralized information distribution network.

The FIP has, as one of its main planks the formation of a new national body which is consistent with these objectives (and the concept of Pastures Australia II) and:

- Comprises the major feedbase industry sectors, RDCs and agencies and provides the forum for cross-sectoral issues.
- Is the peak body and leads feedbase research, development, extension, capacity building, evaluation and policy.
- Provides the national forum for negotiation between public and private sectors at the Program level.
- Is closely linked to Agro-Ecological Teams and Lead Farms

The proposed body is not dissimilar to the “Clearing House” strategy based model proposed in the Pastures Australia Review (Option 2). To quote from that Review “*The review panel is of the view that the “Clearing House” strategy based model supported by the RDCs will see the role of PA transition from being a manager of research projects to one where it provides advice and direction to organizations (e.g. RDCs) as to their investment in RD&E projects which are consistent with a national approach to pasture improvement. In addition it will see PA undertake an active role in establishing and providing a pathway for disseminating the outcomes of the industries RD&E investments (i.e. a clearing house) to pasture industry stakeholders across the supply chain.*

Because of the negative sentiments (voiced through this consultation) towards the previous Pastures Australia model, it is proposed that there be a clean break and that the national body be given a new name – Feedbase Oz. Not only is this distinctive but it includes all components of the feedbase, not just pastures and sits within a structure with links to regions and local farms.

It is recommended that a new national body (called Feedbase Oz) be formed consisting of key people from the existing RDCs and with inclusion of representatives from industry sectors and agro-ecological regional groups. The body would be the peak group for the feedbase industry, and be a forum to co-ordinate activity and optimise collaboration for project support. This structure ensures a funding base directly through the RDCs and indirectly through government and interconnects the various elements and proposals of this FIP (Fig. 24)

7.3 Regional level - Agro-Ecological Teams

The consultation highlighted the broad similarity of issues within the agro-ecological regions, although in more geographically widespread regions, such as Temperate Slopes and Plains, there may be differences within the region that require different approaches. This common understanding of the region provides the basis for bringing together the wide range of expertise from within and outside of that region, including producers, producer groups, private and public consultants, the retail sector, input suppliers and researchers to engage in a stepwise process which:

- Develops a whole farm business strategic framework, relevant for each agro-ecological region, to determine the fit of technologies and their likely importance on farm and within the industry.
- Confirms and further defines the priority issues (as identified through the FIP Consultation) which need be addressed to build more productive and resilient systems. This includes natural resource and economic considerations.
- Further defines the questions which need to be asked.
- Determines what information is already available.
- Determines whether research, adaptation, validation or extension, or a combination is required and ensures known barriers and preferred extension methods (provided through this FIP) are addressed.
- Decides who should lead/do the work and whether it is on/off farm, seeking linkages with the Lead Farm framework (see later).
- Decides who should fund it and develops a joint strategy for funding bids.
- Provides ongoing leadership and management of the project(s) with regular reporting and discussion by the team.

It should be noted that such an approach will depend upon skilled leaders/facilitators for each agro-ecological region (see section 7.3 Feedbase Development Managers).

This cross-sectoral approach within agro-ecological regions has a number of positive attributes including:

- Better allocation of resources to priority issues.
- Better cross-sectoral communication and understanding, based on issues relevant to the farm business.
- Better integration of extension components into research and vice versa leading to higher level research questions. It should be noted that the intent is to add value to the research topic selection, conduct and results delivery processes. This integration will be essential with the move to greater reliance on industry funding.

- Provides economies in joint bidding for projects rather than the competitive process at local level that currently exists. Some funding bodies are now insisting on this joint "regional" approach.
- Provides the basis of building in natural resource management, social, and economic considerations and programs in an integrated manner.
- Provides a sense of team and *esprit de corps* which improves personal satisfaction, sharing of ideas and productivity.

This approach is not entirely new. The Grain and Graze Programs have some elements of it and GRDC is moving strongly down this path of planning on an agro-ecological regional basis – a discussion paper has gone to the various GRDC stakeholders and received widespread and strong support. The GRDC initiative would provide the opportunity for joint consideration of both cropping and livestock issues with very little additional cost. The co-location of Development Managers for both would provide a very potent force for establishing producer cooperation and adoption.

It is recommended that eight Agro-Ecological Teams, based on agro-ecological regions be established. These teams should be linked through Feedbase Oz and supported by a network of Feedbase Development Managers

7.3.1 Feedbase Development Managers

This approach will be overseen by the Agro-Ecological Teams but requires the appointment of a professional to provide leadership and coordination, linkage across other agro-ecological regions and connection to Feedbase Oz. It is proposed that eight Feedbase Development Managers will be required and allocated in the following way. Note, that because of the geographic distribution some of the regions have been combined and others, because of their size, have a number of Feedbase Development Managers.

- Arid Interior NSW / Qld and Semi Arid Sub Tropical Plains
- Sub Tropical Slopes and Plains NSW/Qld
- Temperate Slopes and Plains NSW
- Wet Temperate Coast and Temperate Highlands NSW
- Wet Temperate Coast Tasmania / Victoria and Temperate Highlands Tasmania / Victoria
- Temperate Slopes and Plains Vic and SA
- Temperate Slopes and Plains WA and Wet Temperate Coast WA
- Arid Interior SA and WA

The split of regions and allocation of resources may need further development which would be done through Feedbase Oz.

It is recommended that eight Feedbase Development Managers (FDMs) based on agro-ecological regions be appointed to lead and facilitate regional teams and take responsibility for development, delivery and evaluation of RDE activities.

The Feedbase Development Managers would be responsible to and report to the Agro-Ecological Team, and their performance measured on clearly defined outcomes, agreed by the group. Their role would include liaison between the sectors of the feedbase, to facilitate the transfer of information and technology up, down and within the feedbase sectors as well as ensuring that the information/training needs of providers and producers are met.

In practice, MLA has used a similar model with the delivery of Sheep Genetics, whereby selected staff drive industry communication and adoption. No such approach exists in the feedbase industry to lead and coordinate industry efforts and provide the conduit for project delivery to the community.

7.4 Local level – Lead Farm/Focus Paddock

This concept is dealt with in detail under Section 8 which discusses the basis for the extension model. Briefly, Lead Farms are commercial properties which will be used as the basis of establishing action learning groups of producers, be used as the location for adoption of current technologies and, in some circumstances, be used to identify research projects and house networked research sites. Focus paddocks may be located on the Lead Farm or on farms of producers group members where technologies of interest will be investigated. The choice of Lead Farms will provide the opportunity to engage with various traditional and non-traditional market segments. However it is important that Lead Farms/focus paddocks (including such things as paired paddock comparisons) are all considered as components of the one RD&E process. The whole process at local and regional levels in particular comprises a number of feedback loops which build on and integrate the various activities.

8.0 Feedbase Investment Plan: extension leading to adoption

Success in achieving the first and more immediate goal of the FIP to *increase the productivity and profitability of red meat production by 30% with management that improves the sustainability of the industry by 2015* will be driven by:

- Greater adoption of existing information and key practices
- Improvement of these practices, and development of new information through research.

Respondents identified those existing opportunities which through adaptation, validation and extension, will lead to on-farm actions with the greatest impact for red meat productivity and sustainability. In fact it was widely suggested by respondents that development and extension would provide large and early gains (at least 30%) and that 50% of MLA investment in the feedbase should be allocated to this area.

Respondents also outlined the barriers to adoption and methods by which they prefer technologies and information to be delivered. Existing delivery methods have seldom dealt with these barriers nor accommodated the preferred methods of communication/extension delivery leading to adoption. In this section, the requirements for successful adoption are discussed within the proposed extension and delivery framework. It is acknowledged that producers (and often advisers) will be at different stages in the understanding and adoption of different technologies, and that any framework must be sufficiently flexible to cater for this variability. There is nothing unusual in this because the processes of adoption and the different categories (such as laggards, early adopters etc) have been known for some time. Unfortunately few extension programs take full account of these differences.

8.1 The need for a change in approach to development and extension

A major driver behind this project was that adoption of feedbase improvements appeared to have "flat-lined". Was this due to things like drought, costs and commodity prices, or was it due to producer characteristics which could be best addressed by a change in extension approach?

Other issues, as outlined in the project Terms of Reference, was an often unknown return on investment from previous programs (while there have been numerous estimates such as Hassall & Associates, 2004 most estimates are based on a list of assumptions which erodes confidence in the analysis), insufficient integration across RD&E and a stifling in producers' investments in pasture technology because of declining public extension.

Taken together, there is a general sense that research has outpaced rates of adoption of improved feedbase and associated livestock practices. In the research-extension continuum, this is not an uncommon occurrence.

We contend that one of the main reasons for poor rates of adoption is that the process has largely been information driven, with what seems almost an expectation that if producers have the information they will adopt. In reality there are many other factors that influence the rate of adoption: adoption is rarely limited by a lack of information alone. It is not just the

characteristics of the practice that are important but the financial and social setting of the producers. Producer respondents in this consultation were quite clear on the need for extension to be delivered in the context of the farm system and business. They also rated lowly more traditional extension methods.

Further hampering rates of adoption is that the process of research > development > extension > producer is frequently seen as linear rather than as circular in which all players have a role. This has important implications not just for extension but for future research direction. What is required is a new way of doing extension which seeks to understand and respond to the factors driving adoption on farm and provides feedback loops between producers<>extension<>research.

Such a system needs to respond to the obvious fact that producers are different in their abilities, capacities and aspirations – one size (message) does not fit all. An understanding of this allows us to better address the question of which producer audiences do we give priority and why. There may be good reason to target non-traditional market segments if practices are not only limiting production but having adverse effects for example on the soil resource and environment.

8.1.1 Requirements for successful adoption

Barnett (2007) lists the characteristics of an innovation that determine the extent and rate at which it will be adopted (if at all) by its target market and whether that adoption will be sustained. To broadly paraphrase Barnett:

Relative Advantage

Relative advantage is the degree to which the new practice is perceived as better than the one it replaces. It is measured in terms of economics, social/prestige factors, convenience and satisfaction. Perception is more important than objectively measured advantage. An innovation that is perceived as providing relative advantage is more likely to be adopted.

It was clear from the interviews that, while on-farm actions such as feed utilisation, grazing management and pasture improvement were acknowledged as important, very few respondents could clearly articulate the benefits from adopting them, especially when the whole farm context was considered. We have interpreted this to mean that if advisors are unable to clearly put the improved practices in a whole farm business context and elucidate the benefits in financial and social as well as technical terms, then the likelihood of producers adopting these practices and continuing to use them in future will be diminished.

Compatibility

Compatibility is the degree to which a new practice is seen as being consistent with the existing values, experiences and needs of potential adopters. The more compatible a practice is, the more likely it is that the individual will adopt that practice. On the other hand, attempting to get producers to adopt a new value system is a very slow and often futile process.

For example, integration of pastures and livestock with cropping enterprises has been nominated as a priority for current action and future research. Demographics of land use also indicate the growing importance of enterprise integration, particularly in the Temperate

Slopes and Plains. The extent to which pasture and livestock practices can be demonstrated to be compatible with cropping activities will influence the success of adoption. A perceived lack of compatibility between cropping and livestock has led many producers to cease livestock production. This is not just technical or economic but the conflict between the labour demands of livestock and leisure time, especially amongst younger producers.

Complexity
Complexity refers to the degree to which a practice is perceived as being difficult to understand and use – the simpler an innovation is to understand and use, the more likely it will be adopted. For example, new varieties of pasture or grazing cereal are easy to adopt because it simply means a change of seed and not practice. On the other hand improving feed utilization requires an understanding of the needs of the animal and the amount and quality of feed available, along with the need to maintain ground cover, and the need for labor and improvements in infrastructure such as fencing. For many producers, this is a complex association. In reality many contemporary messages are more complex than those of earlier generations and the challenge is to achieve greater simplicity without losing the authenticity of the message. Helping the producer understand the fit of the practice in the whole farm business is particularly important, and is a challenge for many advisers.

Trialability
A practice that can be experimented on a limited basis before a decision to adopt fully is made is more likely to be adopted. For example, the priority issues of pasture nutrition and plant improvement lend themselves more readily, than grazing management, to on-farm trials. It may also be that simple decision tools will allow producers to trial “what if” scenarios rather than doing physical comparisons.

Observability
This is the degree to which the results of using a practice are visible to the adopter and others. The easier it is for individuals to see the results of a change in practice and the more immediately they see those results, the more likely they are to adopt that practice. It is easier to see the results of a fertilizer comparison for example than a comparison of grazing systems. Seeing the technology in practice on local demonstration farms was identified by respondents from all sectors and agro-ecological regions as the most effective means of fostering on-farm adoption.

Other factors
Two other factors affect the rate and extent of adoption of a new practice:

Communication Channels – are the mechanisms through which information on the innovation is delivered to target adopters at various stages of the adoption decision process. Respondents in this project saw their peer group and Advisers as particularly important but were less supportive of field days (unless associated with on farm trials), brochures and electronic communication.

Social and Peer Group Influences – refers to the culture, structure and customs of the target market. For example, those continuing to run livestock as part of a mixed system are often seen by “croppers only” as being lesser producers. Similarly, those producers managing higher stocking rates may have stock with lower fat scores and with lower rates of production

per head which may be the source of negative comment from peers. This cultural perception and associated peer pressure is real.

Barnett (2007) concludes that, from the perspective of an organisation charged with driving the adoption of innovations, the two most important factors to consider are relative advantage and compatibility. This is because the other factors – complexity, trialability, observability, communication channels and the targeted peer group system – can usually be addressed (to varying degrees of success) by 'product' design and marketing strategy.

One clear message to come out of this consultation is the need to better understand the current knowledge, attitudes and practices of producers as the basis for designing the information products and extending them. This "market research" is rare and explains why programs often fail. There is a tendency for advisors and researchers to assume what producers need, deliver it in a way which suits them, and then wonder why adoption is disappointingly low. Market research is time consuming, and requires skills rarely present in agriculturalists and, because it doesn't provide identifiable outcomes in terms of practice change, is not well supported by funding bodies as a core component of projects. This not only impacts on the project activity but the capacity to evaluate the outcomes.

The FIP makes an important contribution in this area by outlining the barriers to adoption and the preferred extension methods. Perhaps the indication from producers that they prefer extension to target producer groups and to be conducted in a local setting and at the level of the whole farm business is evidence that they want extension/research to better identify relative advantage and compatibility, than has typically been done in the past.

8.2 Proposed Feedbase extension delivery model

There is not a consistently agreed and tested approach between providers of information to producers for the integration of technologies into a farming context. Programs are often presented as stand alone or as modules, with no means of assessing the relative importance of the technology to the producer or its integration in the system. Even if adoption occurs, it often wanes after the programs cease because there is not the on-going support (i.e. maintenance of adoption) and no business framework for the technologies. Industry cannot afford to allow this slippage of adoption to occur and must develop strategies to build cumulatively upon adoption successes.

What is required are integrated programs which are firmly rooted in on-farm reality, are delivered in a whole-farm business context, and build the capacity of those in the research/advisory sectors so that there is continuity of effort as opposed to the 3-5 year terms as currently exist with project funding.

The model proposed to foster adoption of on-farm practices leading to the requisite increases in the profitability and sustainability of red meat production has four components but the intent of the model is described here.

The extension delivery model must be:

- Based on greater producer involvement and an understanding of the producer drivers of adoption.

- Be flexible so that it responds to the different needs and aspirations of famers, as well as changes in such things as seasons and prices, etc.
- Be based on agro-ecological regions so that there is a basis of common issues/environments.
- Engage the various advisory components of the system from public and private sectors, consultants and retail.
- Engage the research sector, not only from within the region but whoever is able to contribute to the issues. Research involvement must be two way – the model provides an effective path to market for research results AND is a source of information to identify future research directions and projects.
- Be driven by competent field-based leaders, attached to the agro-ecological region.
- Provide the opportunity for cross-sectoral engagement between the various livestock interests, associated cropping, natural resource management, climate adaptation and adaptation, etc.
- Have a strong national component which brings the agro-ecological regions and cross-sectoral interests together in a way which supports the FIP and informs industry and government policy.

What is proposed is not just a new way of delivering projects – it provides a fresh approach, based on the outcomes of this consultation and sound extension theory, to drive increased adoption of technologies in the long term and a problem-based context for identification of researchable questions.

Section 7 dealt mainly with national and regional components of this new approach. This section deals with the specifics of the more local farm-based components, which the reader is reminded, integrates closely with regional or Agro-Ecological Teams and ultimately with Feedbase Oz.

8.2.1 Lead Farm proposal and Focus Paddocks

It is clear that most respondents believed that the adoption of existing technologies would significantly lift the profitability of red meat production. In contrast to cropping, implementing on-farm actions in grazing enterprises is complex, with greater time delay (especially in beef) because of the transformation through the feedbase into animal products rather than just a plant output. For example, the high priorities (grazing management and pasture utilization) are clearly interventions that require a systems approach that integrates with the whole farm business operation.

Successful extension must be able to address the barriers to adoption. There was a clear implication from the responses that there was little confidence by producers (and in many cases advisers) about the practical adoption and the benefit from the introduction of several of the “new” technologies. They wanted to see the technology adopted in a whole-farm context in their locality and supported by good financial data as a means of confirming relative advantage and compatibility.

Two integrated types of activity are proposed which will overcome many of the barriers to adoption, place extension in a local context and better integrate the sectors in the feedbase industry. These are:

- Lead Farms which test the adoption of key technologies as part of the whole-farm business system. These Lead Farms (50-100 in the first five years; see footnote to Table 27) will form a network across the agro-ecological regions and be targeted to cover the spectrum of producers' attitudes to innovation. The Lead Farms will be co-ordinated by Feedbase Development Managers and form a delivery network for Agro-ecological Teams. The Lead Farms will be a vehicle to test and integrate on a whole-farm business basis a wide range of information and practices coming from sites within and outside the region. (They will also provide suitable sites for some types of research)
- Focus Paddocks which adapt and validate particular technologies for suitability for particular areas or specific aspects of the farm system. These technologies may originate from the Lead Farm or be used as an initial exploration before incorporation into the Lead Farm, or as an end point in itself.
- A third and ancillary supporting activity is the creation of digital generic\case study farm(s) within agro-ecological regions. The case study farms will be created through the collection of a range of input, output, price and risk parameters by the Agro-Ecological Team and used to identify benchmark performance. This data forms the basis of a simple decision support tool which can be "interrogated" by FDMs with producers groups to assess the outcomes of practice adoption and ask the "what if" scenarios to assess profitability and risk. The main reason for a generic approach is the experience that most producers are reluctant to share the financially sensitive details of their farm business (which are often the most important ones in determining adoption of new practices). This approach is being used increasingly in cropping areas as a tool to assess the sensitivity to changing circumstances; as a factor in deciding research priorities; and as a training tool. It is in fact simple modeling.

The process of recommending the number of Lead Farms is a balance between market penetration and budget allocation (see Table 27) to give the optimal result in terms of budget allocation per producer adoption. Lead Farms and the action-learning groups would be serviced by professional facilitators/consultants (managed by FDMs) whose fees would, in part, be covered within the recommended MLA budget allocation. In addition to MLA support, participating producers would also pay a membership fee and it is likely that such a network would be an attractive option for co-investment from other areas.

It is recommended that the focus for the delivery of feedbase technologies be based on a network (50-100; see Table 27) of commercial and privately-owned Lead Farms. Lead Farms will be used to identify and evaluate technologies appropriate to a particular region and in a farming system context and identify information gaps requiring research solutions. Particular technologies will also be evaluated in Focus Paddocks on other local farms. The whole process will be supported simple decision tools based on case study farms (which may be the lead farms).

A further barrier recognised by a significant number of respondents was the need to consider the implication of the proposed action on labour requirements and management input. Unlike cropping, the grazing industry has been slow to substitute capital for labour. Those technologies that have been identified have lacked sufficient technical development or a clear assessment of the benefits to the farm business. Instead the focus has often been on

the technology itself. Lead Farms and other local case study farms will provide the means to evaluate technologies in the context of all aspects of the farm business.

Flexibility to adopt technologies appropriate to the specific situation is required but it is envisaged that the key adoption issues identified for each agro-ecological region (see Section 5) would form the basis of the farm strategic and tactical plans. This approach also accommodates the adoption and promotion of locally relevant technologies, which may have not generally rated highly in the consultation process.

While this FIP deals specifically with recommendations for feedbase RD&E, the Lead Farm provides the framework for the introduction, evaluation and demonstration of technologies throughout the red meat production system, including livestock programs. If adopted, joint funding from relevant program areas of MLA would be appropriate.

8.2.1.1 Operation of Lead Farms

Groups of producers (could access existing producer networks or establish new networks) would select a farm that would act as a Lead Farm from within their membership. The farm needs to be best placed to demonstrate productivity, profitability and sustainability relevant to the target market of adopters. Each Lead Farm would operate for a set period (minimum 5 years). The owner of the farm would have the final operational say, but would be guided in the strategic direction of the farm by an advisory team consisting of a paid facilitator selected by the group, and including producer members, input suppliers, consultants and the Feedbase Development Manager.

The farms would be expected to develop strategic plans and monitor performance against the plan and budget. A standardised set of physical and financial data would be collected from each operation to allow a cooperative but competitive interaction between the farms. This will be augmented by reference to the case study farm and the associated simple decision support tools.

It is envisaged that group members would trial appropriate technologies on their own farms (through Focus Paddocks) and that their involvement in the group would identify appropriate training needs of participants. In this way the training needs are determined by the context of the Lead Farm and not developed in isolation.

The establishment of these farms would provide a focus for on-farm demonstrations/trials and would provide regional foci for the collection of agronomic and other data. Through the practical implementation of existing technologies, issues for further research would be identified. Research projects would also make use of these Lead Farms and Focus Paddocks which also presents opportunities to determine leading industry research questions and locations for research already linked into a national network. This greater connection of industry sectors will help to overcome the limited opportunity for information transfer between sectors that was identified through the consultation.

How the Lead Farm/Focus Paddock model addresses issues raised in the consultation process

With few exceptions, most extension priorities were similar across the agro-ecological regions. The application of specific technologies to any farming system will always depend on the environment, the producers' aspirations, enterprise and other factors. The Lead Farm concept allows for the technologies to be selected locally and evaluated in a farm systems approach.

How the Lead Farm /focus paddock model addresses the requirements for successful adoption

Relative advantage - The Lead Farm provides the opportunity to demonstrate in a practical and local manner the benefit from adopting appropriate technologies in a commercial context.

Compatibility – The opportunity to see a technology adopted in a farming systems context allows evaluation of the compatibility of the technology. This is not a situation of seeing a technology in isolation and so the Lead Farm model is well placed to address this requirement.

Complexity - The introduction of many of the technologies in the grazing industry requires modification to many parts of the system and the technologies therefore assumes a perceived level of complexity. In reality most systems are not as complex as initially thought, and what is required is a pathway for adopting the technology. The Lead Farm concept has the opportunity to define and refine the process for the introduction of technologies and reduce complexity.

Trialability - The Lead Farm should encourage technologies to be trialed on group members' farms (through Focus Paddocks). The Lead Farm would be used to ground truth the technology and demonstrate the benefits. A properly functioning group, with a professional facilitator supported by a Feedbase Development Manager would provide support and constructive feedback to group members who were trialing the technologies.

Observability – This requirement is perhaps best met using the Lead Farm approach as it provides for observed activities and measured outcomes.

Greater Producer Involvement in RD&E - A network of informed producer groups would provide the basis for greater producer involvement in feedbase RD&E. These are not 3 or 5 year groups but an industry network, which forms the core of fresh new approach to adoption.

Capacity Building - Many technologies are developed as concepts and trialed at limited locations. Local adaptation of those technologies will provide a training role for all participants in the farm.

Better Integration within the Feedbase chain - The opportunity for all sectors of the feedbase chain to be involved should facilitate the transfer of information along and across the chain.

Maintenance of adoption - The development of business plans for each farm will need the critical evaluation and prioritisation of appropriate strategies and tactics to achieve the goals.

This will provide the framework for investment in the farm and reinforce strategies for improving red meat profitability and sustainability.

8.2.1.2 Results from similar extension programs

The Lead Farm concept has a number of similarities with the NZ Focus Farm program and the Scottish Monitor Farm program, but differs in the proposed integration with the whole feedbase. The NZ Focus Farm program has been running since 1991 and the Scottish program since 2003. Analysis of the effectiveness of both these programs indicated benefit:cost ratios of 6.7:1 for the Scottish program and 21:1 for the NZ program. Since the inception of the NZ program some 125 individual monitor producers have passed through the program with an estimated 20,000 producers cumulatively involved through community groups, receiving newsletters or attending field-days. The estimated benefit to producers has been estimated to be in excess of $150 million since the program began. Focus farms are being used increasingly in Australia, including as part of the Grain and Graze II program.

8.3 Summary of proposed industry delivery model and investment plan

The extension activities summarised in Table 26 apply across all agro-ecological regions.

Under the proposed model the priorities for extension would be determined locally, at the level of the Lead Farm group, regionally at the level of the Agro-Ecological Teams and nationally at the level of Feedbase Oz. This is the proposed structure for the Feedbase Industry in Southern Australia.

The evidence gained from this consultation is the basis for the first goal of this FIP. That is, adoption of existing technologies is best facilitated by the proposed industry structure and the impact will be to *increase by 30% the productivity and profitability of red meat production by 50% of producers by 2015 with management that improves the sustainability of the industry and the quality of life for its participants.* It further establishes the research – development – extension – producer networks and processes which will form the basis of continued industry growth.

Table 26: Extension program activities, objectives, deliverables, time frame and regional relevance for investment.

Extension activity	Adoption objectives	Deliverables	Time frame (years)	Agro-ecological significance (1,2,3)[A]
Feedbase Oz	National coordination of feedbase industry activities and linkages	• National Feedbase strategies at the agro-ecological regional level • Coordination across RDCs for project delivery • Linkage of Feedbase industry with national priorities	On-going	All
Agro-ecological teams	Co-ordination of feedbase extension activities on an agro-ecological basis	• Formation of 8 regionally based networks for the adoption of relevant technologies	10	All
		• Appointment of 8 Feedbase Development Managers	On-going	All
		• Regional RD&E priority setting and delivery	On-going	All
Capacity building	Improve the skill base of public and private providers of advice to producers	• Annual updates based on agro-ecological regions	Annually	All
		• Improved feedbase management skills in Advisors, particularly in the mixed cropping grazing zones with livestock management	3	(1) Temperate Slopes and Plains (1) Arid Interior (2) Semi arid Sub Tropical Plains (2) Sub Tropical Slopes and Plains (3) Temperate Highlands (3) Wet Temperate Coast
		• Improved financial management skills in Advisors and Producers	3	All
Lead Farm	On-farm implementation of technologies in a whole farm context	• The phased establishment of a network of lead farms in southern Australia and associated Focus Paddocks	3	All
		• Active engagement of appropriate feedbase sectors in lead farm activities	10	All
		• Adoption of relevant technologies which demonstrate improved profitability and sustainability of red meat production	10	All
		• Identification of component research issues	10	All

[A]Agro-ecological relevance (1) top priority; (2) moderate priority; (3) low priority

On the basis of the activities described above, an investment plan (Table 27) is proposed for a five year period which allocates a total of $17.2M (AUD) to support the extension activities proposed in the FIP. The assumptions behind the costing are provided as footnotes to Table 28. Consideration was given to the number of Lead Farms to provide the optimal return in terms of budget allocation per producer adoption. A sensitivity analysis was conducted with the following assumptions (i) ten producers in each Lead Farm group each contributing $400/year; (ii) annual operating budget of $5000/Lead Farm group; (iii) professional fees of $1200/day; (iv) MLA allocation of $4.6M over 5 years. Operation of 50, 100 or 150 Lead Farms would permit 15, 7 or 4 professional days in each year respectively. Lead Farm numbers more than 100 were not viable with the assumptions stated here. There is also the consideration that Lead Farms may play a role in research activity and from this perspective the number of farms has a statistical relevance. When all these aspects were considered it is recommended that 100 Lead Farms would be a suitable number to commence this initiative. If the concept were adopted, there would be the opportunity for contribution from areas other that the Feedbase budget to utilize the network.

Table 27: Recommended level of financial support for each extension activity

Extension Activity	Major theme	Investment ($ AUD M/5 years)
Feedbase Oz		Not applicable
Agro-ecological Teams	Operation	1.4[A]
	Feedbase Development Managers	6.0[B]
Capacity Building	Regional Industry updates - Advisors	3.2[C]
	Training	2.0[D]
Lead Farms	Establishment and conduct of 100 lead farms	4.6[E]
TOTAL		17.2

[A]Based on $35K p.a. for each Agro-ecological Team.
[B]Eight Feedbase Development Managers at $151K p.a. Includes salary, on-costs, operating and travel.
[C]One Regional Industry Update (one in each of the eight proposed Agro-Ecological Team regions) per year at $80K per update.
[D]Training based on 16 courses per year at $20K per course plus allowance for post course mentoring. Other funding for courses is likely to be provided through other program areas.
[E]Phased introduction of Lead Farms with 1000 operational by end year 3.
Note that these costs do not include possible offset through contribution by participants or sponsorship.

As outlined above, the proposed model allows for extension priorities to be selected locally and regionally to ensure maximum relevance. However, it is anticipated that the priorities for each agro-ecological region will broadly follow the priorities identified from the Feedbase Priority Survey (Fig. 10). These priorities by agro-ecological region, have been summarised in Table 28.

Table 28: Extension priorities (low, moderate, high) for each agro-ecological region as identified from the Feedbase Priority Survey.

Extension Program	Extension Activity	Arid Interior	Semi-Arid Sub-Tropical Plains	Temp Highlands	Wet Temp Coast	Sub-Tropical Slopes & Plains	Temp Slopes & Plains
Pasture improvement	Increased sown perennial grass content	Low	Mod	Mod	Mod	Mod	Mod
	Increased legume content	Mod	Mod	Mod	Mod	Mod	Mod
	Increased native grass content	Mod	Low	Low	-	-	-
Pasture Production	Improved pasture nutrition	Mod	Mod	High	Mod	Mod	Mod
	Soil acidity management	-	-	Mod	Mod		Low
	Weed control	Low	Low	Low	Mod	Low	Low
	Pest control	-	-	-	Low	-	-
Pasture Management and Harvest	Improved grazing management and utilization	High	High	High	High	High	High
	Improved labour efficiency in farm operations	Mod	Mod	Mod	Mod	Mod	Mod
Production Systems	Integration of crops, pastures and livestock	Mod	Low	Low	Low	Low	Low
	Increased use of fodder crops	Low	Low	Low	Low	Low	Low
	Increased use of short term pastures	Low	Low	-	-	Low	Low

Note: a dash (-) implies the extension activity is not relevant to the agro-ecological region.

9.0 Feedbase Investment Plan: research programs addressing future needs

There was strong support from industry for the continued funding of research which leads to a feedbase better able to support improvements in profitability and sustainability of red meat production. Key informants nominated research projects as part of the consultation process. These research projects were clustered into various feedbase components and themes and ranked for frequency of nomination and expected benefits. The resulting research programs were then assessed for relevance across agro-ecological regions and feedbase sectors.

Generally, the research projects were poorly defined by the informants. Caution was needed in trying to get more specific descriptions because of possible bias. For example general responses included, *increasing the legume content of pastures*; *increased persistence of pastures*; and *feed production to meet the demand of top genetics*. These general responses may suggest a lack of critical evaluation of the knowledge gaps in feedbase issues. At the same time, there appeared to be a lack of a comprehensive understanding of the feedbase in terms of performance and limitations for objective definition of research priorities. In some cases (especially with researchers) this arose from what appeared to be a lack of understanding of the management issues in the field.

While research projects were not well defined, the consultation process has clearly identified the priority of general research areas. The clear message from the consultation process was that priority should be given to:

Research programs that address improving the utilization of the existing feedbase, provide greater integration with farming systems and the whole farm business, and then improve pasture choices through evaluation and selection programs.

By focusing the research effort on both the existing feedbase and on improving the species that make up the feedbase, the FIP is addressing both genetic and environmental (i.e. management) factors. In other words, research programs are recommended which deal with feedbase management and plant improvement and both form important and strategic elements to the portfolio of future research programs.

Five components of the Southern Australian feedbase were identified from the consultation process for investment (Table 29). These components (order does not indicate priority) or Research Program areas are:

1. Plant improvement
2. Pasture production
3. Pasture harvest
4. Production systems
5. Evaluation

Tables 30a – 30f separate the research priorities by agro-ecological region.

9.1 Research programs overview

A brief overview is provided for each research program area prior to discussion of proposed financial support and fit with industry resources in later sections. There is clear linkage between the situation analysis of the Feedbase Industry (see Section 4.0) and the recommendations to establish five Program areas. Similarly, the importance of the Temperate Slopes and Plains to red meat production is acknowledged through the research recommendations.

9.1.1 Plant improvement

The usefulness of sown pastures to the Feedbase Industry has been hindered by the high cost of establishment, poorly defined benefits, poor persistence and problems with animal health and feed quality. There is a need to improve a range of traits (see section 5.4.1.1) in several pasture species in order to improve the utility of sown pastures. Industry consultation indicated that persistence under grazing, lower phosphorus requirements, higher nutrient extraction efficiencies, increased quantity and quality of production, less seasonality (out of season) of production, better seedling vigour and fewer animal health issues as the general traits to be addressed in improvement programs. The plants nominated for improvement were legumes (lucerne, medics, sub clover and tropical legumes), perennial grasses in general and phalaris. Other traits for improvement, specific to each species were nominated by key informants (Table 16). It is clear that respondents are placing a high value on persistence, and with the high cost of pasture establishment, perennial species need to be long-lived or it is likely that other options (e.g. grazing cereals) may gain traction.

The need for a compelling farm business case for pasture improvement (using the products of plant improvement programs) should be addressed within this Program area. Sowing pastures is an investment-intensive process that requires high level of production for more than 7 years (in general) to yield a profit. In many cases, the level of production or the length of persistence are insufficient to warrant the initial investment. This is often due to poorly adapted species or poor management in terms of grazing, fertilizer, pest and weed control, etc. In other words, it is a whole of farm management issue.

Establishment of a national and independent plant improvement program, that makes use of genetic and genomic approaches, has pathways that use assessment through the grazing animals and within a commercial farming context, is required to ensure connectivity of these programs to the industry. This does not mean a return to complex grazing trials for evaluation purposes. There is a good opportunity to link such an independent evaluation scheme with the Lead Farm model.

The types of investment in plant improvement (breeding) made by public and private sectors requires discussion and Feedbase Oz is a good forum for this purpose. For example, there would be greater public benefit from public sector investment in germplasm enhancement and platform technologies such as genome sequencing with private sector engagement in cultivar development. The species targeted for public investment should be those which are unlikely to attract stand alone private investment in the traits identified from the Feedbase Priority Survey. White clover, lucerne, perennial ryegrass and fescue are the focus of major and existing investments by plant breeders. On this basis the targeted species should include phalaris, sub clover for the medium/high rainfall areas, medics and grazing crops for low rainfall areas and subtropical species. Further investment in Lucerne was a strong outcome of the consultation and, despite private sector investment, its small occupation of potential area (4%) supports its inclusion as a keystone species warranting public investment.

A related component is the need for improvements in crops for grazing, their agronomy (such as seeding rate, time of sowing, grazing practice, hay/grain production), and their fit within the farm system. While this topic was not as highly nominated as those plants already listed, it is likely that, with the increased emphasis on cropping and the uncertainty of irrigation supply, crops will form an increasingly important part of the feedbase, especially in terms of risk management and in response to "failure to persist" issues with perennial grasses.

9.1.2 Pasture production

The key theme with this program area is pasture nutrition. Pasture nutrition (i.e. feedbase nutrition) refers to improvements in the efficiency of fertilizer use by better testing and application regimes and better harnessing of soil biological processes. Addressing the objectives provided in Table 29, will lead to a greater marginal return from fertilizer investment. The key nutrient listed by informants was phosphorus but mention was also made of sulphur and potassium. In essence, there is a need for research that allows for a more targeted procedure for fertilizer application while at the same time elucidation of practices (or products) that increase the transfer of soil phosphorus into the plant available pool; probably through biological mineralisation pathways. Optimal fertilizer practices for mixed farming systems is also of interest as the pasture tends to be restricted to soil nutrients left over after the crop.

The financial case for fertilizer inputs is compelling (see Appendix 2) but declining terms of trade and spikes in fertilizer price, in concert with the growth in the range of less traditional unproven products, acts to weaken confidence and demand. It is expected that this Program area will have close linkages with plant improvement because of the focus on extraction efficiency of soil nutrients.

9.1.3 Pasture management and harvest

Pasture harvest relates principally to the themes of grazing and pasture management. The objective of this Program area is to develop grazing systems for better utilization of pastures and shrubs, which encourage perenniality, and which achieve high livestock performance with high labour efficiency. Despite large programs in the form of the Temperate Pastures Sustainability Key Program, Sustainable Grazing Systems, EverGraze, Grain and Graze and Land, Water and Wool there remains a number of important research questions which have been nominated to be addressed. The specific deliverables will provide indicators to guide grazing rotation decisions for the different agro-ecological regions and livestock enterprises. Deliverables will demonstrate the linkage between pasture utilisation and stocking rate and inform on the impact of these measures on livestock performance, risk, profit and sustainability.

The role of grazing management for regulating pasture persistence under high stocking rates has also been identified as requiring further research. There is little information on the dynamics of mob characteristics (e.g. mob size and stocking density) on livestock and feedbase productivity. Grazing management (i.e. grazing systems) was generally rated most highly by informants from more arid agro-ecological regions, where there are fewer options for managing the feedbase. It is also relevant to the grazing management of crops, particularly in the Temperate Slopes and Plains.

These deliverables imply that difficulty in matching feed supply to animal demand still exists even after the timing of key activities such as lambing, calving and shearing is optimised. The difficulty arises not just because of a variable feed production but also because of a variable livestock market. The second objective of pasture management will develop strategies to fill feed gaps and

maintain consistency of legume content of pastures. This is where opportunities for integrating crops, with grazing potential, into perennial and cropping systems should be an area for future research.

9.1.4 Production systems

Better understanding and managing pastures, livestock and cropping enterprises was a frequently nominated research theme with clear emphasis from the Temperate Slopes and Plains and lesser emphasis from the Temperate Highlands and the Wet Temperate Coast. The Program objective is to develop systems to improve integration of livestock, and the pastures that support them, with cropping enterprises. Primary attention needs to be given to the role of grazing cereals, legume break crops and the strategic use of containment feeding. The increased area used for cropping in combination with higher value of sheep and their products underpins the interest in ways to integrate these enterprises. Central to this interest is the role of pastures/crops, including legumes, as break crops for disease control and for high quality feeds, and the strategic use of containment feeding for meeting market specifications and managing the natural resource base.

9.1.5 Evaluation

Evaluation of the feedbase takes two forms. The first is the documentation of the costs and returns from multiple enterprises, at an enterprise business level, as a guide to decision making and enterprise selection. This activity has obvious connectivity with the Lead Farm model and satisfies one of the key elements, (i.e. more detailed financial information on the technology) nominated through the consultation process, as a requirement for effective extension.

The second is the further development of models to assist with optimisation of farming systems and adaptation to seasonal variation with special reference to risk and system profit. Models are becoming a basic building block of research and extension programs. They are not just important in assessing outcomes but in the process of deciding the inputs and the relationships to build the model.

Table 29: Research program areas, themes, objectives, deliverables, time frame and agro-ecological relevance for investment in the feedbase of Southern Australia.

Research Program	Major themes	Research objectives	Deliverables	Time frame (years)	Agro-ecological relevance (1,2,3)[A]
Plant Improvement	Evaluation and selection programs	• Implement an independent plant evaluation and selection program using appropriate quantitative genetic and genomic technologies to improve the persistence, quality and productivity of existing keystone species and evaluation of new species.	• A network of linked sites that provide uniform and independent genetic evaluation of pastures species. • Investment in germplasm enhancement and platform technologies such as genome sequencing.	6 - 9	(1) Temperate Slopes and Plains (1) Temperate Highlands (1) Wet Temperate Coast (2) Sub Tropical Slopes and Plains
		• Selection to provide the base pasture traits identified through the consultation process. These traits are required for all the pasture species which are listed below. Species specific traits, in addition to the deliverables for this objective, are provided below.	Base general pasture traits: • better persistence under grazing and moisture stress • lower phosphorus requirements and/or higher nutrient extraction efficiency • higher feed quality and production • out of season production • better seedling vigour • lower animal health toxicity		All
	Legumes	• Selection to increase the tolerance to low soil pH and mixed-sward compatibility of **lucerne** • Selection of shorter-season **medics** with better seed production and **sub clovers** with greater consistency across variable seasons	• Lucerne cultivars with greater tolerance of low soil pH and better compatibility in a mixed sward (i.e. grass/lucerne) • Medic cultivars with a shorter season and better seed set for recruitment and sub clovers with greater adaptation to climate variability	6 - 9	(1) Temperate Slopes and Plains (1) Temperate Highlands (2) Wet Temperate Coast
	Phalaris	• Selection to reduce phalaris toxicity and increase aluminium tolerance	• Phalaris cultivars with lower toxicity for livestock and better aluminium tolerance	6 - 9	(1) Temperate Slopes and Plains (1) Temperate Highlands (2) Wet Temperate Coast
	Subtropical species	• Selection of legumes for better adaptation to sub-tropical grass pastures • Selection of Subtropical grasses for adaptation to southern Australia	• Legumes better adapted to persist in sub-tropical pastures • Subtropical grasses adapted to southern Australian soil and climate	6 - 9	(1) Sub Tropical Slopes and Plains (2) Temperate Slopes and Plains
Pasture Production	Pasture nutrition	• Improve the efficiency of fertilizer use by better testing and application regimes and better harnessing of soil biological processes.	• Improved precision of nutrient status determination , pasture requirements and application technologies to enhance the marginal return from on-farm fertilizer applications • Greater understanding of soil biology and its role in reducing fertilizer requirements	6 - 9	(1) Temperate Highlands (1) Wet Temperate Coast (2) Temperate Slopes and Plains (2) Sub Tropical Slopes and Plains
Pasture Management and Harvest	Grazing management	• Develop grazing systems for better utilization of pastures and shrubs, which encourage perenniality, achieve high livestock performance with high labour efficiency.	• Grazing rotation indicators (e.g. stock density, graze and rest periods, pasture residuals) for different feedbase systems, enterprises and agro-ecological regions • Demonstration of the linkages between optimal rates of pasture utilisation (% of pasture growth) and stocking rate decisions (including seasonal variation) • Development of trigger points for matching stocking rate to planned rates of utilisation • Evaluation of the impact of grazing rotation and pasture utilisation strategies on livestock performance, risk exposure, profit and sustainability	3 - 6	(1) Arid Interior (1) Semi arid Sub Tropical Plains (1) Temperate Highlands (1) Wet Temperate Coast (1) Sub Tropical Slopes and Plains (2) Temperate Slopes and Plains
	Pasture management	• Develop information to allow management of pastures to fill feed gaps for increased persistence, quality and productivity in a variable climate.	• Integrated systems that fill feed gaps including the role of forage crops and fodder conservation • Management strategies to increase the consistency of the legume content of pastures	3 - 6	(1) Temperate Slopes and Plains (1) Temperate Highlands (1) Wet Temperate Coast (2) Sub Tropical Slopes and Plains
		• Develop more labour efficient approaches to sheep production	• Evaluation of ways to improve labour efficiency of sheep production	1 - 3	All
Production Systems	Integration of crops, pastures and livestock	• Develop systems for better integration of livestock and the pastures that support them with cropping enterprises. Primary attention to the role of grazing cereals, legume break crops and the strategic use of containment feeding.	• Development of the technical basis for the role of livestock in mixed enterprises for managing crop diseases, risk and impact on profit • Evaluate the strategic role of containment feeding in mixed cropping/livestock feeding	3 - 6	(1) Temperate Slopes and Plains (1) Sub Tropical Slopes and Plains (1) Semi arid Sub Tropical Plains (1) Temperate Highlands

					(1) Wet Temperate Coast (2) Arid Interior
Evaluation	Farm system models and financial benchmarks	• Further develop models that will assist with climate adaptation, financial performance and system optimization.	• Analysis of farm system options on profit, risk, resource management and labour • Analysis of the impact of climate change in models to predict species abundance and feedbase productivity	1 - 3	All

[A]Agro-ecological relevance (1) top priority; (2) moderate priority; (3) low priority.

Table 30a: Research program areas, themes, objectives, deliverables, time frame and agro-ecological relevance for investment in the feedbase in the Arid Interior

Research Program	Major themes	Research objectives	Deliverables	Time frame (years)	Priority
Pasture Management and Harvest	Grazing management	• Develop grazing systems for better utilisation of pastures and shrubs, which encourage perenniality, achieve high livestock performance with high labour efficiency.	• Grazing rotation indicators (e.g. stock density, graze and rest periods, pasture residuals) for different feedbase systems, enterprises and agro-ecological regions • Demonstration of the linkages between optimal rates of pasture utilisation (% of pasture growth) and stocking rate decisions (including seasonal variation) • Development of trigger points for matching stocking rate to planned rates of utilisation • Evaluation of the impact of grazing rotation and pasture utilisation strategies on livestock performance, risk exposure, profit and sustainability	3 - 6	High
		• Develop more labour efficient approaches to sheep production	• Evaluation of ways to improve labour efficiency of sheep production	1 - 3	High
Production Systems	Integration of crops, pastures and livestock	• Develop systems for better integration of livestock and the pastures that support them with cropping enterprises. Primary attention to the role of grazing cereals, legume break crops and the strategic use of containment feeding.	• Development of the technical basis for the role of livestock in mixed enterprises for managing crop diseases, risk and impact on profit • Evaluate the strategic role of containment feeding in mixed cropping/livestock feeding	3 - 6	Moderate
Evaluation	Farm system models and financial benchmarks	• Further develop models that will assist with climate adaptation, financial performance and system optimization.	• Analysis of farm system options on profit, risk, resource management and labour • Analysis of the impact of climate change in models to predict species abundance and feedbase productivity	1 - 3	High

Table 30b: Research program areas, themes, objectives, deliverables, time frame and agro-ecological relevance for investment in the feedbase in the Semi-Arid Sub-Tropical Plains.

Research Program	Major themes	Research objectives	Deliverables	Time frame (years)	Priority
Pasture Management and Harvest	Grazing management	• Develop grazing systems for better utilisation of pastures and shrubs, which encourage perenniality, achieve high livestock performance with high labour efficiency.	• Grazing rotation indicators (e.g. stock density, graze and rest periods, pasture residuals) for different feedbase systems, enterprises and agro-ecological regions • Demonstration of the linkages between optimal rates of pasture utilisation (% of pasture growth) and stocking rate decisions (including seasonal variation) • Development of trigger points for matching stocking rate to planned rates of utilisation • Evaluation of the impact of grazing rotation and pasture utilisation strategies on livestock performance, risk exposure, profit and sustainability	3 - 6	High
		• Develop more labour efficient approaches to sheep production	• Evaluation of ways to improve labour efficiency of sheep production	1 - 3	High
Production Systems	Integration of crops, pastures and livestock	• Develop systems for better integration of livestock and the pastures that support them with cropping enterprises. Primary attention to the role of grazing cereals, legume break crops and the strategic use of containment feeding.	• Development of the technical basis for the role of livestock in mixed enterprises for managing crop diseases, risk and impact on profit • Evaluate the strategic role of containment feeding in mixed cropping/livestock feeding	3 - 6	High
Evaluation	Farm system models and financial benchmarks	• Further develop models that will assist with climate adaptation, financial performance and system optimization.	• Analysis of farm system options on profit, risk, resource management and labour • Analysis of the impact of climate change in models to predict species abundance and feedbase productivity	1 - 3	High

Table 30c: Research program areas, themes, objectives, deliverables, time frame and agro-ecological relevance for investment in the feedbase in the Wet Temperate Coast

Research Program	Major themes	Research objectives	Deliverables	Time frame (years)	Priority
Plant Improvement	Evaluation and selection programs	• Implement an independent plant evaluation and selection program using appropriate quantitative genetic and genomic technologies to improve the persistence, quality and productivity of existing keystone species and evaluation of new species.	• A network of linked sites that provide uniform and independent genetic evaluation of pastures species. • Investment in germplasm enhancement and platform technologies such as genome sequencing.	6 - 9	High
		• Selection to provide the base pasture traits identified through the consultation process. These traits are required for all the pasture species which are listed below. Species specific traits, in addition to the deliverables for this objective, are provided below.	Base general pasture traits: • better persistence under grazing and moisture stress • lower phosphorus requirements and/or higher nutrient extraction efficiency • higher feed quality and production • out of season production • better seedling vigour • lower animal health toxicity	6 - 9	High
	Legumes	• Selection to increase the tolerance to low soil pH and mixed-sward compatibility of **lucerne** • Selection of shorter-season **medics** with better seed production and **sub clovers** with greater consistency across variable seasons	• Lucerne cultivars with greater tolerance of low soil pH and better compatibility in a mixed sward (i.e. grass/lucerne) • Medic cultivars with a shorter season and better seed set for recruitment and sub clovers with greater adaptation to climate variability	6 - 9	Moderate
	Phalaris	• Selection to reduce phalaris toxicity and increase aluminium tolerance	• Phalaris cultivars with lower toxicity for livestock and better aluminium tolerance	6 - 9	Moderate
Pasture Production	Pasture nutrition	• Improve the efficiency of fertilizer use by better testing and application regimes and better harnessing of soil biological processes.	• Improved precision of nutrient status determination , pasture requirements and application technologies to enhance the marginal return from on-farm fertilizer applications • Greater understanding of soil biology and its role in reducing fertilizer requirements	6 - 9	High
Pasture Management and Harvest	Grazing management	• Develop grazing systems for better utilisation of pastures and shrubs, which encourage perenniality, achieve high livestock performance with high labour efficiency.	• Grazing rotation indicators (e.g. stock density, graze and rest periods, pasture residuals) for different feedbase systems, enterprises and agro-ecological regions • Demonstration of the linkages between optimal rates of pasture utilisation (% of pasture growth) and stocking rate decisions (including seasonal variation) • Development of trigger points for matching stocking rate to planned rates of utilisation • Evaluation of the impact of grazing rotation and pasture utilisation strategies on livestock performance, risk exposure, profit and sustainability	3 - 6	High
	Pasture management	• Develop information to allow management of pastures to fill feed gaps for increased persistence, quality and productivity in a variable climate.	• Integrated systems that fill feed gaps including the role of forage crops and fodder conservation • Management strategies to increase the consistency of the legume content of pastures	3 - 6	High
		• Develop more labour efficient approaches to sheep production	• Evaluation of ways to improve labour efficiency of sheep production	1 - 3	High
Production Systems	Integration of crops, pastures and livestock	• Develop systems for better integration of livestock and the pastures that support them with cropping enterprises. Primary attention to the role of grazing cereals, legume break crops and the strategic use of containment feeding.	• Development of the technical basis for the role of livestock in mixed enterprises for managing crop diseases, risk and impact on profit • Evaluate the strategic role of containment feeding in mixed cropping/livestock feeding	3 - 6	High
Evaluation	Farm system models and financial benchmarks	• Further develop models that will assist with climate adaptation, financial performance and system optimization.	• Analysis of farm system options on profit, risk, resource management and labour • Analysis of the impact of climate change in models to predict species abundance and feedbase productivity	1 - 3	High

Table 30d: Research program areas, themes, objectives, deliverables, time frame and agro-ecological relevance for investment in the feedbase in the Temperate Highlands

Research Program	Major themes	Research objectives	Deliverables	Time frame (years)	Priority
Plant Improvement	Evaluation and selection programs	• Implement an independent plant evaluation and selection program using appropriate quantitative genetic and genomic technologies to improve the persistence, quality and productivity of existing keystone species and evaluation of new species.	• A network of linked sites that provide uniform and independent genetic evaluation of pastures species. • Investment in germplasm enhancement and platform technologies such as genome sequencing.	6 - 9	High
		• Selection to provide the base pasture traits identified through the consultation process. These traits are required for all the pasture species which are listed below. Species specific traits, in addition to the deliverables for this objective, are provided below.	Base general pasture traits: • better persistence under grazing and moisture stress • lower phosphorus requirements and/or higher nutrient extraction efficiency • higher feed quality and production • out of season production • better seedling vigour • lower animal health toxicity	6 - 9	High
	Legumes	• Selection to increase the tolerance to low soil pH and mixed-sward compatibility of **lucerne** • Selection of shorter-season **medics** with better seed production and **sub clovers** with greater consistency across variable seasons	• Lucerne cultivars with greater tolerance of low soil pH and better compatibility in a mixed sward (i.e. grass/lucerne) • Medic cultivars with a shorter season and better seed set for recruitment and sub clovers with greater adaptation to climate variability	6 - 9	High
	Phalaris	• Selection to reduce phalaris toxicity and increase aluminium tolerance	• Phalaris cultivars with lower toxicity for livestock and better aluminium tolerance	6 - 9	High
Pasture Production	Pasture nutrition	• Improve the efficiency of fertilizer use by better testing and application regimes and better harnessing of soil biological processes.	• Improved precision of nutrient status determination , pasture requirements and application technologies to enhance the marginal return from on-farm fertilizer applications • Greater understanding of soil biology and its role in reducing fertilizer requirements	6 - 9	High
Pasture Management and Harvest	Grazing management	• Develop grazing systems for better utilisation of pastures and shrubs, which encourage perenniality, achieve high livestock performance with high labour efficiency.	• Grazing rotation indicators (e.g. stock density, graze and rest periods, pasture residuals) for different feedbase systems, enterprises and agro-ecological regions • Demonstration of the linkages between optimal rates of pasture utilisation (% of pasture growth) and stocking rate decisions (including seasonal variation) • Development of trigger points for matching stocking rate to planned rates of utilisation • Evaluation of the impact of grazing rotation and pasture utilisation strategies on livestock performance, risk exposure, profit and sustainability	3 - 6	High
	Pasture management	• Develop information to allow management of pastures to fill feed gaps for increased persistence, quality and productivity in a variable climate.	• Integrated systems that fill feed gaps including the role of forage crops and fodder conservation • Management strategies to increase the consistency of the legume content of pastures	3 - 6	High
		• Develop more labour efficient approaches to sheep production	• Evaluation of ways to improve labour efficiency of sheep production	1 - 3	High
Production Systems	Integration of crops, pastures and livestock	• Develop systems for better integration of livestock and the pastures that support them with cropping enterprises. Primary attention to the role of grazing cereals, legume break crops and the strategic use of containment feeding.	• Development of the technical basis for the role of livestock in mixed enterprises for managing crop diseases, risk and impact on profit • Evaluate the strategic role of containment feeding in mixed cropping/livestock feeding	3 - 6	High
Evaluation	Farm system models and financial benchmarks	• Further develop models that will assist with climate adaptation, financial performance and system optimization.	• Analysis of farm system options on profit, risk, resource management and labour • Analysis of the impact of climate change in models to predict species abundance and feedbase productivity	1 - 3	High

Table 30e: Research program areas, themes, objectives, deliverables, time frame and agro-ecological relevance for investment in the feedbase in the Temperate Slopes and Plains

Research Program	Major themes	Research objectives	Deliverables	Time frame (years)	Priority
Plant Improvement	Evaluation and selection programs	• Implement an independent plant evaluation and selection program using appropriate quantitative genetic and genomic technologies to improve the persistence, quality and productivity of existing keystone species and evaluation of new species.	• A network of linked sites that provide uniform and independent genetic evaluation of pastures species. • Investment in germplasm enhancement and platform technologies such as genome sequencing.	6 - 9	High
		• Selection to provide the base pasture traits identified through the consultation process. These traits are required for all the pasture species which are listed below. Species specific traits, in addition to the deliverables for this objective, are provided below.	Base general pasture traits: • better persistence under grazing and moisture stress • lower phosphorus requirements and/or higher nutrient extraction efficiency • higher feed quality and production • out of season production • better seedling vigour • lower animal health toxicity	6 - 9	High
	Legumes	• Selection to increase the tolerance to low soil pH and mixed-sward compatibility of **lucerne** • Selection of shorter-season **medics** with better seed production and **sub clovers** with greater consistency across variable seasons	• Lucerne cultivars with greater tolerance of low soil pH and better compatibility in a mixed sward (i.e. grass/lucerne) • Medic cultivars with a shorter season and better seed set for recruitment and sub clovers with greater adaptation to climate variability	6 - 9	High
	Phalaris	• Selection to reduce phalaris toxicity and increase aluminium tolerance	• Phalaris cultivars with lower toxicity for livestock and better aluminium tolerance	6 - 9	High
	Subtropical species	• Selection of legumes for better adaptation to sub-tropical grass pastures • Selection of Subtropical grasses for adaptation to southern Australia	• Legumes better adapted to persist in sub-tropical pastures • Subtropical grasses adapted to southern Australian soil and climate	6 - 9	Moderate
Pasture Production	Pasture nutrition	• Improve the efficiency of fertilizer use by better testing and application regimes and better harnessing of soil biological processes.	• Improved precision of nutrient status determination , pasture requirements and application technologies to enhance the marginal return from on-farm fertilizer applications • Greater understanding of soil biology and its role in reducing fertilizer requirements	6 - 9	Moderate
Pasture Management and Harvest	Grazing management	• Develop grazing systems for better utilisation of pastures and shrubs, which encourage perenniality, achieve high livestock performance with high labour efficiency.	• Grazing rotation indicators (e.g. stock density, graze and rest periods, pasture residuals) for different feedbase systems, enterprises and agro-ecological regions • Demonstration of the linkages between optimal rates of pasture utilisation (% of pasture growth) and stocking rate decisions (including seasonal variation) • Development of trigger points for matching stocking rate to planned rates of utilisation • Evaluation of the impact of grazing rotation and pasture utilisation strategies on livestock performance, risk exposure, profit and sustainability	3 - 6	Moderate
	Pasture management	• Develop information to allow management of pastures to fill feed gaps for increased persistence, quality and productivity in a variable climate.	• Integrated systems that fill feed gaps including the role of forage crops and fodder conservation • Management strategies to increase the consistency of the legume content of pastures	3 - 6	High
		• Develop more labour efficient approaches to sheep production	• Evaluation of ways to improve labour efficiency of sheep production	1 - 3	High
Production Systems	Integration of crops, pastures and livestock	• Develop systems for better integration of livestock and the pastures that support them with cropping enterprises. Primary attention to the role of grazing cereals, legume break crops and the strategic use of containment feeding.	• Development of the technical basis for the role of livestock in mixed enterprises for managing crop diseases, risk and impact on profit • Evaluate the strategic role of containment feeding in mixed cropping/livestock feeding	3 - 6	High
Evaluation	Farm system models and financial benchmarks	• Further develop models that will assist with climate adaptation, financial performance and system optimization.	• Analysis of farm system options on profit, risk, resource management and labour • Analysis of the impact of climate change in models to predict species abundance and feedbase productivity	1 - 3	High

Table 30f: Research program areas, themes, objectives, deliverables, time frame and agro-ecological relevance for investment in the feedbase in the Sub-Tropical Slopes and Pains

Research Program	Major themes	Research objectives	Deliverables	Time frame (years)	Priority
Plant Improvement	Evaluation and selection programs	• Implement an independent plant evaluation and selection program using appropriate quantitative genetic and genomic technologies to improve the persistence, quality and productivity of existing keystone species and evaluation of new species.	• A network of linked sites that provide uniform and independent genetic evaluation of pastures species. • Investment in germplasm enhancement and platform technologies such as genome sequencing.	6 - 9	Moderate
		• Selection to provide the base pasture traits identified through the consultation process. These traits are required for all the pasture species which are listed below. Species specific traits, in addition to the deliverables for this objective, are provided below.	Base general pasture traits: • better persistence under grazing and moisture stress • lower phosphorus requirements and/or higher nutrient extraction efficiency • higher feed quality and production • out of season production • better seedling vigour • lower animal health toxicity	6 - 9	High
	Subtropical species	• Selection of legumes for better adaptation to sub-tropical grass pastures • Selection of Subtropical grasses for adaptation to southern Australia	• Legumes better adapted to persist in sub-tropical pastures • Subtropical grasses adapted to southern Australian soil and climate	6 - 9	High
Pasture Production	Pasture nutrition	• Improve the efficiency of fertilizer use by better testing and application regimes and better harnessing of soil biological processes.	• Improved precision of nutrient status determination , pasture requirements and application technologies to enhance the marginal return from on-farm fertilizer applications • Greater understanding of soil biology and its role in reducing fertilizer requirements	6 - 9	Moderate
Pasture Management and Harvest	Grazing management	• Develop grazing systems for better utilisation of pastures and shrubs, which encourage perenniality, achieve high livestock performance with high labour efficiency.	• Grazing rotation indicators (e.g. stock density, graze and rest periods, pasture residuals) for different feedbase systems, enterprises and agro-ecological regions • Demonstration of the linkages between optimal rates of pasture utilisation (% of pasture growth) and stocking rate decisions (including seasonal variation) • Development of trigger points for matching stocking rate to planned rates of utilisation • Evaluation of the impact of grazing rotation and pasture utilisation strategies on livestock performance, risk exposure, profit and sustainability	3 - 6	High
	Pasture management	• Develop information to allow management of pastures to fill feed gaps for increased persistence, quality and productivity in a variable climate.	• Integrated systems that fill feed gaps including the role of forage crops and fodder conservation • Management strategies to increase the consistency of the legume content of pastures	3 - 6	Moderate
		• Develop more labour efficient approaches to sheep production	• Evaluation of ways to improve labour efficiency of sheep production	1 - 3	High
Production Systems	Integration of crops, pastures and livestock	• Develop systems for better integration of livestock and the pastures that support them with cropping enterprises. Primary attention to the role of grazing cereals, legume break crops and the strategic use of containment feeding.	• Development of the technical basis for the role of livestock in mixed enterprises for managing crop diseases, risk and impact on profit • Evaluate the strategic role of containment feeding in mixed cropping/livestock feeding	3 - 6	High
Evaluation	Farm system models and financial benchmarks	• Further develop models that will assist with climate adaptation, financial performance and system optimization.	• Analysis of farm system options on profit, risk, resource management and labour • Analysis of the impact of climate change in models to predict species abundance and feedbase productivity	1 - 3	High

9.2 Investment in research and programs

The allocation of MLA support to the FIP is based on a number of factors.

- Industry consultation provided clear support for both extension and research activities.
- The impact from the adoption of existing technologies and future technologies was judged by informants to be of a similar magnitude (i.e. approximately 30% increase in profit and major improvements in sustainability) and on this basis the budget has been split equally between extension and research activities.
- Financial support for research programs areas was assessed from four perspectives,
  1. Estimated impact on red meat profitability and sustainability as informed by the consultation process and the situation analysis, the project cash costs, time frame for completion of the research, and likelihood of adoption.
  2. Existing industry investment and future investment trends.
  3. Existing industry capacity in the form of staff.
  4. Other activity of RDCs and private sector businesses.

9.2.1 Impact on red meat profitability and sustainability

The estimated impact of activities on the profitability and sustainability of red meat production was broadly similar for the program areas (with the exception of being lower for Production Systems). On this basis, it is proposed that the financial allocation to each program area is proportional to the number of distinct objectives within each program. Research projects were estimated to require an average cash investment of $1.1M (total investment and not per annum) and a total of 3.5 – 6.0 years for completion (Table 31).

Likelihood of adoption for the deliverables of each program area was assessed by considering the issues of relative advantage and compatibility (see Section 8.0) (Table 32). The program area with the greatest chance of adoption success is Pasture Production, with Plant Improvement and Evaluation considered to have the lowest chance of success. Our concern is that a national plant improvement scheme may not satisfy the test of relative advantage or compatibility for the retail and input supply sectors. It was apparent from the consultation, that the retail sector values plant improvement to a much greater extent than other sectors (see Fig. 20). The notion of retail sector contribution to a public benefit program is uncertain and this supports comments from respondents (see Section 5.5) who are concerned of market failure in this program area. These concerns highlight the importance of engaging this industry for activities in this program area, from an early stage, so as to negotiate a path to market and pecuniary arrangements.

Table 31: Expected improvement in profitability of red meat production arising from the adoption of proposed research with expected duration and cash cost.

	Improvement in profitability (%)	Impact on sustainability	Duration of research (years)	Cash required ($M)	Likelihood of adoption[A]
Plant improvement	20 (28)	minor- major	5.0 (6.1)	0.7 (1.1)	low - mod
Pasture production	20 (25)	minor- major	4.0 (5.1)	0.4 (0.9)	high
Pasture management and harvest	20 (29)	minor- major	5.0 (5.9)	1.1 (1.7)	moderate
Production systems	20 (23)	minor	5.0 (4.8)	1.4 (1.6)	moderate
Evaluation	20 (28)	minor- major	2.0 (3.6)	0.4 (0.8)	low - mod

Values in table are means, followed by (medians). Both statistics are provided because of the distribution of responses.

Table 32: Relative advantage and compatibility of research program areas to feedbase sectors as a guide to the likelihood of adoption.

	Relative advantage	Compatibility
Plant improvement	• Low for the Retail and Input Supply sector • National, independent evaluation may be perceived as not meeting company sales objectives • High for Producers and their Advisors	• Low for the Retail and Input Supply sector • High for Producers and their Advisors
Pasture production	• High for all sectors • Will lead to greater sales and increased on-farm marginal returns	• Moderate for Retail sector • Will require capital investment • High for Producers and their Advisors
Pasture management and harvest	• Low for Retail and Input Supply sectors • Difficult to define benefits • Moderate for Producers and their Advisors • Results may not be immediately obvious or require measurement and calculation to quantify. Benefits may not be clearly attributed but form part of the farm business	• Low for Retail and Input Supply sector • Moderate for Producers and their advisors • Will require more managerial input and capital investment
Production systems	• Moderate for Retail and Input Supply sector • Enterprise flexibility may increase size of market • Moderate for Producers and their Advisors • Results may not be immediately obvious, subject to climate, require measurement and calculation to quantify and be obscured by being an integral part of the farm business	• Moderate for Retail and Input Supply sector • Moderate for Producers and their advisors • Will require more managerial input and capital investment.
Evaluation	• Low for Retail and Input Supply sectors • Few clear benefits • Moderate for Producers • Benefits difficult to visualise • High for Advisors • Increased confidence in advice	• Low for Retail and Input Supply sectors • Moderate for Producers • High for Advisors

9.2.2 Existing industry investment and its future trend

There is considerable existing investment in most of the research program areas (Table 22). An approximate aggregation of these investments into the program areas proposed in this FIP is provided in Table 33. It was not possible to identify existing industry investments as relevant to the Evaluation program but this was a restrictive issue of the categories used in the survey. Responses from the consultation indicated a likely increase in investment in all program areas over the next ten years. It is likely that the majority of this industry investment takes the form of staff

salaries and associated costs. Investment provided through this FIP would then provide good leverage from in-kind support and contribute to a favourable benefit cost analysis for MLA.

Table 33: Industry investment and likely trends in the research program areas nominated in this FIP.

Program area	Existing industry investment ($M/year)	Future trend
Plant improvement	13.571	increase
Pasture production	7.015	increase
Pasture management and harvest	10.725	increase
Production systems	3.299	increase
Evaluation	not applicable	increase

9.2.2.1 Existing industry capacity

In response to a request from this Project Team, the State, CSIRO and University representatives on the RMCiC provided an indication of the number of staff working in the general areas of soil and water science and crop and pasture production. This process identified a total of 103 staff (FTE) contributed by CSIRO, state agencies and universities. A much larger estimate of the number of research and technical staff involved in feedbase research was provided by the RD&E Provider consultations (Fig. 22). Summation of staff numbers indicated 260 full- time equivalent research and 152 technical and support staff from the 23 organisations consulted. This number is closer to that reported in the National Beef Production (2010) and Sheepmeat Production (2010) Strategies which indicate a capacity within state agencies, CSIRO and the university sector of 275 FTE for sheepmeat production and 459 for beef production areas. Presumably there is overlap between these estimates because some staff work across both sheep and beef production.

Aggregation of staff numbers from feedbase component to research program area indicated that plant improvement, pasture production and pasture management and harvest contained the greatest staff number (63% of research and technical total contained in the three program areas). Nevertheless, there was still good support for production systems and evaluation program areas.

The number of staff active in the research program areas indicates a good current capacity to undertake and complete research though no information was collected on the age profile of staff or on the funding source for the appointments. In other words, the proportion of staff on short-term contracts supported by industry grants has not been determined in this FIP. Numerous comments were received through the consultation indicating an ageing staff profile at times barely covering research program areas. Taken together, the staff numbers that exist in the feedbase industry are likely to provide good support for achievement of the research deliverables in the immediate future. This not mean to say that there are not gaps in some technical areas, agro-ecological regions, or that age structure will not pose problems in future.

9.2.2.2 Other activity of RDCs and private sector businesses

The major other pasture/grazing crop activities are supported by the GRDC. These include Grain and Graze 2; Farm Systems Programs; Water use Efficiency Programs; as well as research on grazing cereals and hay crops; crop nutrition; medic development; soil biology as it affects plant nutrition and root diseases; and programs on profitability/risk management. Feedbase activity is also part of the remit of Dairy Australia but the operating environment for the dairy and livestock

industry differ considerably in climate variability. Any new research (and extension) should take into account what is already being done in these programs and this is best managed by the MLA Feedbase Program Manager and ultimately through Feedbase Oz and Agro-Ecological Teams.

Amongst private and public sector research, development and delivery activities there are four current Cooperative Research Centres that can influence the implementation of the FIP across Southern Australia.

Future Farm Industries (FFI) CRC: Dryland agriculture faces multiple threats including climate variability and increased drought. The research and education focus of FFI CRC is the development of innovative farming systems and new perennial plant species and cultivars that improve productivity through effective water use and maintaining ground cover while enhancing natural resource values. FFI CRC's goal is to have Profitable Perennials™ adopted on 7.5 million ha or 13% of Southern Australian farmlands by 2030. These technologies will become the foundation for future livestock and cropping enterprises augmented by new biomass production to the benefit of farms, regions and landscapes.

CRC for Sheep Industry Innovation: The Sheep CRC is targeting change in the sheep industry through options for easier management of sheep and improving efficiency of production and eating quality for lamb. The CRC's 'Information Nucleus' involves 5000 sheep at eight sites across four states with measurement of 166 phenotypic characteristics in approximately 18,000 animals. This core activity provides information for accelerated genetic gain and management options.

Dairy Futures CRC: The Dairy Futures CRC will directly address the major dairy industry challenge – a return to 2% total factor productivity gains. A key component of this improvement is on farm. Research, development and delivery activities include new approaches to selective breeding of pasture, farm management and practice change.

CRC for Spatial Information: The CRC for Spatial Information aims to spatially enable Australian agriculture. This will be achieved through the creation of a coordinated national network of satellite system reference stations to permit real-time precise positioning of people, vehicles, built infrastructure and natural assets. This will be achieved by automating essential spatial information products combining existing data stores with the increasing stream of data from satellites, airborne imaging platforms, and ground-based sensor systems.

The CRCs offer new technologies to improve the development of plants and animals as well as management on farm. The CRCs undertake research, development and communication activities that are directly relevant to development and productivity of the feedbase across Southern Australia. Their engagement and active participation would assist implementation of the plan and would occur regionally with the Agro-Ecological Teams and nationally through Feedbase Oz

9.3 Conclusion and FIP research investments

Given this body of information it is now possible to recommend levels of investment in the FIP and the probability of successfully transforming the outcomes and outputs of research into a more profitable and sustainable red meat industry. While human capacity is likely to be sufficient, in the short-medium term, for the conduct of the proposed research (albeit requiring a greater team approach), the chance of success (i.e. industry transformation) is considered to be highest for pasture production and lowest for the areas of plant improvement and evaluation. This is not

considered to be an impenetrable barrier to these program areas but highlights the importance of industry linkages at early stages of the research in order to ensure that collaborative arrangements with the private sector are complete. The public sector benefits and investments were discussed in Section 9.1.1.

The research programs described in the FIP do not stand separate from the extension delivery framework (see Sections 7.0 and 8.0) and are linked through the Lead Farm concept. This model provides an on-farm context for the research sector to collaborate with producer/ advisor and retail sectors – something which is not happening well in the present moment. The other advantage of the linkage of research and extension is through the identification of the next generation of research questions which will emerge as Lead Farms encounter barriers to production.

On the basis of the discussion in this FIP a budget is proposed to support a research program over five years to achieve the deliverables outlined in the FIP (Table 30). A total budget of $19.0M is required to support the proposed research areas over a period of 5 years (Table 34) which is calculated from the estimates of cash requirements and industry impact collected through the consultation. This amount represents 9% of the industry investment over the five year period.

Table 34: Recommended level of financial support for each research program area

Research Program	Major theme	Investment ($M/5 years)
Plant improvement	Evaluation and selection programs	1.7
	Legumes	2.2
	Phalaris	1.5
	Subtropical species	0.5
Pasture production	Pasture nutrition	2.5
Pasture harvest	Grazing management	4.0
	Pasture management	1.5
Production systems	Integration of crops, pastures and livestock	3.5
Evaluation	Farm system models	1.0
	Financial benchmarks	0.6
TOTAL		19.0

10.0 Capacity building

10.1 Research

In the consultations with research staff themselves, the issue of maintenance and development of research capacity was an issue that invoked strong responses from many scientists. While the data suggest broadly that there is sufficient research capacity in most feedbase components, in many cases respondents commented that the skill base is thin and in decline. The decline is being driven by staff that are near retirement and there is no depth in the replacement pipeline. It is also evident (other survey responses not shown) that expertise in pasture agronomy has been diverted to other disciplines as agencies seek to adjust to budget cuts. The comment was also made that the current deployment of expertise within the industry is volatile and strongly influenced by government and industry policy. A number of recommendations were formed about industry human capacity, which are provided in section 10.3 below.

10.2 Advisory services: extension and consulting

The expected continued withdrawal of on-farm private benefit extension resources by the government (public) sector means that the delivery of feedbase (and general farm) advice will rely increasingly on the private sector. There is currently a shortage of such capacity in the field which requires action in three ways to establish better sectoral linkages.

10.2.1 Private consultants

The development and support of a robust private advisory sector will be essential for the continued development of feedbase advice. The consultation indicated that there are four levels of support required:

- Training of consultants/advisors in specific technologies. This need was particularly noted in the cropping/grazing region where pasture and animal management skills are lacking in many consultants, and are being sought by them.
- Regular updating of providers on relevant technologies. It **is recommended that annual regional interactive forums based on agro-ecological regions be held** where there is the opportunity for new technologies to be discussed and where there is the opportunity for advisors to provide feedback on specific research and policy issues. Such a program is used by GRDC.
- Training in farm business management to the point that consultants can assess the financial implications of the practices. This should be based on local farm data to ensure relevance.
- Training in whole farm business analysis and decision processes. Based on real case studies, this may include the use of simple decision support tools.

10.2.2 Feedbase Development Managers

A potential limitation with the implementation of recommendations contained in this FIP is the shortage of sufficiently experienced people to take on the role of Feedbase Development Manager (a similar limitation exists with the GRDC proposal) with its multidisciplinary requirements. It is recommended that, at least in the short term, appointments to these positions work alongside an experienced consultant, on an agreed mentoring program, which the consultant is paid to deliver. This is not unlike the mentoring program being used by MLA to foster capacity in the research sector.

10.2.3 Advisors associated with product sales

The sales value per hectare from grazing properties is currently far less than that from cropping enterprises, with the result that there are very few pasture-only sales agronomists. As well, there has been a significant reduction in the sales staff of many input suppliers, such as fertilizer companies. While retail services will always be an important part of advice to producers, there remains the issue of conflict between advice and sales. The difference between the private and retail sectors was obvious from the surveys with the latter more interested in issues such as pest and weed management which relate more directly to product sales. Some retail outlets provide fee for service to clients, but generally this has been in the cropping or mixed cropping grazing areas. It has not developed in the pastures area to any great extent.

Generally speaking the retail sector is now employing better trained staff than was once the case and have comprehensive programs to keep their staff up to date and are an important source of information for many producers. The involvement of this sector will be essential given the overall

shortage of field resources and effort should be made to include this sector in the regional teams and training.

10.2.4 Public Sector

Whilst there seems to be a general shift from public to private extension delivery (and even field research), it is important to provide the same training opportunities to public advisors. They may act more as wholesalers of information to the retail (private) sector, as is common in some though not all States.

10.3 Recommendations to build human capacity

1. That a more detailed assessment be carried out as the age structure and succession of existing staff in the feedbase industry and how this might be impacted by changes in government support for R,D&E.
2. The adequacy of current programs to attract and train people to meet the projected needs of the feedbase industry be assessed.
3. Further develop the MLA mentoring program to target particular needs and to broaden beyond research to include advisory services.
4. Annual regional interactive forums based on agro-ecological regions be held where there is the opportunity for new technologies to be discussed and where there is the opportunity for advisors to provide feedback on specific research and policy issues.
5. The need for whole farm business skills be recognized and steps taken to provide these to the various sectors, but particularly those engaged in extension.
6. That the particular needs of crop agronomists to have greater knowledge and skills in feedbase management be recognized and addressed.
7. That Feedbase Oz plays a lead role in engaging the private and public sectors.

11.0 References and literature reviewed

Anon (1998) *Phalaris for Improved Wool Production, Proposal for the International Wool Secretariat*. CSIRO Plant Industry.

Anon (2001) *Draft Corporate Plan Southern Beef Program*, Livestock Production Innovation, Meat & Livestock Australia.

Anon (2001) *Feedbase Forum Workshop Notes*, Tullamarine Motor Inn, Melbourne.

Anon (2001) *Lamb and Sheepmeat Research and Development Program, Strategic Plan 2001-2006*. Livestock Production Innovation, Meat & Livestock Australia.

Anon (2002) *Net Benefits from CSIRO Plant Industry Research, some Case Studies*. Centre for International Economics.

Anon (2010) *Rural Research and Development Corporations, Productivity Commission Draft Report*, http://www.pc.gov.au/projects/inquiry/rural-research/draft, accessed 13-01-2011, draft enquiry report, Canberra.

Anon (undated) *Grain & Graze Border Rivers Final Report*. LWA Project Number QMD2, Land Water Australia.

Barnett, R (2007) *Best Practice Pasture Utilisation & Natural Resource Management, A Review of Current Extension Adoption*. Project number B.COM.0112.2, Meat & Livestock Australia.

Black, J (2002) *More Beef From Pastures*, Project Number SBP.004, Meat & Livestock Australia.

Culvenor, R (2007) *Improved Phalaris Varieties 1998-2007*, Final Report Project EC35. CSIRO Plant Industry.

Gout, M and Jones, S (2006) *Pastures Australia Market Analysis and Workshop Report, Investment on Pasture Improvement*.

Hassall & Associates (2004) *Economic Analysis of Sheep Production Systems*. Project Number SCSB.051, Meat & Livestock Australia.

Hill, MJ and Donald, GE (1998) *Determination of Benefits from Pasture Improvement*, Final Report for Australian Meat Research Corporation, CSIRO Division of Animal Production.

Holmes Sackett (2009) *Southern Beef Situation Analysis*. Report for Meat & Livestock Australia.

Johnston, B, Healy, T, I'ons, J and McGregor, M (1992) *Rural Research – The Pay Off*. CSIRO and Australian Bureau of Agricultural and Resource Economics.

McEachern, S, Sackett, D and Holmes, P (2005) *Keys to Profitable Lamb Production – 2005 and Beyond*. Project number SCSB.075, Meat & Livestock Australia.

Moore, A (2009) *Regional Adaptation Workshops Delivered at >- 2 Locations Within One NSW Region*. Final Report, Project WP321, report to Australian Wool Innovation.

Moore, A, Bell, LW and Revell, DK (2009) Feed gaps in mixed-farming systems: insights from the Grain & Graze program. *Animal Production Science*, 49, 736-748.

Moore, AD, Robertson, MJ, Bell, LW, Doole, GJ, Dove, H, Hargreaves, JNG, Herrmann, NI, Holzworth, DP, Lawes, RA, Lilley, JM, McIvor, JM, Peake, AS, Revell, DK, Whish, JPM and Whitbread, AM (2008) *Grain & Graze National Feedbase Project Final Report*. Land Water Australia.

Pastures Taskforce (2009) *Pastures for Profit*, A Report to the Department of Agriculture and Food, WA and Pastures Australia.

Pengelly, B and Brown, S (2008) *Development of the Interactive PA Home Page and of "Pastures of Australia" – a Decision Tool for Farmers and Advisors*. Final Report, CSIRO Sustainable Ecosystems.

Pengelly, B, Crocker, G and Hall, C (2006) *NAPLIP II (CSA 3) Final Technical Report 2006*. CSIRO Sustainable Ecosystems and NSW DPI.

Pengelly, B. (2000) *National Annual Pasture Legume Improvement Program (NAPLIP) QLD*, Final Report. Grains Research & Development Corporation.

PISC (2010) *National Beef Production RD&E Strategy*, Primary Industries Standing Committee.

PISC (2010) *National Sheepmeat Production RD&E Strategy*, Primary Industries Standing Committee.

Reeve, I and Thompson, LJ (2005) *Integrated Parasite Management in Sheep Project Benchmark Survey*. http://www.wool.com/Grow_Animal-Health_Integrated-Parasite-Management_Integrated-Parasite-Management-sheep_IPM-s-National-Survey.htm, accessed 13-01-2011, Report for Australian Wool Innovation

Trompf, JP and Sale, PW (2000) The paired-paddock model as an agent for change on grazing properties across south-east Australia, *Australian Journal of Experimental Agriculture* 40(4) 547 – 556

Trompf, JP, Sale, PW, Saul, G, Shovelton, J and Graetz, B (1998) Changes in practices and decisions resulting from the paired-paddock model used in the Grassland's Productivity Program, *Australian Journal of Experimental Agriculture* 38(8) 843 – 853

Williams, J, Hook, R and Hamblin, A (2002) *Agro-Ecological Regions of Australia, Methodologies for their derivation and key issues for resource management*. CSIRO Land and Water.

Appendix 1 The Changing Value of Pastures, 2001 - 2015

A Report Prepared by David Hudson (SGA Solutions Pty. Ltd.)
October 2010

Table of Contents **Page**

Disclaimer

This publication has been prepared in good faith on the basis of information available at the date of publication without any independent verification.

The contents reflect the Consultant's best judgment based on the information reviewed at the time of writing and therefore the Consultant can accept no responsibility if the information is used for other purposes.

SGA Solutions Pty. Ltd. does not guarantee or warrant the accuracy, reliability, completeness or currency of the information in this publication nor its usefulness in achieving any purpose.

Readers are responsible for assessing the relevance and accuracy of the content of this publication. SGA Solutions Pty. Ltd. will not be liable for any loss, damage, cost or expense incurred or arising by reason of any person using or relying on the information in this publication.

David Hudson
SGA Solutions Pty. Ltd.
P.O. Box 65
Gisborne. Vic. 3437

Phone: 0354 284 990
Fax: 0354 284 998
Mobile: 0418 951 479

Email: rock@sgasolutions.com.au

Executive Summary

Pastures are an important component of the feed base for livestock enterprises across many parts of Australia's agro-ecological and agricultural production landscape. Within the regions of interest the value generated by pastures in livestock production and contribution to winter crop production increased from $4.994b in 2001, to $6.253b in 2006 and $6.504b in 2009.

The primary drivers for the increase in value generated were:

- the continued "sell off" of sheep and cattle for slaughter as a result of the declining availability of pastures for grazing due to the drought,
- the decreasing value of wool, and
- the increase in the adoption and intensification within traditional pasture of winter crops.

Of the regions of interest the primary contributor of value during the 2001 to 2009 period was the Temperate Slopes and Plains region which contributed the majority (approximately 50%) of the value generated from beef, sheep and winter crops in each of the three years of the ABS census. Consistently, the two major state contributors of value from pastures were New South Wales and Victoria contributing approximately 30+% of the value generated from livestock and winter crops in each of 2001, 2006 and 2009.

Within the period of the analysis (2001 – 2009) the major changes in land available to generate pastures and winter crops in the regions of interest decreased from 95.3m Ha in 2001 to 74.61m Ha. Of this, the area of crops increased from 19.15 m Ha to 21.89m Ha. However, the area of native and self-sown pastures declined from 55.45m Ha to 37.7m Ha and the area of sown pastures declined from 20.94m Ha to 15.42m Ha.

The decline in pasture feedbase available for livestock production has been primarily driven by:

- the impact of the extended drought, resulting in a loss of permanent, native and self –sown pasture due to degradation;
- the loss of perennial and annual pastures seed banks;
- the decline in value of livestock products which reduced the impetus for pasture renewal;
- the increasing value and adoption of crops as an alternative investment for traditional livestock producers.

Consistent with the decline in the area of pasture available for livestock grazing between 2001 and 2009 the size of the beef herd and sheep flock within the six regions of interest declined during the same period. The size of the beef cattle herd across all regions declined from 10.17 million head in 2001 to 9.66 million head in 2009. The size of sheep flocks within the regions of interest continued to decline significantly during the 2001 to 2009 period with the total number of sheep and lambs falling from 101.46 million in 2001 to 68.48 million in 2009.

In 2001 there was total of $2.950b in value generated from the sale of cattle and calves meat, this increased to $3.468b in 2009 and declined slightly to $3.267b in 2009. The Temperate Slopes and Plains region generated the majority of the value derived from cattle and calves meat sold contributing $1.086b (36.8%) in 2001, $1.307b (37.6%) in 2006 and $1.067b (32.6%) in 2009.

New South Wales and Victoria dominated the supply of beef cattle and calves meat to the market. In 2001 New South Wales contributed $1.162b (39.41%) and Victoria $974.67m (33.04%) of the

cattle meat sold. By 2009 this had increased to $1.243b (38.06%) and $1.160b (35.50%) respectively in each state.
The value generated from the sale of sheep and lamb meat in 2001 equated to $1.311b which increased to $2.023b in 2006 and $2.401b in 2009. The supply of sheep and lambs was dominated by the Temperate Slopes and Plains region which contributed $804.29m (61.31%) in 2001, a further $1.229b (60.76%) in 2006 and $1.409b (58.71%) in 2009.

In 2001, the value generated from winter crops of interest attributable to pastures (e.g. nitrogen) was estimated to represent a total $733.20m. By 2006, the value had increased to $762.24m and by 2009 it had further increased to $836.10m.

The major winter crop was winter cereals, which represented approximately 90+% of the total value generated from winter crops in each of the three years of the ABS census. The value of winter cereals increased from $658.05m in 2001 to $758.16m in 2009. For the corresponding period the value of canola grown increased from $46.12m to $63.26m). However the value of grain legumes declined from $30.79m in 2001 to $16.78m in 2009.

Prospects for the beef, sheep and grains industries within the regions and states of interest have been remarkably transformed due to the improved climatic conditions experienced since the end of 2009. Heavy falls of rain across the south eastern region of Australia have dramatically improved soil moisture and pasture conditions as well as water storage levels. Resulting in improved irrigation water allocations in the short to mid-term for crop and pasture production along the Murray Darling irrigation system.

Based on the projections of ABARE for an increase of beef cattle numbers of on average 3.0% and considering that in 2009 the beef cattle herd within the regions of interest represents 38.83% of the national herd it is estimated that between 2010 and 2105 the cattle herd within these regions has the potential to increase cumulatively by approximately 717,000 cattle.

In 2009 the sheep flock herd within the regions of interest represented 94 % of the national flock it is estimated that between 2010 and 2105 the sheep flock within these regions has the potential to increase cumulatively by approximately 5.081 million head.

Based on the projected growth in the number of beef cattle and sheep within the regions of interest and considering the nutritional requirements of each livestock enterprise it is estimated that across all regions of interest and between 2010 and 2015 an incremental 20.832 million DSEs will need to be added to the current feedbase in order to meet the incremental nutritional requirements of the incremental beef cattle and sheep. Of the total projected incremental nutritional requirement the beef cattle herd will require and incremental 9.849m DSE and the sheep flock will require 10.983 m DSE over the projected five year period.

The incremental feedbase (DSEs) to meet the nutritional requirements of the extra beef cattle and sheep may be generated by an increase in the adoption of farmers of one or more of the following as part of their feedbase strategy:

- the planting of perennial and annual pastures as a replacement for cropping paddocks as they are taken out of rotation;

- the replacement of native and or self-sown pastures with the planting of higher energy producing perennial and annual pastures;
- the use of short rotation high energy pastures;
- the planting of fodder crops for grazing and/or fodder conservation; and
- the application of fertilizers to native and self-sown pastures;

1.0 Introduction

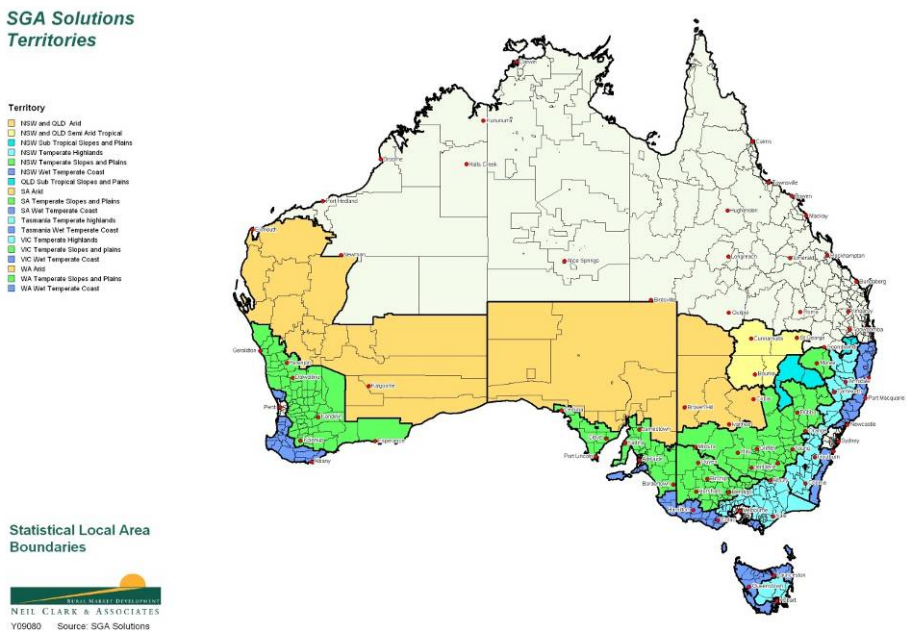
The value of pastures to Australian agriculture has been quantitatively estimated using a format similar to that undertaken by SGA Solutions for Pastures Australia (2009) and Productive Pastures for the GRDC (2006).

In this analysis estimates have been made to compare the value of pastures from the ABS 2001, 2006 and 2009 Statistical data and for the purpose of estimating future trends to 2015 the author has referenced a number of additional industry references which are listed in the bibliography.

The analysis has examined the value of pastures directly to the beef and sheep meat industries and provides an estimate of the contribution to broad acre winter crops of interest within the regions of interest. The report has not included the value to wool and dairy or other livestock types, hay production, small seed production or the contribution to other crops.

The analysis was based on the collation and allocation of 2001, 2006 and 2009 ABS data into various regions of pasture and livestock production within South Eastern and Western Australia (Map One and Appendix One). The maps and allocation of the ABS data within each region and each state were prepared and created by Neil Clark & Associates following the nomination of the shires within each respective zone by MLA.

Map One: Pasture and Livestock Zones of South Eastern and Western Australia



A summary the allocation and classification by MLA of pasture and livestock regions for each state is presented in the following table:

Table One: MLA Pasture and Livestock Zones Classification

Pasture Zone	Qld.	NSW	Vic.	Tas.	SA	WA
Arid Interior						
Semi-Arid Sub-Tropical						
Sub-Tropical Slopes and Plains						
Temperate Highlands						
Temperate Slopes and Plains						
Wet Temperate Coast						

Since 2001, detailed pasture data has not been collected regularly by the ABS within its surveys rather it has sought data that related to the general classification of 'Native & Self Sown' pastures and 'Sown' pasture.

The ABS definition of 'Native & Self Sown' pastures refers to 'native and naturalized pasture including all grasses and legumes indigenous to the area or those introduced in the past which are now reproducing naturally'. (In 2001 the national total for this pasture group was 162 million hectares). This commodity represents pasture in low input pastoral areas and some degraded pastures in higher rainfall zones.

In addition ABS collected information relating to 'Sown' pasture commodity. (In 2001 the national total for this pasture group was 25.6 million hectares). This commodity represents improved and more highly productive pasture in higher rainfall zones.

For the purpose of the analysis the area of 'Sown' pastures has been derived for 2006 and 2009 by indexing livestock numbers with DSE/ha ratings.

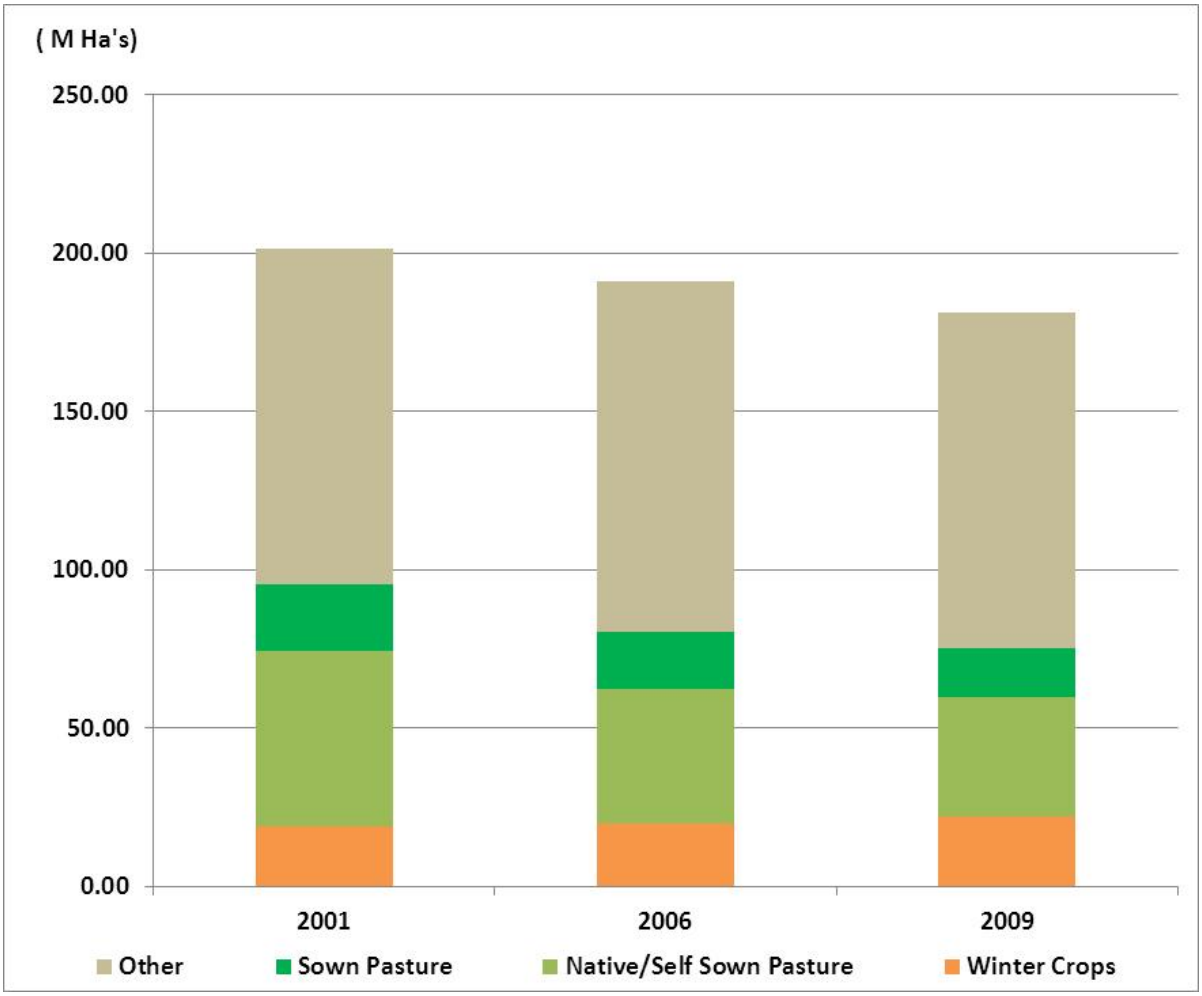
2.0 Status of Pasture and Winter Crop Areas within Regions of Interest (2001 – 2009)

In 2001, within the regions of interest a total of 202 million hectares was occupied by farming operations. Of this area 95.3 million hectares (47.10%) were utilised for livestock and/or winter crop production. By 2006 the total area reported had declined to 191 million hectares of which 80.40 million hectares (42.09%) were utilised for livestock and/or winter crop production.

Consistent with the steady decline in land available for agricultural production between 2001 and 2006, the area reported in 2009 had further declined to 181 million hectares of which 74.61 million hectares (41.22%) were utilised for livestock and/or winter crop production.

For the period between 2001 and 2009, there was a decline of 20.69 million hectares (-21.71%) reported within the ABS census of agricultural land utilised for livestock and/or winter crop production.

Chart One: Agricultural land Utilisation for Livestock and Winter Crop Production in Regions of Interest. (2001, 2006, 2009)



Within each of the six livestock and pasture regions identified by MLA the area of winter crop increased from 19.15 m ha in 2001 to 21.89 m Ha in 2009, an overall increase of 14.31%.

By contrast for the same period, the area of “Native & Self Sown’ pasture declined from 55.45 M ha to 37.77 m Ha (- 32.10%) and the area of ‘Sown’ pasture declined from 20.94 m Ha to 15.42 m Ha (-26.36%). (Table One)

Table One: Area of Australian Winter Crops, Native & Self Sown Pastures and Sown Pastures by Livestock and Pasture Zone (2001, 2006, 2009)

	Year	Arid Interior	Semi-Arid Sub-Tropical	Sub-Tropical Slopes & Plains	Temperate Highlands	Temperate Slopes and Plains	Wet Temperate Coast	Total
Winter Crops (M ha)	2001	0.17	0.13	0.68	0.24	17.58	0.35	19.15
	2006	0.13	0.17	0.64	0.25	18.41	0.33	19.94
	2009	0.14	0.23	0.82	0.30	19.79	0.60	21.89
Native & Self Sown Pasture (M Ha)	2001	28.32	5.74	2.13	3.92	14.67	0.67	55.45
	2006	19.51	3.43	1.83	3.71	13.05	0.78	42.32
	2009	17.72	3.85	1.67	3.36	10.41	0.75	37.77
Sown Pasture (M Ha)	2001	0.12	0.23	0.13	4.01	12.47	3.98	20.94
	2006	0.07	0.17	0.12	3.41	11.03	3.42	18.21
	2009	0.06	0.21	0.11	2.93	8.89	3.23	15.42

The change in area of pastures and winter crop by livestock and pasture region and by state are presented in Charts Two and Three respectively.

The decline in pastures available for livestock production has been primarily driven by:

- the impact of the extended drought, resulting in a loss of pasture due to degradation;
- the loss of perennial and annual pastures seed banks;
- the decline in value of livestock products which reduced the impetus for pasture renewal;
- the increasing value of crops as an alternative investment for traditional livestock producers.

It is anticipated that the area of annual and perennial ‘Sown’ pastures will increase between 2010 and 2015 due to:

- the end of the drought,
- the need to re-build cattle herds and sheep flocks for production, and
- the increasing export demand for Australian red meat.

Chart Two: Area of Winter Crops, Native & Self Sown Pastures, Sown Pastures by Livestock and Pasture Regions of Interest. (2001, 2006, 2009)

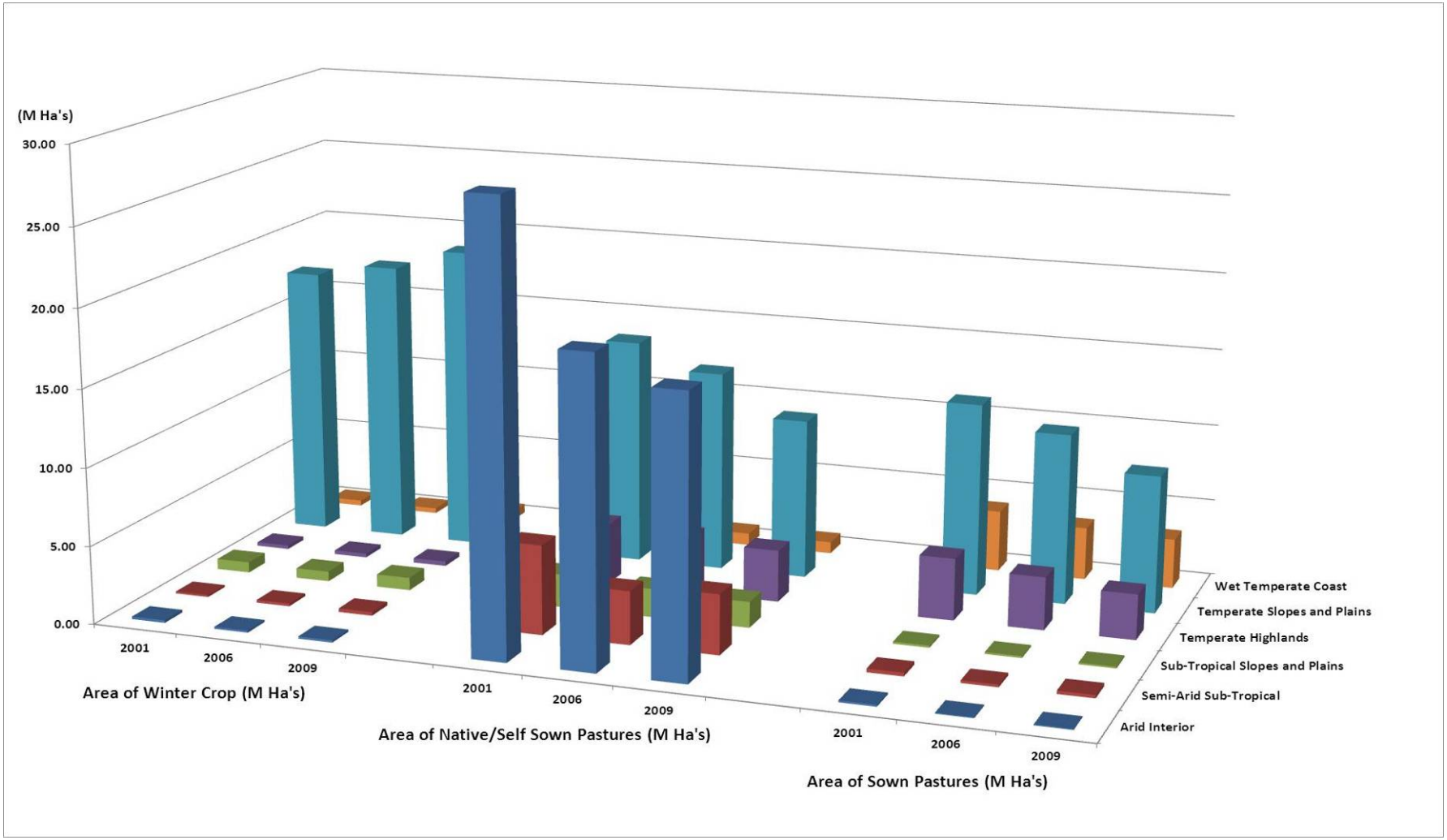
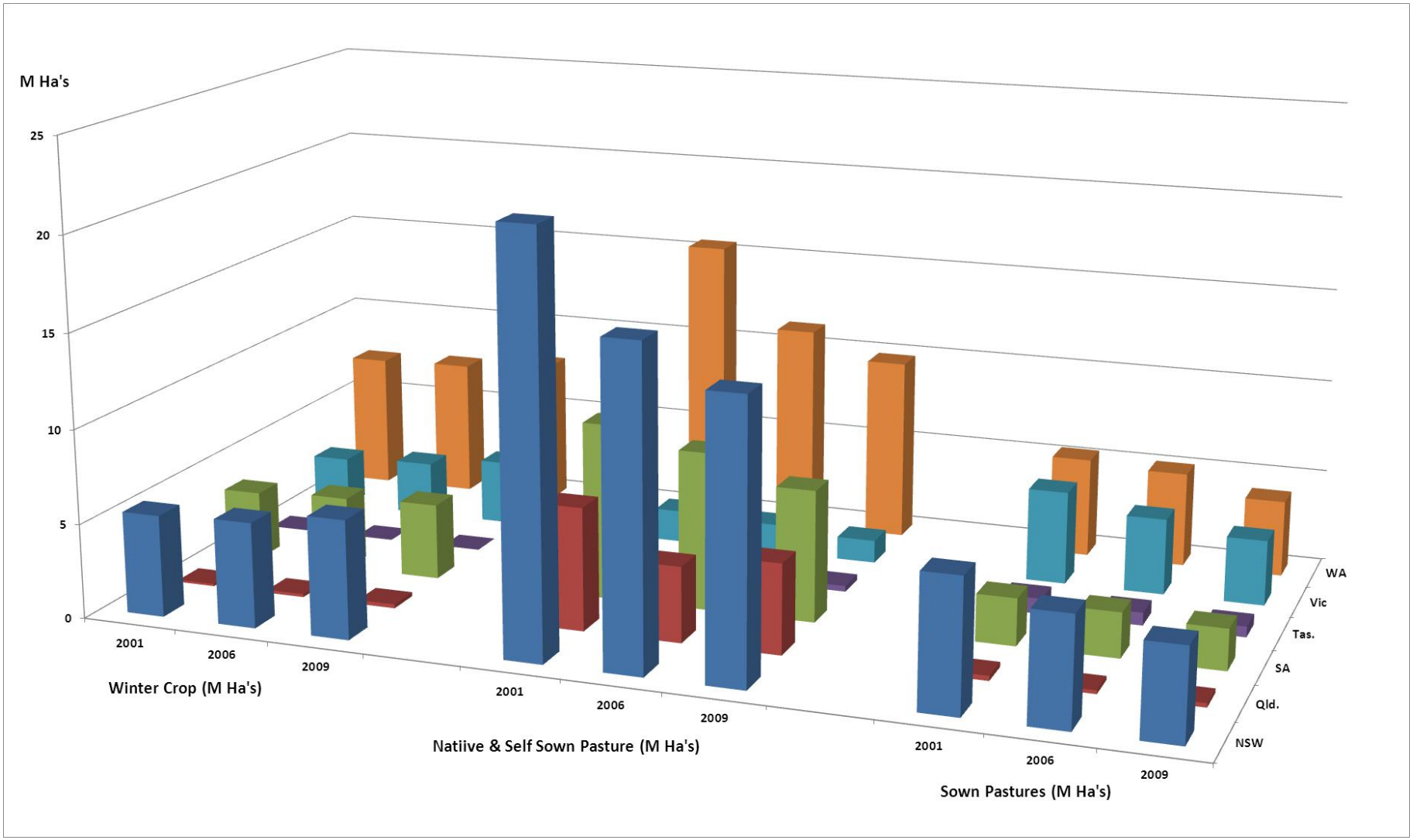


Chart Three: Area of Winter Crops, Native & Self Sown Pastures and Sown Pastures by State. (2001, 2006, 2009)



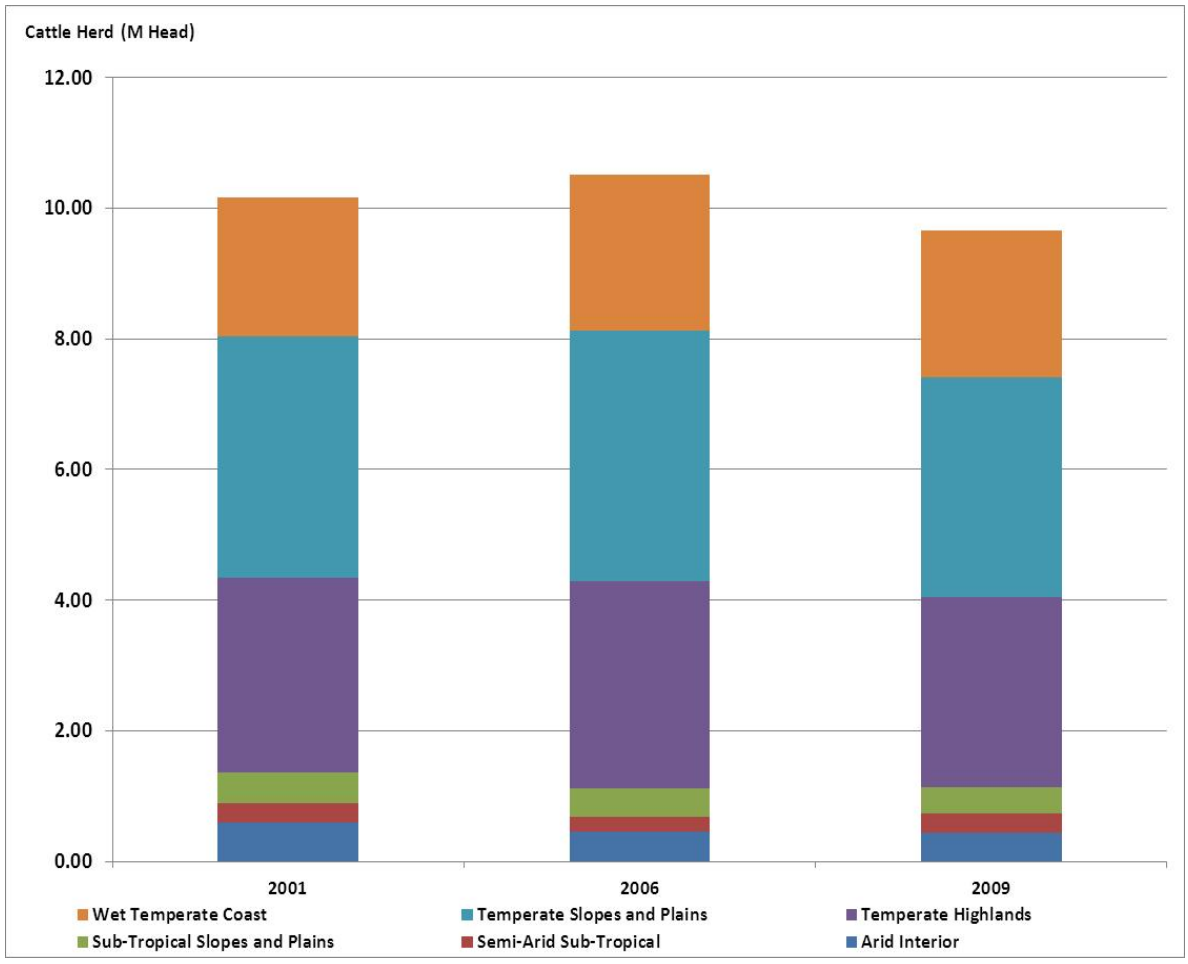
3.0 Status of the Beef Cattle Herd within the Regions of Interest and by State (2001 – 2009)

Consistent with the decline in the area of pasture available for livestock grazing between 2001 and 2009 the size of the beef herd and sheep flock within the six regions of interest declined during the same period.

Despite a short term increase in the size of the beef cattle herd across all regions from 10.17 million head in 2001 to 10.51 million head in 2006, by 2009 there was an overall decline in the size of the cattle herd to 9.66 million head in the regions of interest. The cattle herd within the regions of interest in 2009 represented 38.87% of the national beef cattle herd.

Within the regions of interest the only region to increase the size of the cattle herd during the 2001 – 2009 period was the Wet Temperate Coast Region which increased the size of its herd from 2.13 million head in 2001 to 2.25 million head in 2009 (+5.6%). The size of the beef cattle herd in the Semi-Arid Interior Tropical region remained flat during this period at 300,000 head. (Chart Four)

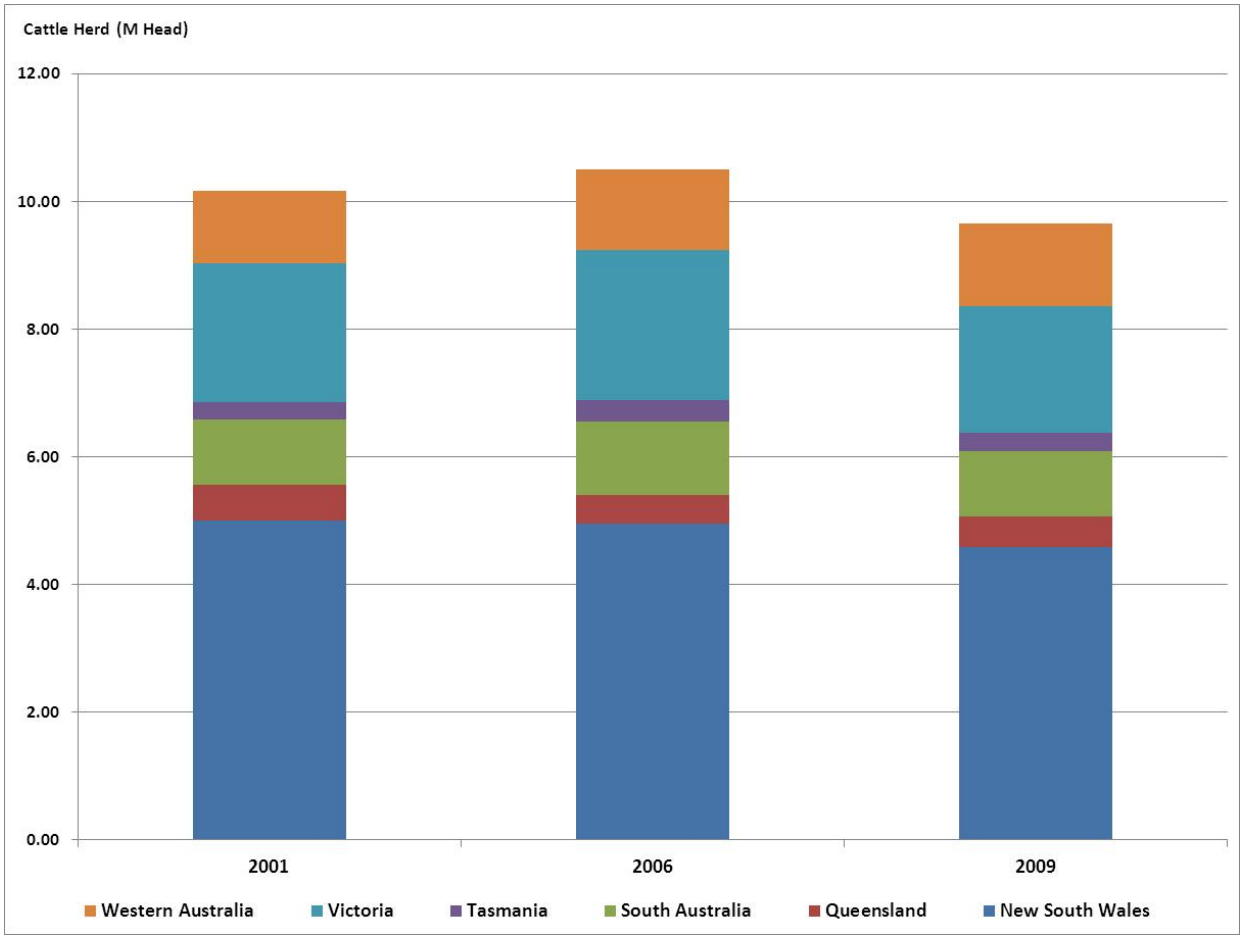
Chart Four: Beef Cattle Herd Size by Region of Interest. (2001, 2006, 2009)



Between 2001 and 2009 Western Australia (+170k head) and Tasmania (+10k Head) increased the size of their respective beef cattle herds. The beef cattle herd in South

Australia remained flat at 1.03 million head. New South Wales recorded the biggest reduction in beef cattle numbers with a decline of 420,000 head between 2001 and 2009, while Victoria's beef cattle herd also declined by 170,000 head for the same period. (Chart Five)

Chart Five: Beef Cattle Herd Size by State. (2001, 2006, 2009)



4.0 Status of the Sheep Flock within the Regions of Interest and by State (2001 – 2009)

The size of sheep flocks within the regions of interest continued to decline significantly during the 2001 to 2009 period with the total number of sheep and lambs falling from 101.46 million in 2001 to 86.15 million in 2006. In 2009 the sheep flock had decline to 68.48 million which represented approximately 95% of the Australian sheep flock. The decline in the sheep flock from 2001 to 2006 was approximately 15.09% and between 2006 and 2009 increased in decline to 20.51%, representing an overall decline of 32.51% in the size of the sheep flock in the regions of interest.

The region which recorded the largest decline in total numbers was the Temperate Slopes and Plains region with the size of the sheep flock declining by 18.55 million head (-31.24%) from 2001 to 2009. By contrast the region which recorded the largest decline as a percentage of the total flock was in the Semi-Arid Interior Tropical region where a decline of 1.36 million head represented a decline of 49.28% of the total sheep flock within the region.

The state which recorded the largest decline in its sheep flock was New South Wales with a decline of 15.04 Million head (-37.08%). The lowest decline in sheep flock numbers as a percentage of the flock in 2001 was in South Australia where the flock fell by 2.58 million, which represented a decline of 20.65%. In Queensland, despite recording a decline of 920,000 head between 2001 and 2009 which was the lowest of all states, the decline represents a loss of 43.10% from its sheep flock.

Chart Six: Sheep Flock Size by Region of Interest. (2001, 2006, 2009)

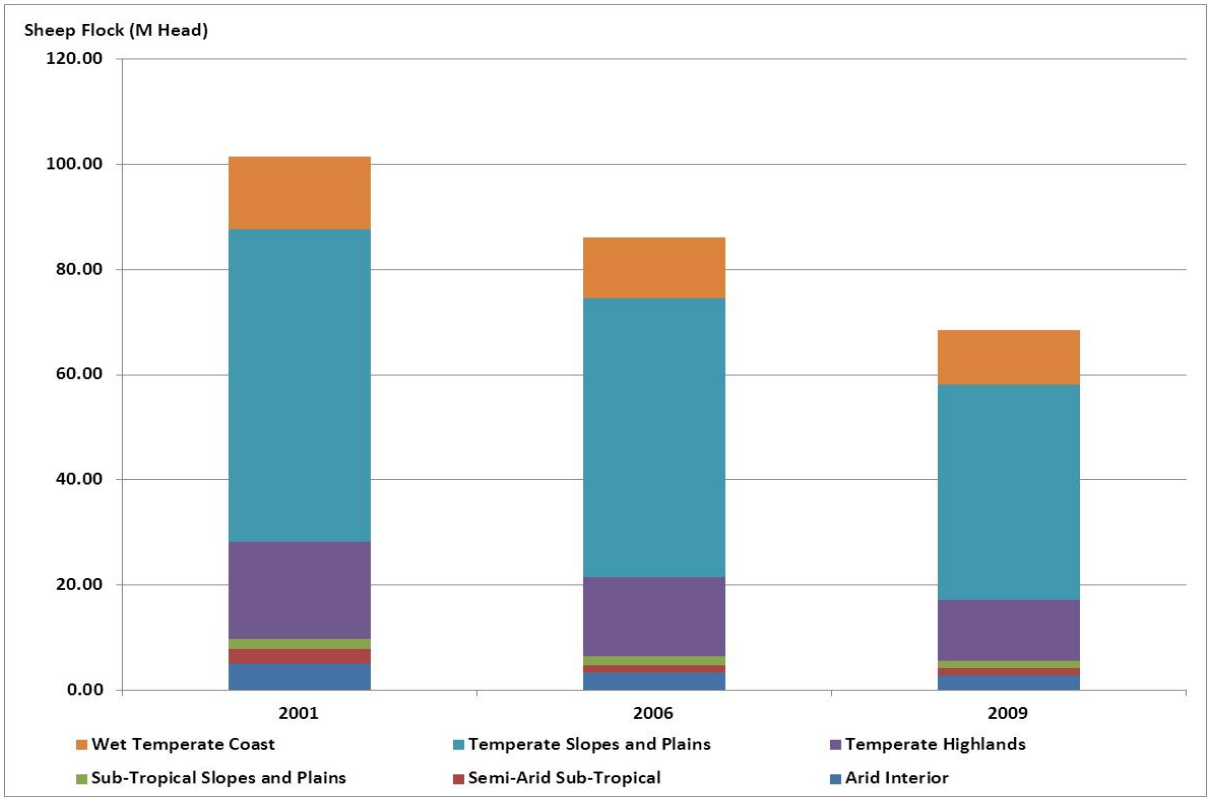
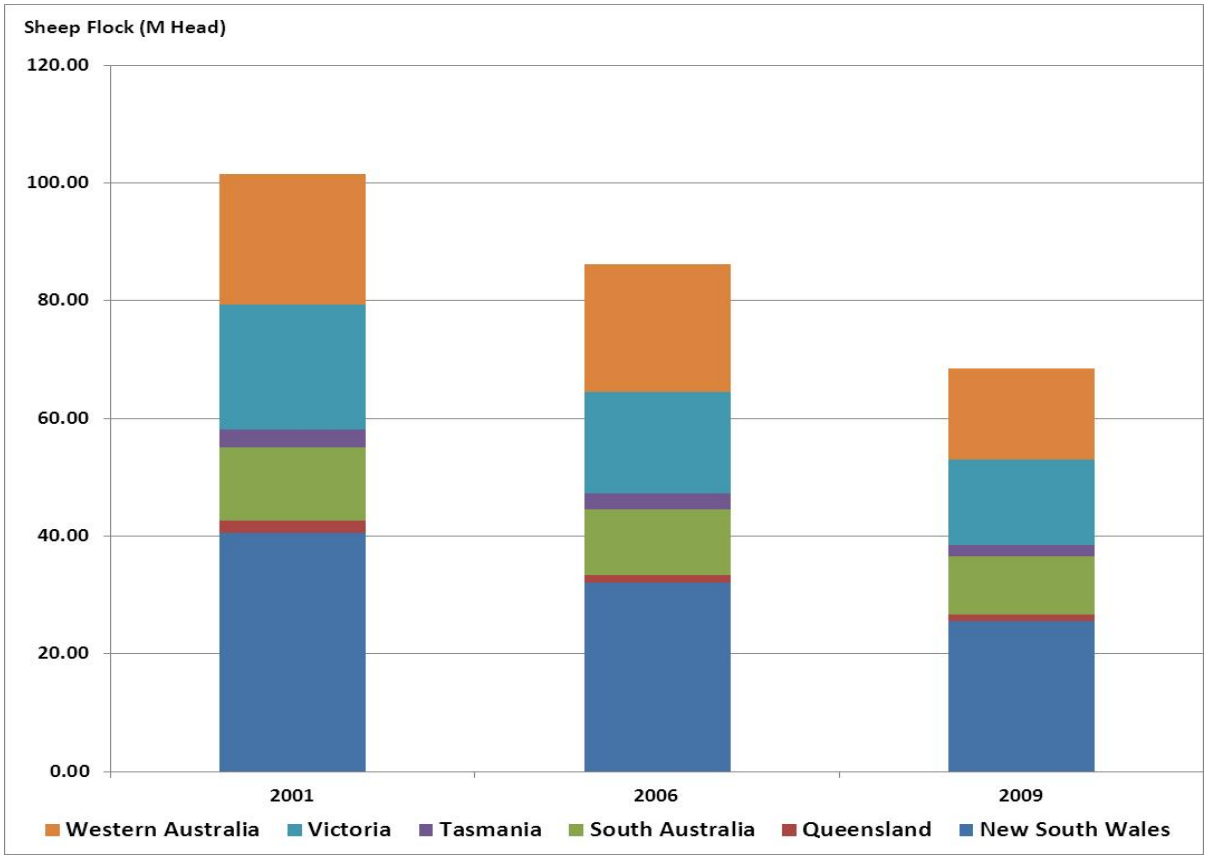


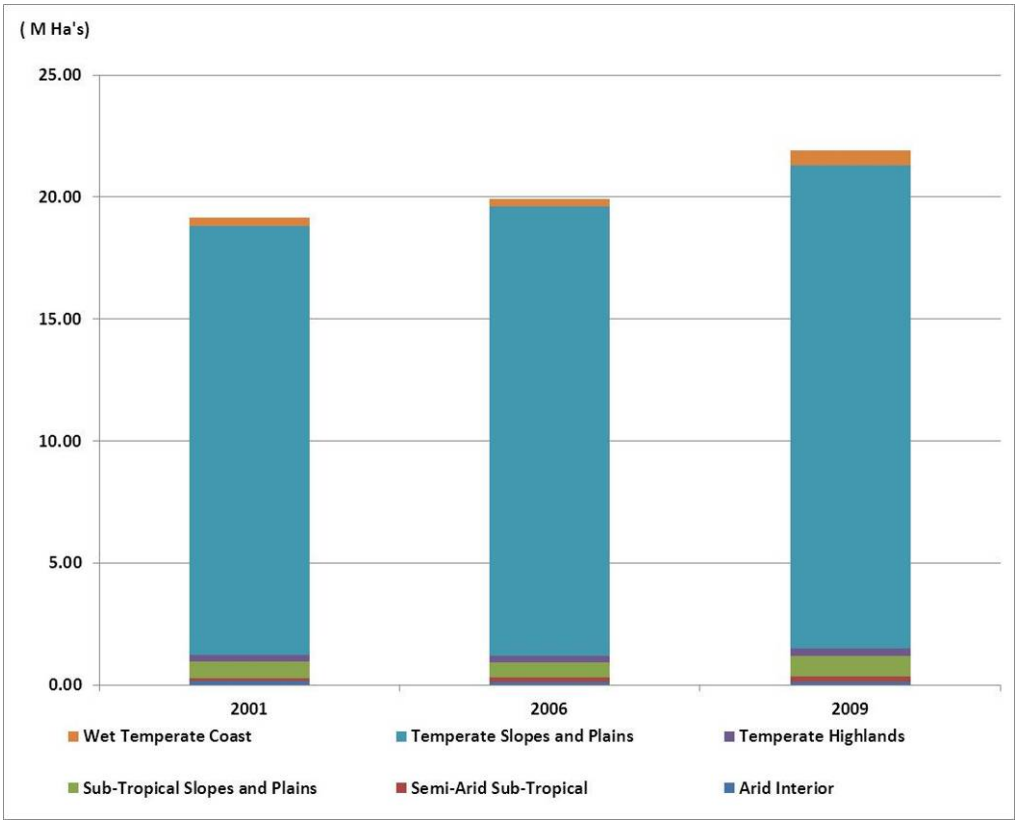
Chart Seven: Sheep Flock Size by State. (2001, 2006, 2009)



5.0 Status of Winter Crops within the Regions of Interest and by State (2001 – 2009)

Between 2001 and 2009 the total area of winter crops of interest (canola, winter cereals and grain legumes) increased from 19.136 million hectares in 2001 to 21.725 million hectares in 2009, an overall increase of 13.53 % in area planted. (Chart Eight & Chart Ten)

Chart Eight: Area of All Winter Crops Planted within Regions of Interest. (2001, 2006, 2009)



Of the regions of interest the Temperate Slopes and Plains region dominates the area of winter crop production across all crop types of interest representing greater than 90% of the total area of each crop of interest planted in each of the years 2001, 2006 and 2009. (Table Two)

Table Two: Temperate Slopes & Plains Regions Market Share of Winter Crops - Canola, Cereals and Grain Legumes. (2001, 2006, 2009)

Year	Canola	Winter Cereal	Grain Legumes	All Winter Crops
	K Ha	K Ha	K Ha	K Ha
2001	1429.74	15598.88	2107.44	19136.05
2006	944.78	17341.09	1649.27	19935.14
2009	1640.38	18669.52	1416.00	21725.89
Temperate Slopes & Plains Share (%)				
	%	%	%	%
2001	93.41%	91.60%	94.14%	92.02%
2006	91.29%	92.34%	95.28%	92.53%
2009	87.10%	91.06%	90.86%	90.75%

Between 2001 and 2009 the area of winter crops increased in New South Wales increased by 858,000 hectares (+15.8%) which represented the largest increase in area of all states. Victoria recorded the second largest increase of approximately 730,000 hectares (+26.9%),

followed by Western Australia at 561,000 hectares (+7.7%) and South Australia at 340,000 hectares (+9.3%).

Queensland recorded the highest percentage increase of 94.1 %; however this was of a relatively low base and represented an area increase of 98,000 hectares. Tasmania recorded the lowest increase in winter crops both in terms of area (+1,600 hectares) and percentage (+6.7%). (Chart Nine & Chart Eleven)

Chart Nine: Area of All Winter Crops Planted within States. (2001, 2006, 2009)

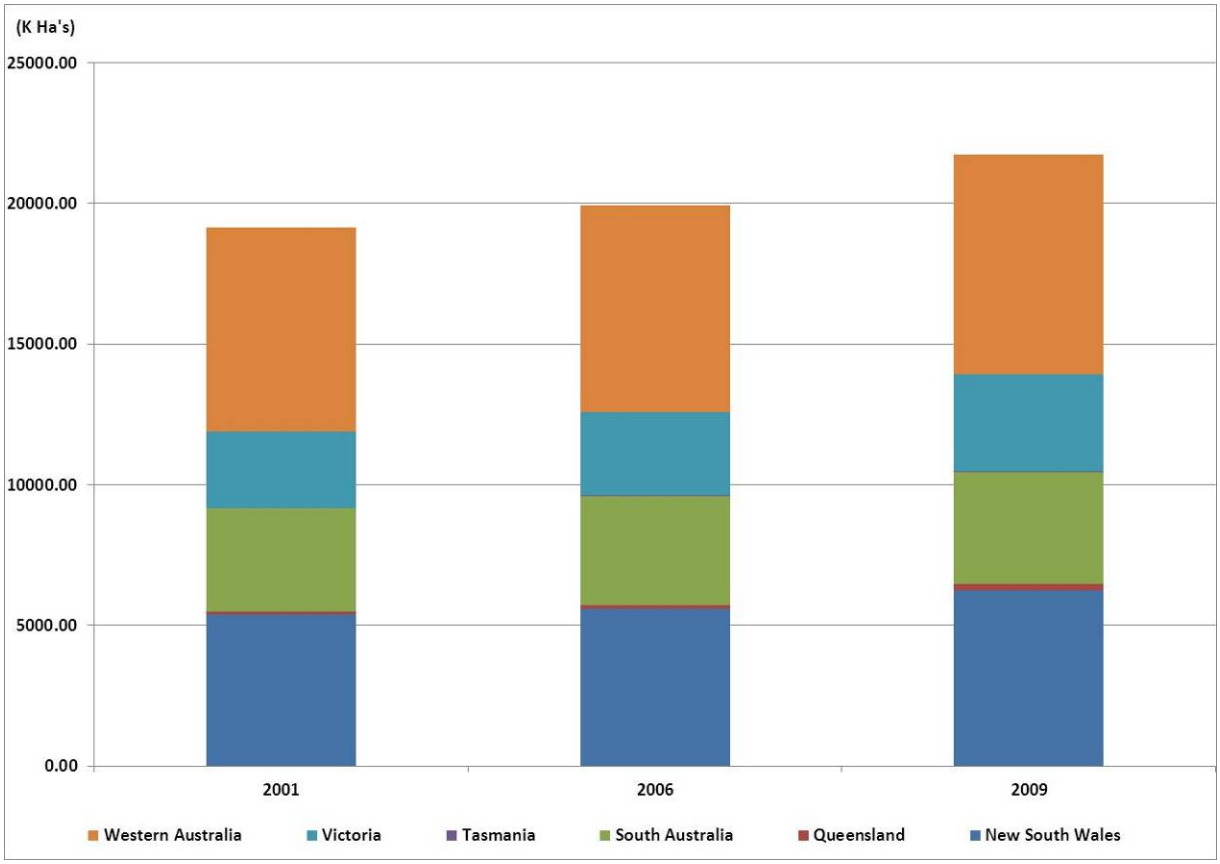


Chart Ten: Area of Winter Crops of Interest by Regions of Interest. (2001, 2006, 2009)

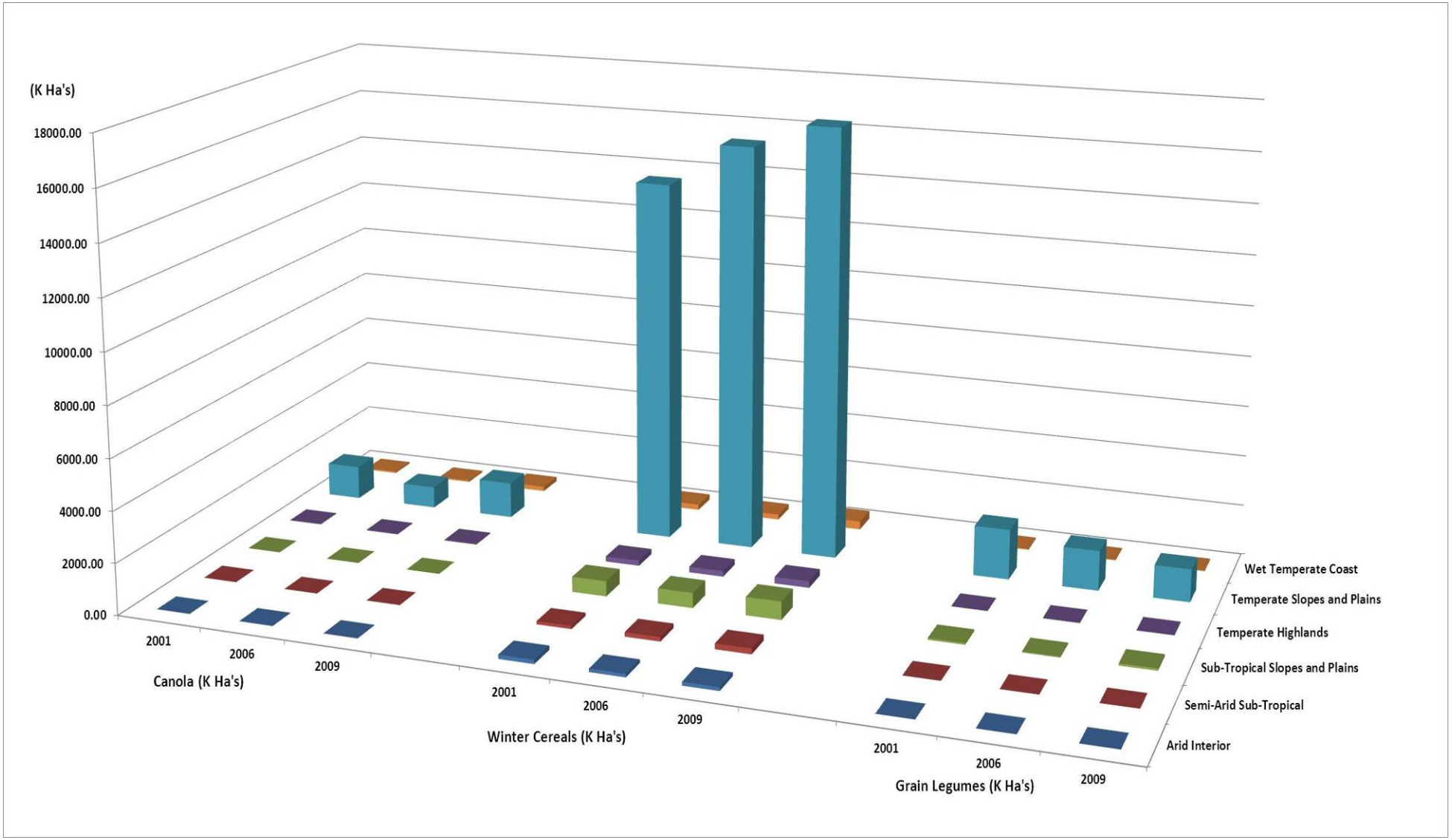
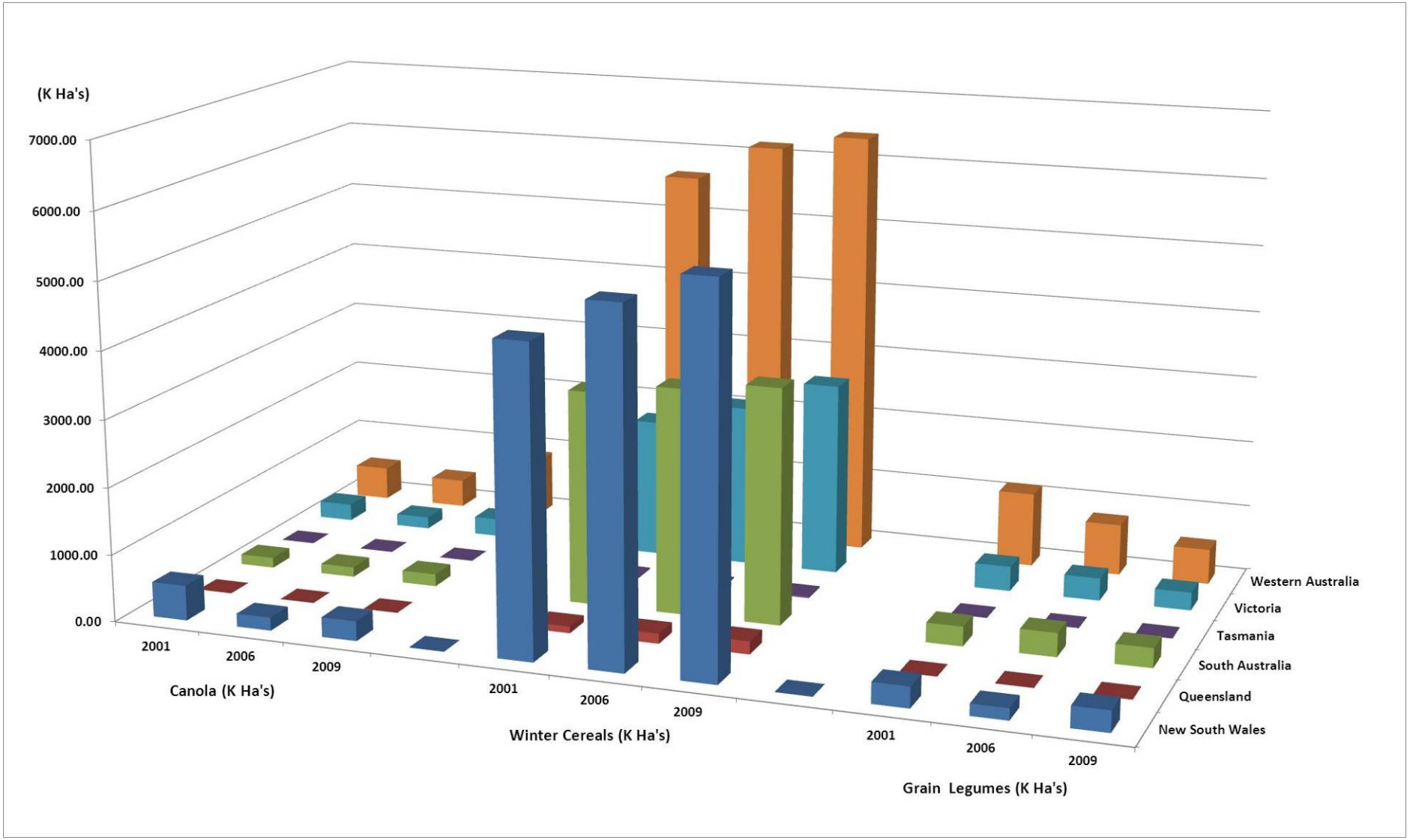


Chart Eleven: Area of Winter Crops of Interest by State. (2001, 2006, 2009)



6.0 Pasture and Livestock Value Contribution 2001 – 2009

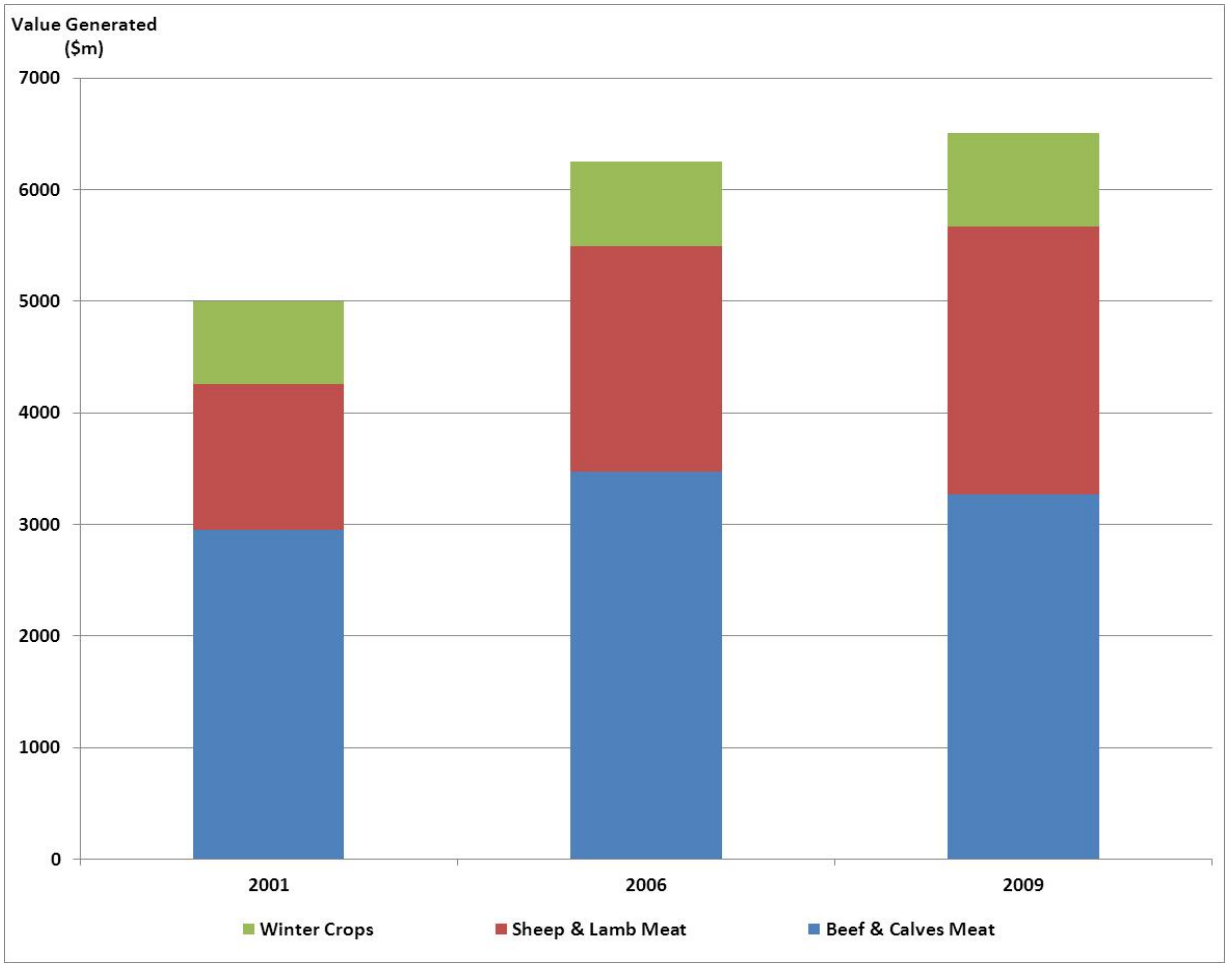
The value generated by pastures in livestock production and contribution to winter crops increased from $4.994b in 2001, to $6.253b in 2006 and $6.504b in 2009. The primary drivers for the increase in value generated were:

- the continued “sell off” of sheep and cattle for slaughter as a result of the declining availability of pastures for grazing due to the drought,
- the decreasing value of wool, and
- the increase in the adoption and intensification within traditional pasture of winter crops.

The major contributor, albeit declining to the value generated during this period was from the cattle meat sector which represented 59.06 % in 2001, 55.46% in 2009 and 50.23 % in 2009.

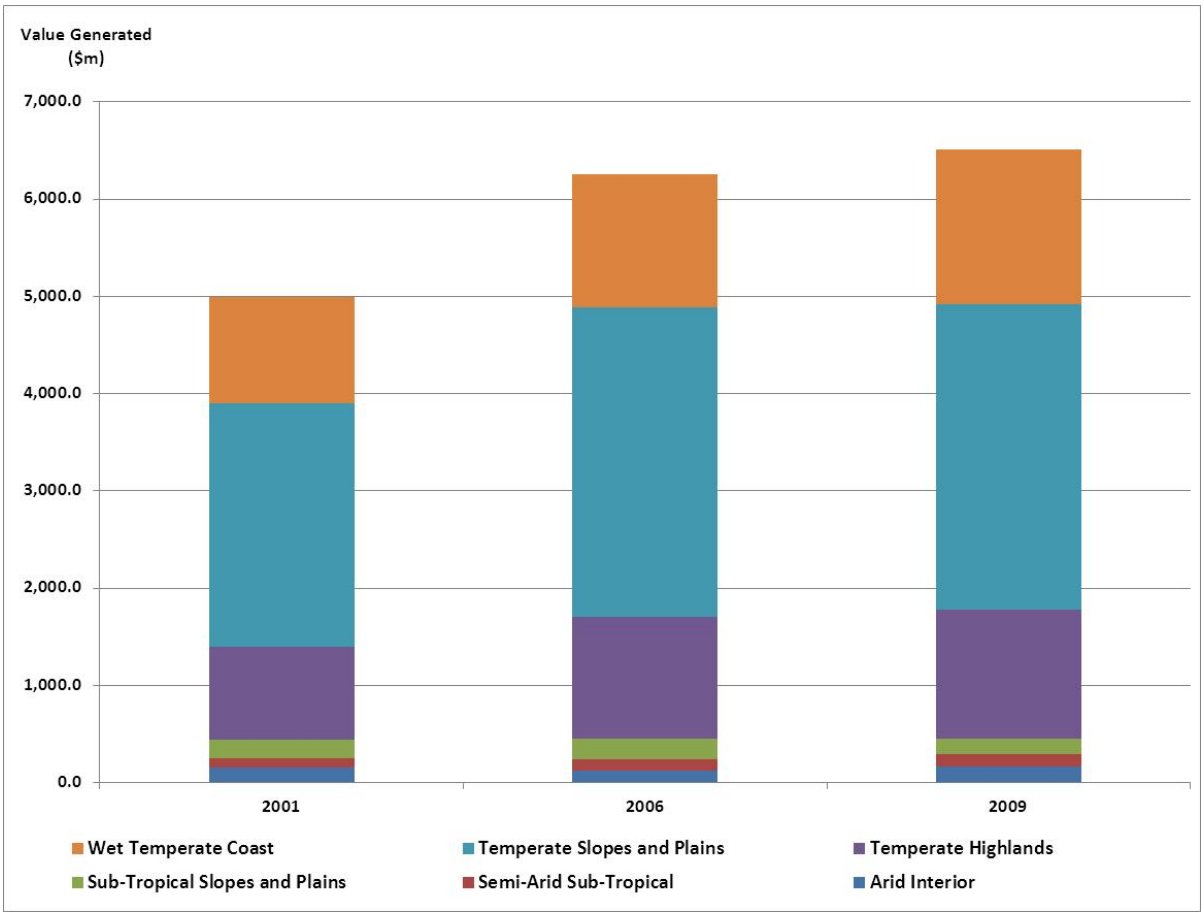
For the 2001 to 2009 period the value contribution of sheep and lamb meat increased from 26.26% in 2001 to 36.91% in 2009. Despite the increasing value and area of winter crops planted for the same period the value contribution declined from 14.68% in 2001 to 12.85% in 2009.

Chart Twelve: Pasture and Livestock Value Generated within Regions and States of Interest. (2001, 2006, 2009)



Of the regions of interest the primary contributor of value during the 2001 to 2009 period was the Temperate Slopes and Plains region which contributed the majority (approximately 50%) of the value generated from beef, sheep and winter crops in each of the three years of the ABS census. (Chart Thirteen & Chart Fifteen)

Chart Thirteen: Pasture and Livestock Value Generated within Regions of Interest. (2001, 2006, 2009)



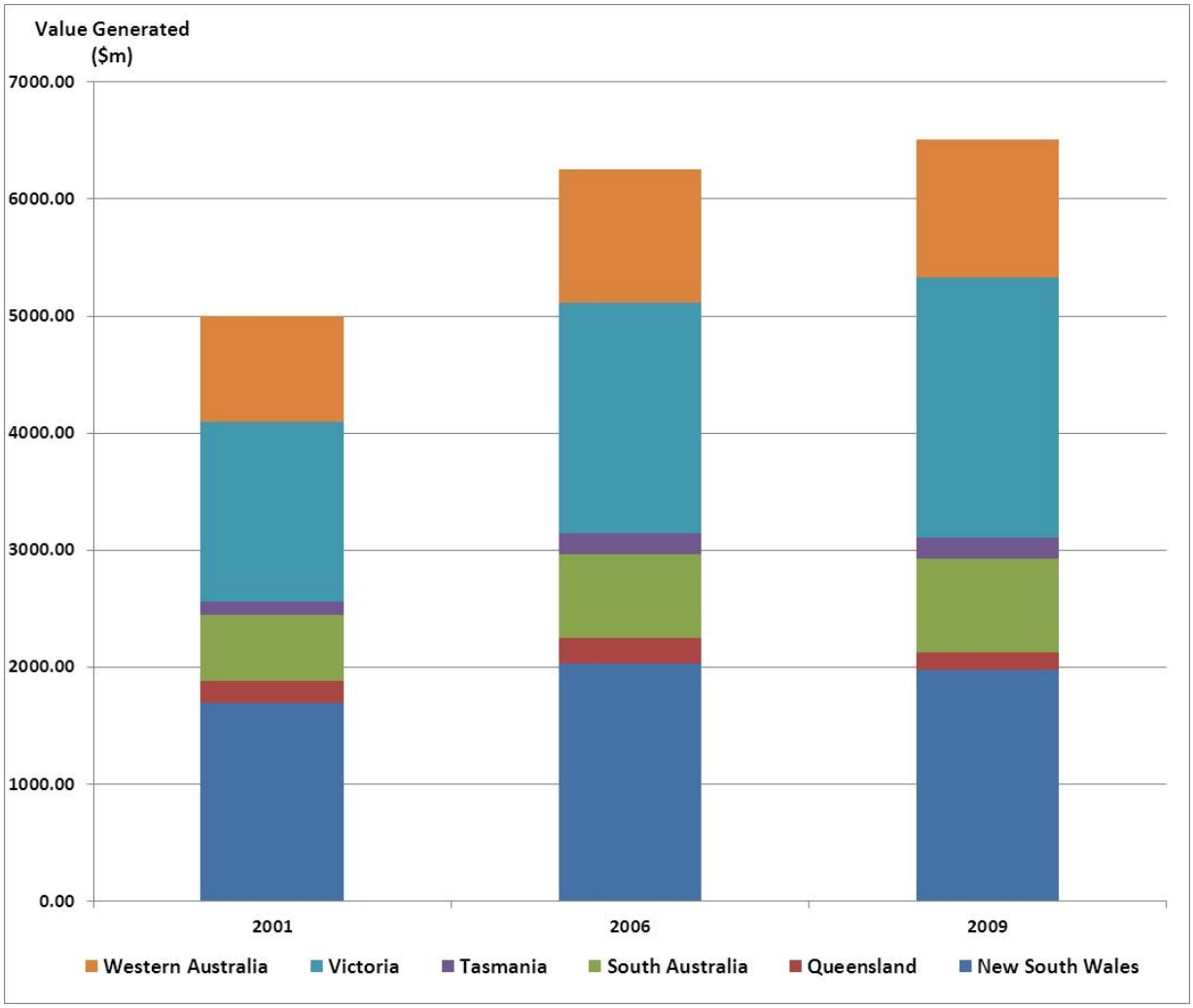
The contribution of value from pastures via livestock and winter crop production in each of the states from both a total dollar and percentage basis remained consistent across the three years of the ABS census. (Chart Fourteen, Chart Fifteen & Table Three)

Consistently the two major state contributors of value from pastures were New South Wales and Victoria contributing approximately 30+% of the value generated from livestock and winter crops in each of 2001, 2006 and 2009.

Table Three: Value Generated by Livestock and Winter Crops from Pastures by State. (2001, 2006, 2009)

Year	New South Wales	Queensland	South Australia	Tasmania	Victoria	Western Australia
2001	33.94%	3.74%	11.35%	2.21%	30.70%	18.07%
2006	32.49%	3.39%	11.47%	2.94%	31.46%	18.25%
2009	30.32%	2.28%	12.35%	2.70%	34.20%	18.14%

Chart Fourteen: Value Generated by Livestock and Winter Crops from Pastures by State. (2001, 2006, 2009)



In 2001 there was total of $2.950b in value generated from the sale of cattle and calves meat, this increased to $3.468b in 2009 and declined slightly to $3.267b in 2009. The Temperate Slopes and Plains region generated the majority of the value derived from cattle and calves meat sold during each of the three years of the ABS census contributing $1.086b (36.8%) in 2001, $1.307b (37.6%) in 2006 and $1.067b (32.6%) in 2009. Of note is that during the same period the Wet Temperate Coast region increased its share of the beef cattle and calves meat market from $770.56m (26.1%) in 2001 to $942.21m (28.8%) in 2009. In addition the Temperate Highlands region also increased its share of the beef cattle

and calves meat market from $762.04m (25.8%) in 2001 to $963.52m (29.5%) in 2009. (Chart Fifteen)

New South Wales and Victoria dominated the supply of beef cattle and calves meat to the market in 2001, 2006 and 2009. In 2001 New South Wales contributed $1.162b (39.41%) and Victoria $974.67m (33.04%) of the cattle meat sold. By 2009 this had increased to $1.243b (38.06%) and $1.160b (35.50%) respectively in each state. (Chart Sixteen)

The value generated from the sale of sheep and lambs meat in 2001 equated to $1.311b which increased to $2.023b in 2006 and $2.401b in 2009. The supply of sheep and lambs was dominated by the Temperate Slopes and Plains region which contributed $804.29m (61.31%) in 2001, a further $1.229b (60.76%) in 2006 and $1.409b (58.71%) in 2009. (Chart Fifteen)
Supply of sheep and lambs from various states remained relatively consistent between states for the 2001 – 2009 period with some minor changes recorded between states. (Table Four & Chart Sixteen)

Table Four: Value and Market Share of Sheep and Lambs Sold by State. (2001, 2006, 2009)

Year	New South Wales	Queensland	South Australia	Tasmania	Victoria	Western Australia
Value of Sheep and Lambs Sold ($m)						
2001	338.00	14.89	191.36	20.45	448.96	298.07
2006	475.14	15.65	305.16	42.99	723.97	460.41
2009	512.06	20.86	403.32	41.18	902.54	521.27
Market Share x State (%)						
2001	25.77%	1.14%	14.59%	1.56%	34.23%	22.72%
2006	23.48%	0.77%	15.08%	2.12%	35.78%	22.76%
2009	21.32%	0.87%	16.80%	1.71%	37.59%	21.71%

Chart Fifteen: Pasture and Livestock Value Generated by Enterprise Type within Regions of Interest. (2001, 2006, 2009)

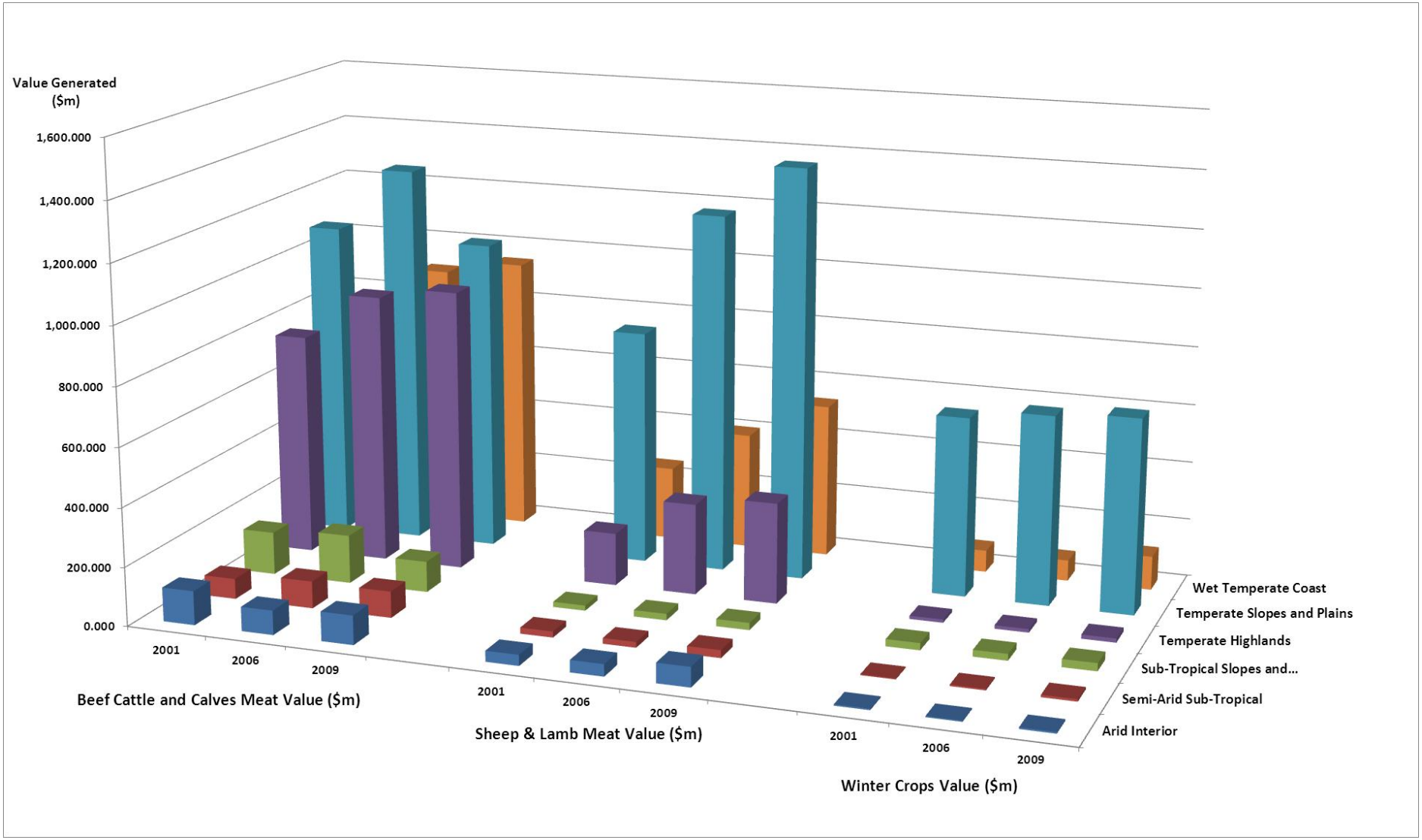
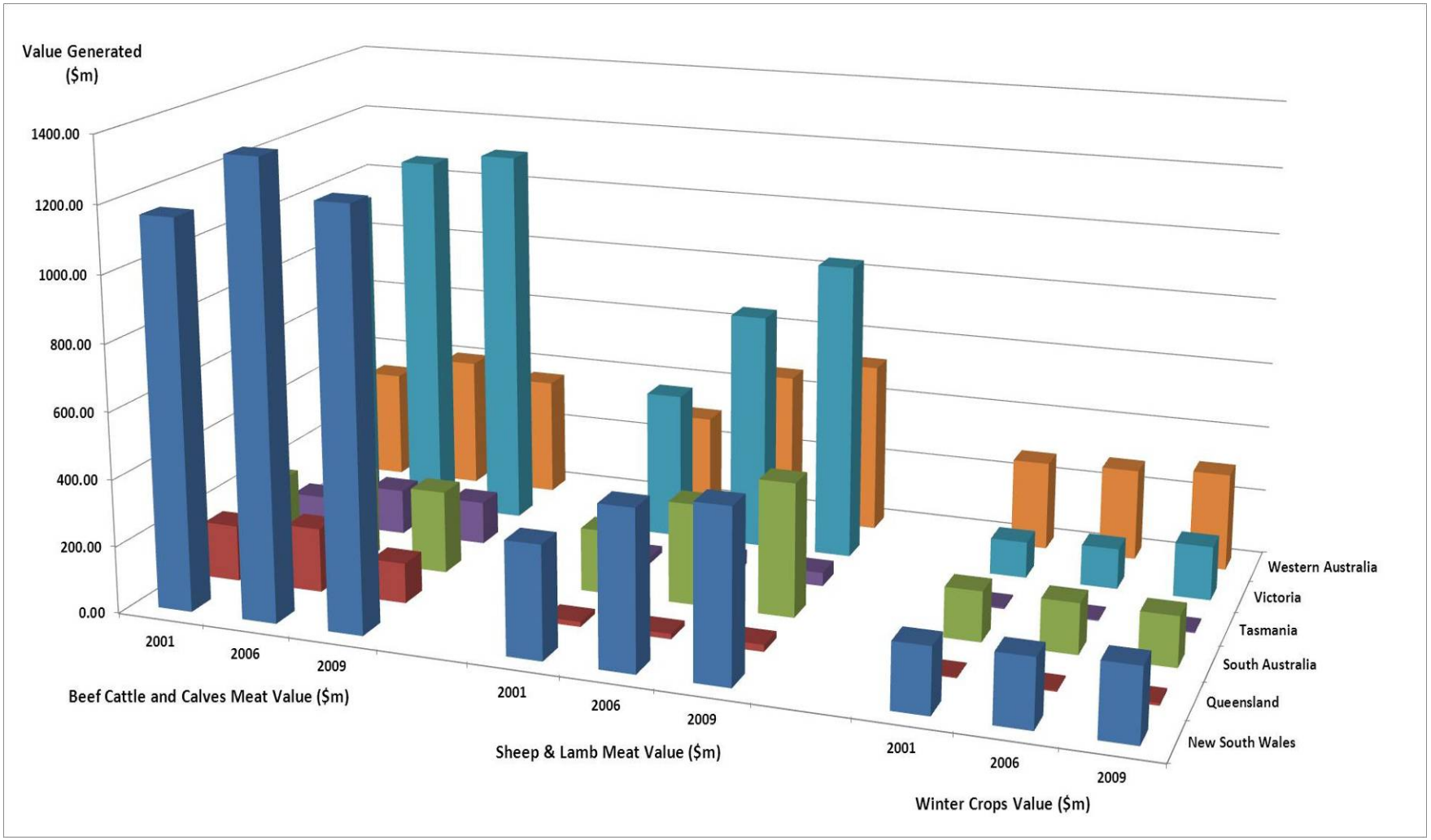


Chart Sixteen: Pasture and Livestock Value Generated by Enterprise Type by State. (2001, 2006, 2009)



The contribution of pasture to crop production and value was estimated using the following assumptions of benefits to first year crop yields which were derived from the Productive Pastures Report (2006):

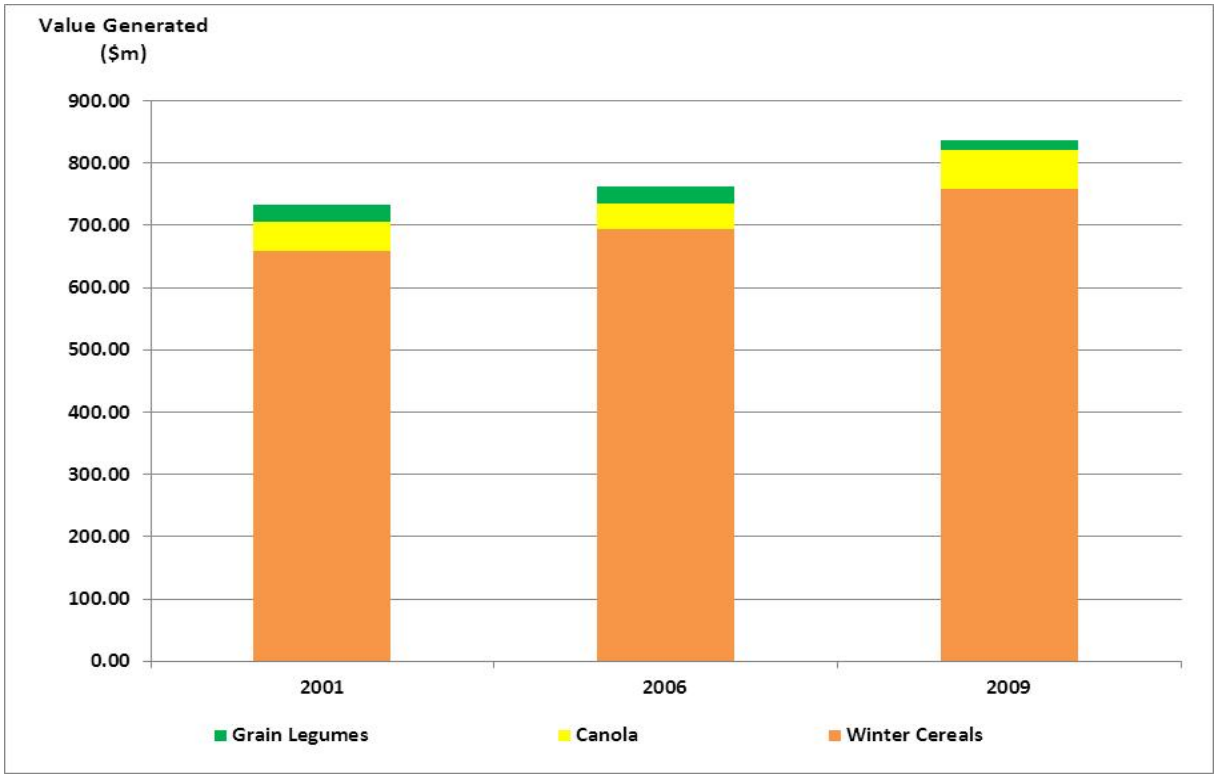
- High rainfall – 1t/ha for cereals, 0.4t/ha for oilseeds, 0.3t/ha for grain legumes
- Medium rainfall – 0.7t/ha for cereals, 0.3t/ha for oilseeds, 0.2t/ha for grain legumes
- Low rainfall – 0.4t/ha for cereals, 0.2t/ha for oilseeds, 0.1t/ha for grain legumes.

In 2001, the value generated from winter crops of interest attributable to pastures (e.g. nitrogen) was estimated to represent a total $733.20m. By 2006, the value had increased to $762.24m and by 2009 it had further increased to $836.10m. (Chart Seventeen)

The major winter crop was winter cereals, which represented approximately 90+% of the total value generated from winter crops in each of the three years of the ABS census. The value of winter cereals increased from $658.05m in 2001 to $758.16m in 2009. For the corresponding period the value of canola grown increased from $46.12m to $63.26m). However the value of grain legumes declined from $30.79m in 2001 to $16.78m in 2009.

A major driver for the increase in value generated by winter cereals and canola was the conversion of previous perennial and native/self-sown annual pastures utilised for livestock and fodder production into winter crops.

Chart Seventeen: Value Generated from Winter Crops of Interest. (2001, 2006, 2009)



The Temperate and Slopes region dominated the value generated from winter crops of interest producing $614.7m (83.84%) in 2001, increasing to $648.3m (85.06%) in 2006 and further increasing to $666.5m (79.77%) in 2009. (Chart Eighteen)

The value of winter crops from various states remained relatively consistent between states for the 2001 – 2009 period with some minor changes recorded between states. (Table Five & Chart Nineteen) The major state contributing value from winter crops is Western Australia followed by New South Wales and Victoria.

Table Five: Value and Market Share of Winter Crops by State. (2001, 2006, 2009)

Year	New South Wales	Queensland	South Australia	Tasmania	Victoria	Western Australia
Value of Winter Crops of Interest ($m)						
2001	195.14	2.95	150.81	4.75	110.39	271.53
2006	203.16	4.10	151.93	3.62	122.65	278.58
2009	217.46	6.83	150.55	4.23	162.69	296.44
Market Share x State (%)						
2001	26.53%	0.40%	20.50%	0.65%	15.01%	36.91%
2006	24.24%	0.49%	18.13%	0.43%	14.63%	33.23%
2009	25.94%	0.81%	17.96%	0.51%	19.41%	35.37%

Chart Eighteen: Value Generated by Winter Crops of Interest Type within Regions of Interest. (2001, 2006, 2009)

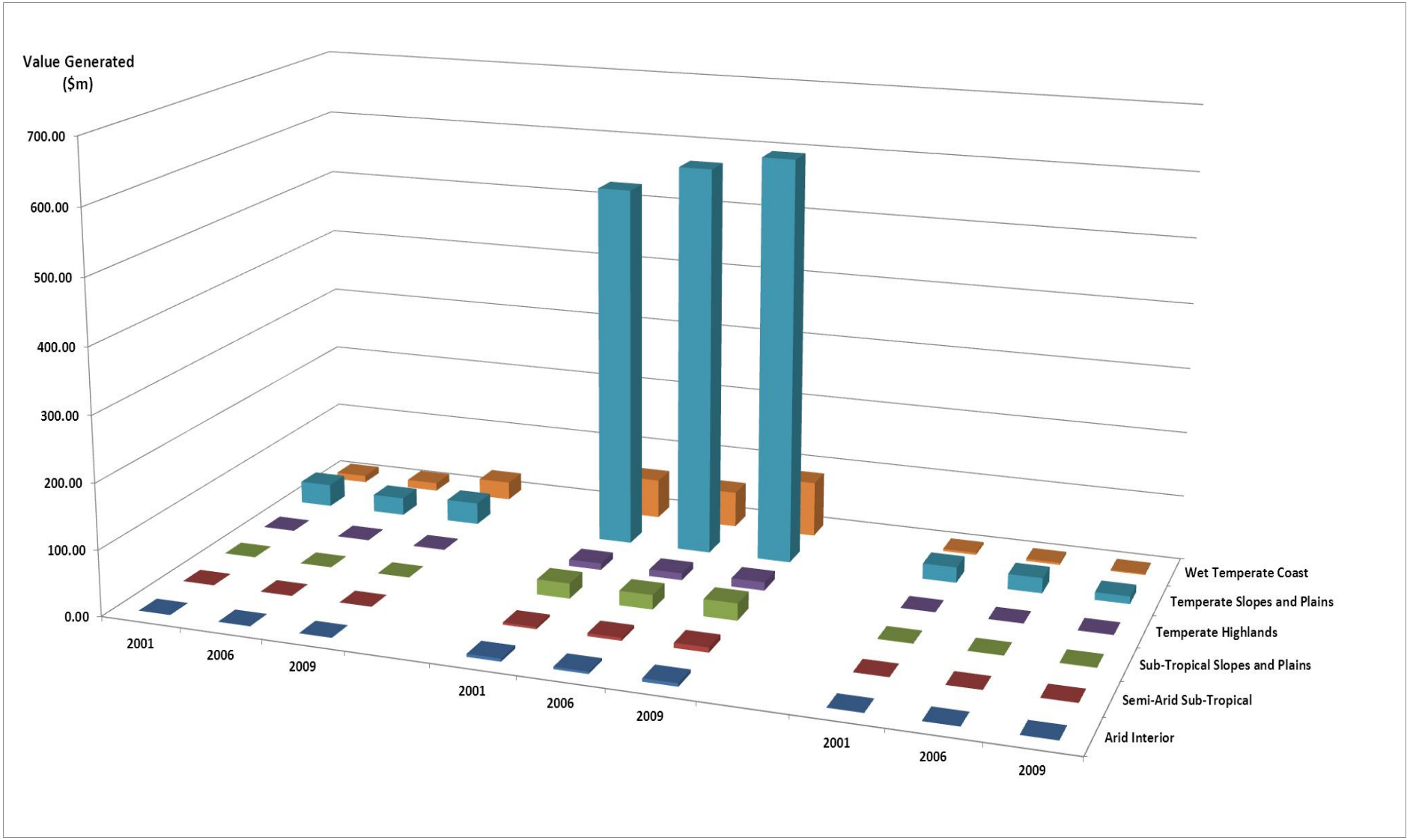
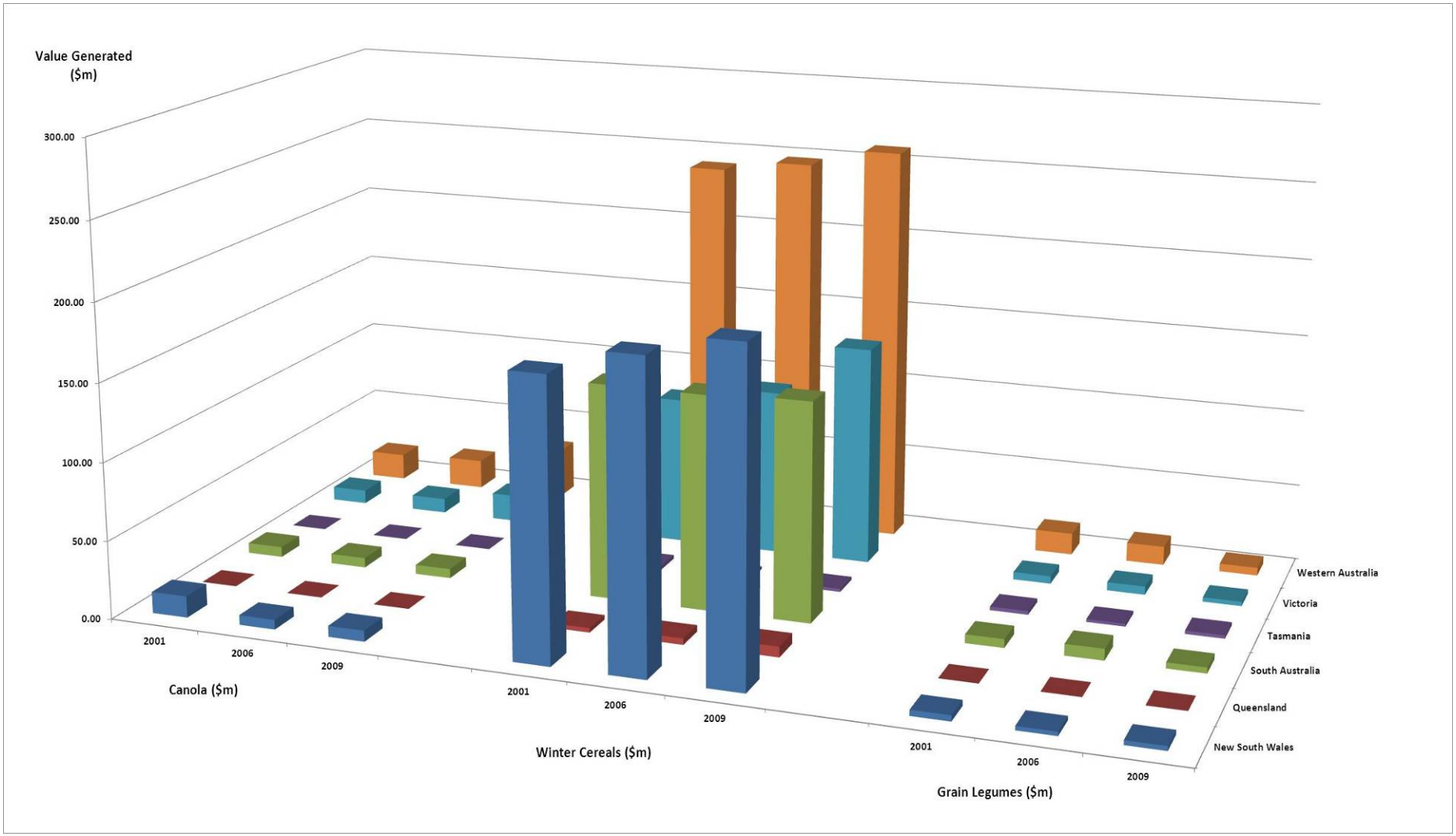


Chart Nineteen: Value Generated by Winter Crops of Interest Type by State. (2001, 2006, 2009)



7.0 Pasture and Livestock Outlook 2010 - 2015

Prospects for the beef, sheep and grains industries within the regions and states of interest have been remarkably transformed due to the improved climatic conditions experienced since the end of 2009. Heavy falls of rain across the south eastern region of Australia have dramatically improved soil moisture and pasture conditions as well as water storage levels. Resulting in improved irrigation water allocations in the short to mid-term for crop and pasture production along the Murray Darling irrigation system.

7.1 Beef Cattle Herds

Over the medium term, the Australian cattle herd is expected to increase gradually as result of the continued favorable climatic conditions. The cattle herd is project by ABARE to increase by almost 3 % between 2010 and 2015, reaching around 28 million head by the end of 2014 – 2015. ABARE predict that much of the increase in the cattle herd is expected to occur in northern Australia due to significant reduction in breeding stock which occurred during the drought period of 2003 – 2009, when compared to the marginal reduction in breeding stock which occurred in south eastern and Western Australia during the same period.

Since the commencement of the drought in 2002-2003 in south eastern Australia the female share in total beef slaughtered increased only slightly increased when compared to northern Australia. This suggests that livestock producers in this region were more willing to purchase fodder and hold onto the majority of the breeding herd in order to come out of the drought in a strong position to maintain or expand on production relative to pre-drought levels.

The first signs of this trend occurred in late 2009 following significant rains throughout the majority of Australia (except WA) which generated pasture growth that allowed livestock producers to reduce the number of beef cattle and sheep being sold for slaughter. For example in October and November of 2009, slaughter of beef cattle was 12% lower compared with the same period in both 2008 and 2009.

Reflecting the move by livestock producers to start re-building their beef cattle herds, the female share of cattle slaughtered in the first eight months of 2009 – 2010 declined to just under 47%, compared with almost 50% in 2008-2009.

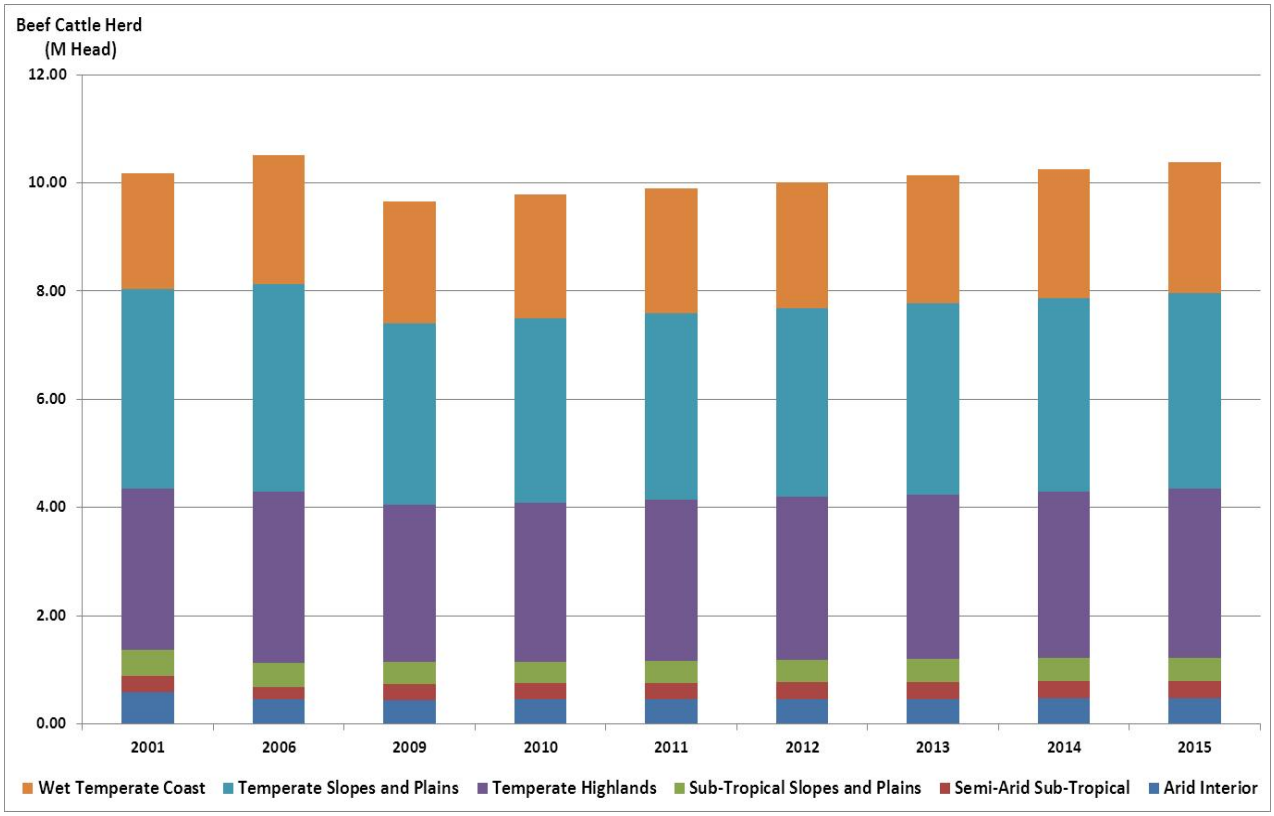
Based on the projections of ABARE for an increase of beef cattle numbers of on average 3.0% and considering that in 2009 the beef cattle herd within the regions of interest represents 38.83% of the national herd it is estimated that between 2010 and 2105 the cattle herd within these regions has the potential to increase cumulatively by approximately 717,000 cattle.

Table Six and Chart Twenty present the projected increase in cattle numbers within the regions of interest where the allocation of the projected increase in cattle herd numbers has been proportionally allocated across all regions.

Table Six: Projected Beef Cattle Herd Increase per year within Regions of Interest. (2010 – 2015)

Year	Arid Interior	Semi-Arid Sub-Tropical	Sub-Tropical Slopes and Plains	Temperate Highlands	Temperate Slopes and Plains	Wet Temperate Coast	Total (Head)
2010	5292	3556	4827	34888	40352	27038	115953
2011	5355	3598	4885	35306	40837	27363	117344
2012	5420	3641	4944	35730	41327	27691	118752
2013	5485	3685	5003	36159	41822	28023	120177
2014	5551	3729	5063	36593	42324	28360	121619
2015	5617	3774	5124	37032	42832	28700	123079
Total	**32720**	**21984**	**29845**	**215708**	**249494**	**167174**	**716924**

Chart Twenty: Projected Beef Cattle Herd within Regions of Interest. (2010 – 2015)



7.2 Sheep and Lamb Flocks

In recent years, the Australian sheep industry has increasingly shifted its focus to meat production as the national sheep flock continues to decline. Production of sheep meat, particularly lamb has been maintained as a result of strong demand. In the period 2010 to 2015 sheep producers are forecast to continue to focus on meat production, as sheep meat returns are expected to remain favorable when compared to wool.

Over the medium term, a projected gradual recovery in wool prices combined with favorable sheep meat prices is expected to lead to a gradual rebuilding of the sheep flock toward 2015.

The shift away from sheep enterprises into alternatives such as cropping is expected to slow over the outlook period. Unfavourable cropping seasons in some regions of Australia over recent years could encourage some mixed livestock-cropping producers to shift their enterprise mix toward sheep. The sheep industry is expected to remain focused on meat production. Producers are therefore expected to increase their breeding stock, with little expansion in non-breeding adult sheep (wethers) numbers until the latter part of the outlook period. Total sheep numbers are projected to begin to increase from 2011-12, despite projected relatively high turn-off of lambs in response to favourable prices.

Adult sheep slaughter is forecast to fall to 10 million head in 2009-10, and by a further 13 per cent in 2010-11 to 8.8 million head. In the medium term, sheep slaughter is projected to gradually increase from 2011-12 to around 9.6 million head by 2014-15 as the sheep flock expands.

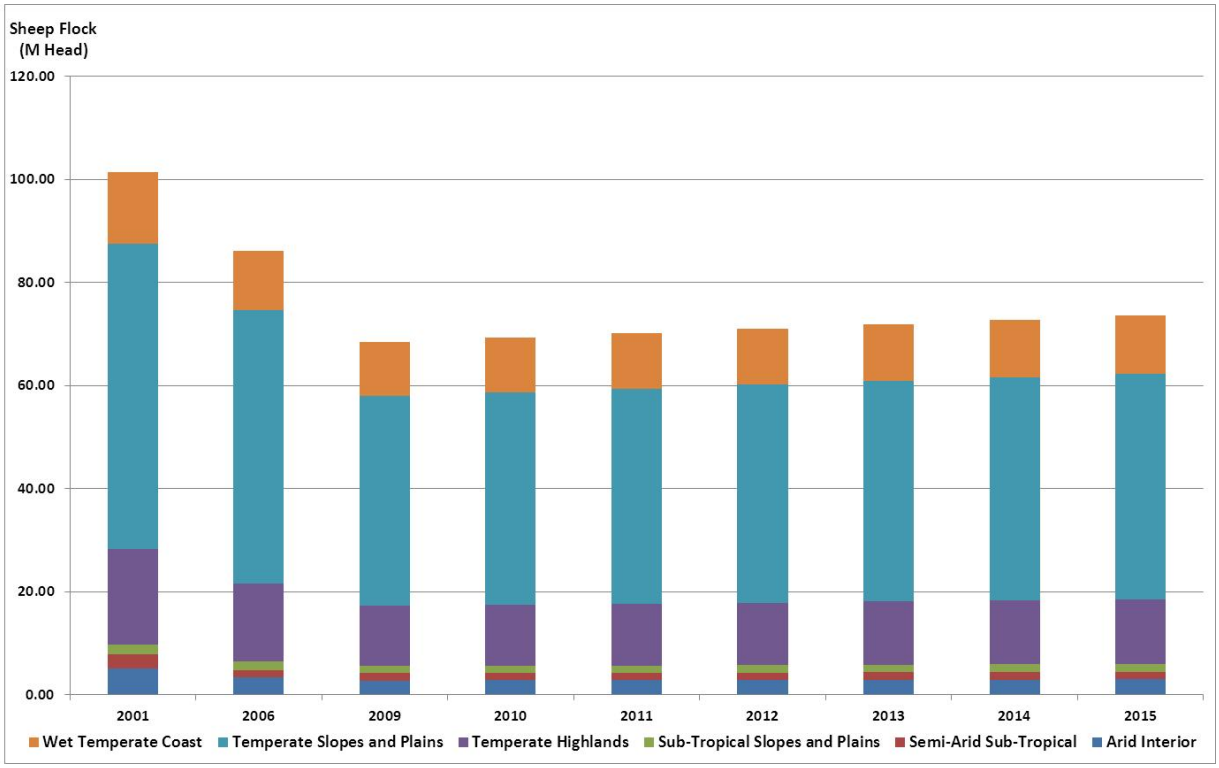
Based on the projections of ABARE for an moderate increase in the size of the national sheep flock and considering that in 2009 the sheep flock herd within the regions of interest represented 94 % of the national flock it is estimated that between 2010 and 2105 the sheep flock within these regions has the potential to increase cumulatively by approximately 5.081 million head.

Table Seven and Chart Twenty One present the projected increase in cattle numbers within the regions of interest where the allocation of the projected increase in cattle herd numbers has been proportionally allocated across all regions.

Table Seven: Projected Sheep Flock Increase per year within Regions of Interest. (2010 – 2015)

Year	Arid Interior	Semi-Arid Sub-Tropical	Sub-Tropical Slopes and Plains	Temperate Highlands	Temperate Slopes and Plains	Wet Temperate Coast	Total (Head)
2010	33085	16830	16574	140189	489860	125275	821812
2011	33482	17032	16773	141871	495738	126778	831674
2012	33884	17236	16974	143573	501687	128299	841654
2013	34291	17443	17178	145296	507707	129839	851754
2014	34702	17652	17384	147040	513800	131397	861975
2015	35119	17864	17593	148804	519965	132974	872319
Total	**204563**	**104058**	**102477**	**866773**	**3028757**	**774561**	**5081189**

Chart Twenty One: Projected Sheep Flock within Regions of Interest. (2010 – 2015)



7.3 Pasture Feed Base

Over the five years to 2015, the area sown to grains and oilseeds is projected to average around 23.5 million hectares, compared with an average of 22.5 million hectares over the 10 years to 2009.

Since the 1990's, there has been an increase in the area of pastures converted to cropping, especially in the Temperate Slopes and Plains and Wet Temperate Coast regions. It is projected that over the next 2 – 3 years competition for land use within these regions between livestock and winter crop production is expected to increase because prices for beef cattle and sheep are projected to remain high as livestock producers restrict market supply as they rebuild their beef cattle herds and sheep flocks and re-establish pastures.
At the same time it is expected that livestock producers having gained experience in cropping practices, especially in the Wet Coastal Temperate region will look to shorten the length of permanent pasture phases prior to the introduction of a cropping phase. As a result of this forecast trend the contribution of pastures to the value of winter crops is expected to decline due to the expected decline in crop area.

Based on the projected growth in the number of beef cattle and sheep within the regions of interest and considering the nutritional requirements of each livestock enterprise it is estimated that across all regions of interest and between 2010 and 2015 an incremental 20.832 million DSE will need to be added to the current feedbase in order to meet the incremental nutritional requirements of the incremental beef cattle and sheep. Of the total projected incremental nutritional requirement the beef cattle herd will require and incremental 9.849m DSE and the sheep flock will require 10.983 m DSE over the projected five year period.

The Tables Eight, Nine and Ten and Chart Twenty Two present the breakdown by region of interest of the incremental demand for DSE per year to meet the nutritional demands for the extra beef cattle and sheep entering the livestock production system.

Table Eight: Projected Incremental Feedbase Requirement (DSE) to meet the incremental nutritional requirements (DSE) within each region of interest. (2010 – 2015)

Year	Arid Interior	Semi-Arid Sub-Tropical	Sub-Tropical Slopes and Plains	Temperate Highlands	Temperate Slopes and Plains	Wet Temperate Coast	Total Incremental K DSE/Year
2010	119.09	69.22	81.42	943.56	1383.24	772.83	**3369.36**
2011	120.52	70.05	82.40	954.89	1399.84	782.11	**3409.80**
2012	121.97	70.89	83.38	966.34	1416.64	791.49	**3450.71**
2013	123.43	71.74	84.38	977.94	1433.64	800.99	**3492.12**
2014	124.91	72.60	85.40	989.68	1450.84	810.60	**3534.03**
2015	126.41	73.47	86.42	1001.55	1468.25	820.33	**3576.44**
Total	**736.32**	**427.95**	**503.40**	**5833.96**	**8552.46**	**4778.37**	**20832.46**

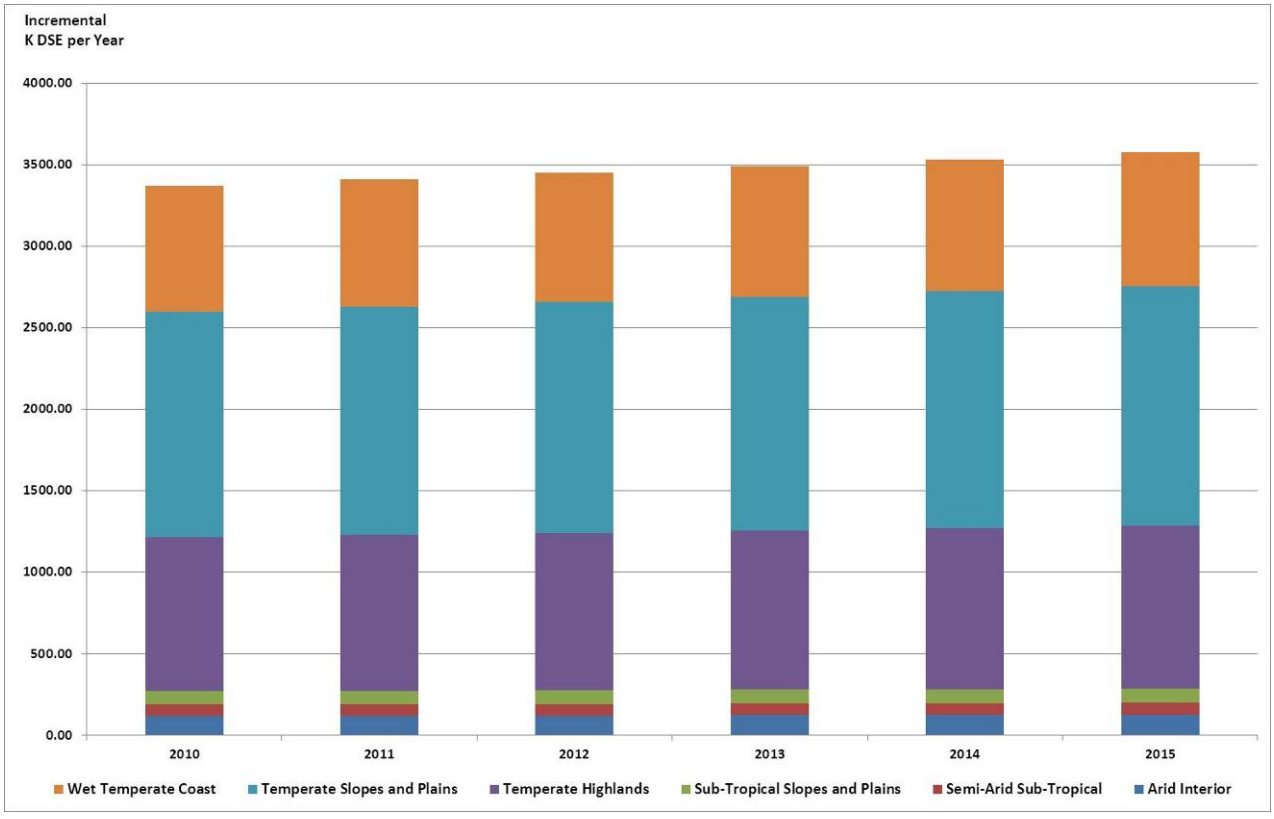
Table Nine: Projected Incremental Feedbase Requirement (DSE) to meet the incremental nutritional requirements (DSE) for the incremental Beef herd within each region of interest. (2010 – 2015)

Year	Arid Interior	Semi-Arid Sub-Tropical	Sub-Tropical Slopes and Plains	Temperate Highlands	Temperate Slopes and Plains	Wet Temperate Coast	Total Incremental K DSE/Year
2010	52.92	35.56	48.27	593.09	403.52	459.65	**1593.01**
2011	53.55	35.98	48.85	600.21	408.37	465.16	**1612.12**
2012	54.20	36.41	49.44	607.41	413.27	470.75	**1631.47**
2013	54.85	36.85	50.03	614.70	418.22	476.40	**1651.05**
2014	55.51	37.29	50.63	622.08	423.24	482.11	**1670.86**
2015	56.17	37.74	51.24	629.54	428.32	487.90	**1690.91**
Total	**327.20**	**219.84**	**298.45**	**3667.03**	**2494.94**	**2841.96**	**9849.42**

Table Ten: Projected Incremental Feedbase Requirement (DSE) to meet the incremental nutritional requirements (DSE) for the incremental Sheep Flock within each region of interest. (2010 – 2015)

Year	Arid Interior	Semi-Arid Sub-Tropical	Sub-Tropical Slopes and Plains	Temperate Highlands	Temperate Slopes and Plains	Wet Temperate Coast	Total Incremental K DSE/Year
2010	66.17	33.66	33.15	350.47	979.72	313.19	**1776.36**
2011	66.96	34.06	33.55	354.68	991.48	316.94	**1797.67**
2012	67.77	34.47	33.95	358.93	1003.37	320.75	**1819.24**
2013	68.58	34.89	34.36	363.24	1015.41	324.60	**1841.08**
2014	69.40	35.30	34.77	367.60	1027.60	328.49	**1863.17**
2015	70.24	35.73	35.19	372.01	1039.93	332.43	**1885.53**
Total	**409.13**	**208.12**	**204.95**	**2166.93**	**6057.51**	**1936.40**	**10983.05**

Chart Twenty Two: Projected Incremental Feedbase Requirement (DSE) to meet the incremental nutritional requirements (DSE) within each region of interest. (2010 – 2015)



The incremental feedbase (DSE) to meet the nutritional requirements of the extra beef cattle and sheep may be generated by an increase in the adoption of farmers of one or more of the following as part of their feedbase strategy:

- the planting of perennial and annual pastures as a replacement for cropping paddocks as they are taken out of rotation;

- the replacement of native and or self-sown pastures with the planting of higher energy producing perennial and annual pastures;
- the use of short rotation high energy pastures;
- the planting of fodder crops for grazing and/or fodder conservation; and
- the application of fertilizers to native and self-sown pastures;

As a result of the forecast trend to replace current crops with pastures within key livestock producing regions of interest, in the near term the contribution of pastures to the value of winter crops is expected to decline due to the projected decline in cropping area.

However in the mid to long term this is expected to be countered by the expected trend of livestock producers having gained experience in cropping practices, especially in the Wet Coastal Temperate region will look to shorten the length of the permanent pasture prior to the introduction of a cropping phase. Hence, rebuilding the value that pastures contribute to Australian cropping systems.

References:

ABARE 2010, Australian Beef: Financial performance of beef cattle producing farms, 2007-08 to 2008-09, 10.1, June. Canberra

ABARE 2010, Australian lamb: Financial performance of slaughter lamb producing farms, 2007-08 to 2008-09, 10.1, Canberra

ABARE 2010, Australian Commodities. Vol. 17. Nos. 1. March Quarter 2010

National Beef Production R, D & E Strategy, January 2010. Primary Industries Standing Committee – R & D Sub-Committee.

National Sheepmeat Production R, D & E Strategy, January 2010. Primary Industries Standing Committee – R & D Sub-Committee.

Australia – Livestock and Products Annual, 2010. USDA GAIN Report No: AS 1032. August 2010.

The Changing Value of Pastures to the Australian Economy 2001 – 2015. Pastures Australia Report. March 2009.

Investment in Pasture Improvement - A Market Analysis and Workshop Report. Pastures Australia. March 2006.

Appendix 2 Soil fertility and fertiliser use

Soil fertility is a major driver of red meat production through its influence of pasture productivity. The results of the Grassland's Productivity Program (GPP) and the Triple P Program (PPP) identified that significant lifts in productivity and profitability of broad acre grazing systems could be achieved through the correction of nutrient deficiencies and the efficient utilisation of the extra feed produced (Table 1).

Table 1. Stocking rate increases achieved in the Grassland's Productivity Program conducted in Southern NSW, Victoria, Tasmania and South East South Australia.

Enterprise		Number sites	Average increase in stocking rate (DSE/ha)	Increase (%)
Cattle	Dry	3	7	23
	Autumn Calving	6	6	32
	Spring Calving	4	8	57
Meat Sheep	Autumn Lambing	23	5	33
	Spring Lambing	16	6	39
Wool	Dry	15	4	40
	Autumn Lambing	9	2	25
	Spring Lambing	50	6	39
Mixed Enterprises		4	6	30
All Sites			5	37

The results from the GPP were mirrored in the results of the PPP which was conducted throughout the medium and high rainfall regions of NSW between 2000 and 2006.
For participants who completed the program, there was an average:

- 34% increase in stocking rate,
- 30% increase in gross margin,
- 23% reduction in the net cost of production of wool and
- 128% return on the investment in fertilizer and extra stock

Nutrient deficiencies are widespread throughout the medium to high rainfall regions. The most recent assessment of soil nutrient status was reported in the National Land and Water Resources Audit (2001). Significant areas used for red meat production have restrictive soil phosphorus (P) levels (Fig. 1). Soils with Values of less than 30 mg/kg (Colwell) are likely to be responsive.

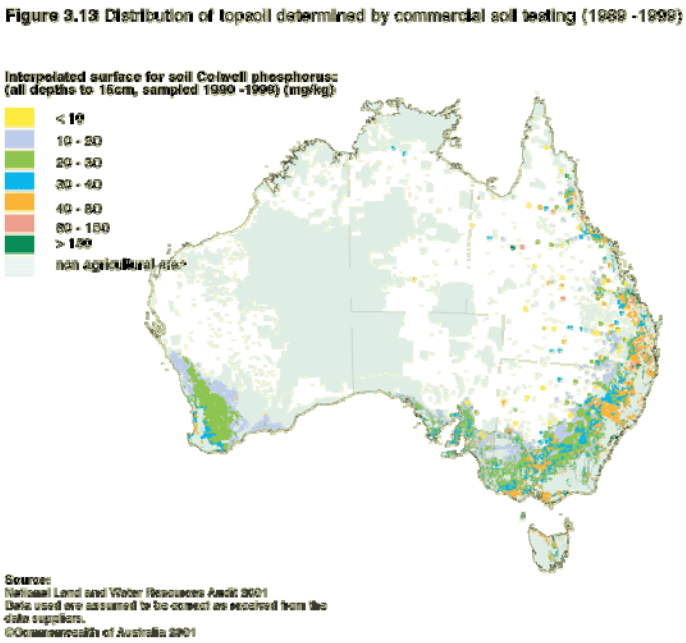


Figure 1: Distribution of topsoil Colwell phosphorus levels.

Similarly, the same review identified considerable areas of potassium deficiency in the medium and high rainfall areas of southern Australia (Fig. 2).

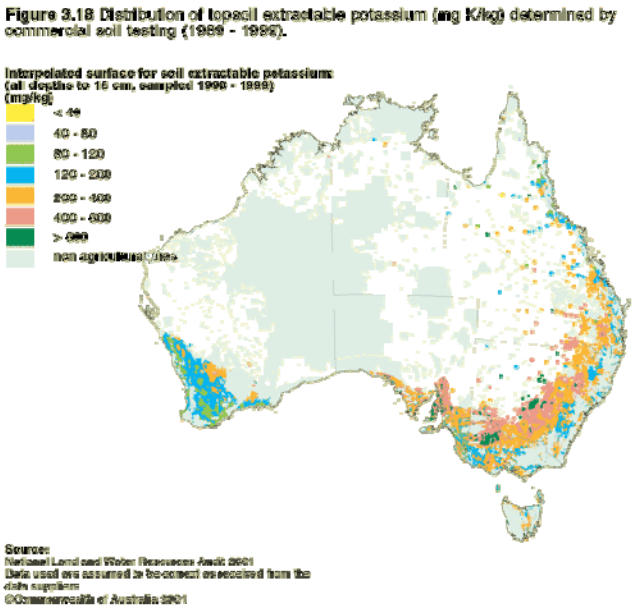


Figure 2: Distribution of topsoil extractable potassium levels.

The soil nutritional levels identified in the 2001 report and the level of responsiveness of pastures identified in the GPP and PPP programs need to be considered in relation to the trends on fertilizer application of both potassium and phosphorus. Barnett (2007) estimated fertilizer consumption on pastures by dividing the average enterprise expenditure on fertilizer in each year by the average price of the main fertilizer types in each year for the period 1990 - 2000 and 2001 – 2005 (Table 2).

Table 2: Estimated fertilizer use by enterprise for the period 1990- 2005

Enterprise and Variable	1990-2000 (average)	2001-2005 (average)	Change (%)
Specialist Beef			
Average Area Cropped	54	42	-22.2%
Average Fertilizer Usage	17	18	+5.9%
Mixed Beef			
Average Area Cropped	377	616	+79.3%
Average Fertilizer Usage	54.3	71.9	+32.4%
Specialist Sheep			
Average Area Cropped	132	187	+41.6%
Average Fertilizer Usage	30.8	29.7	-3.6
Mixed Sheep			
Average Area Cropped	401	494	+23.2
Average Fertilizer Usage	61	83.1	+36.2
Prime Lamb			
Average Area Cropped	415	531	+28%
Average Fertilizer Usage	62.6	64.3	+2.7%

Barnett (2007) concluded that the significant increases in fertilizer consumption in the cases of mixed beef and mixed sheep enterprises have coincided with significant increases in the area cropped and were likely to have been the result of expanding cropping enterprises rather than fertilizer applied to pastures. However, there has been a significant decrease in the average area cropped by beef specialist enterprises, accompanied by an increase in fertilizer expenditure suggesting that there may have been a trend toward increasing application of fertilizer to pastures by beef specialist enterprises.

Data from Western Australia (CSBP pers. comm.) (Fig. 3) indicate the trend in use of single superphosphate for the period up until 2000 in that state. Single superphosphate sales since 2000 have been around 150,000 t/annum, although they are heavily influenced by fertilizer price. For example, when prices were high, in autumn 2009, superphosphate sales plummeted. As most graziers are likely to have a set fertilizer budget then a doubling of fertilizer prices would cause a halving of application rates. Another factor related to the decline in superphosphate sales may be the increased use of cropping fertilizers (i.e. higher analysis) on pastures.

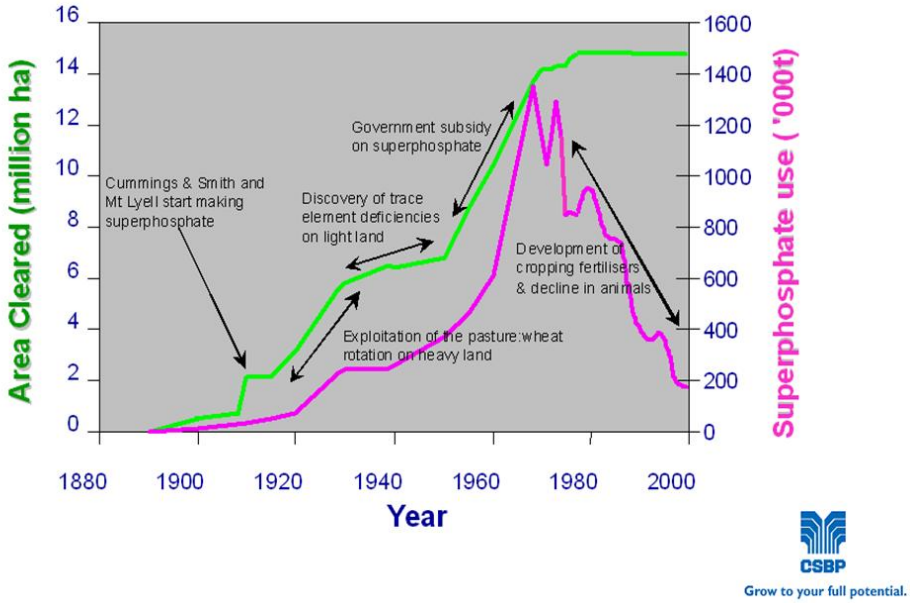


Figure 3: Historical trends in superphosphate use in Western Australia.

The more recent trends in the amounts of phosphorus applied to all pastures in the eastern States between 1994/1995 and 2009/2010 shows a steady decline from 140,000 tonnes of elemental phosphorus in 1994/95 to about 70,000 tonnes in 2009/10. As with the Western Australian experience, there was a marked drop in application of pasture fertilizer associated with the large price rise in 2007/08 (IPL pers. comm.) (Fig. 4).

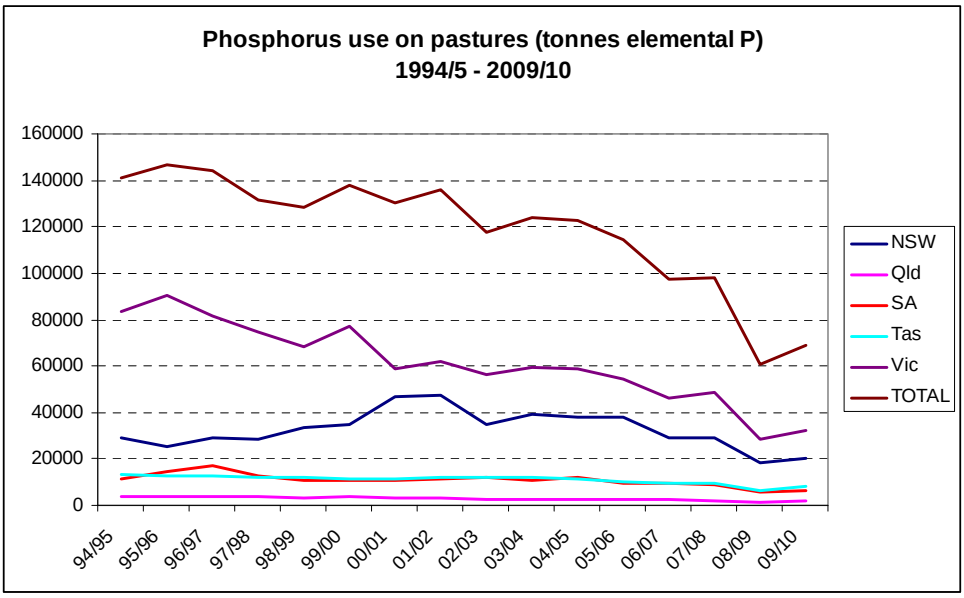


Figure 4: Declining phosphorus use on pastures 1994/5 to 2009/10 in the eastern states of Australia.

Potassium is a current, and increasing, nutrient deficiency in the higher rainfall regions. Potassium sales in the eastern States were maintained reasonably well until the doubling of the price of potassium in 2007/08 (Fig. 5). The data do not allow for the differentiation between the application

to dairy pastures and other broad-acre grazing and it is likely that a significant proportion of the potassium was applied to dairy pastures. However, as indicated earlier in this section, potassium deficiency is widespread in many areas and it is likely that most farms, or areas of most farms, are in negative potassium balance and that the incidence of potassium deficiency is likely to increase.

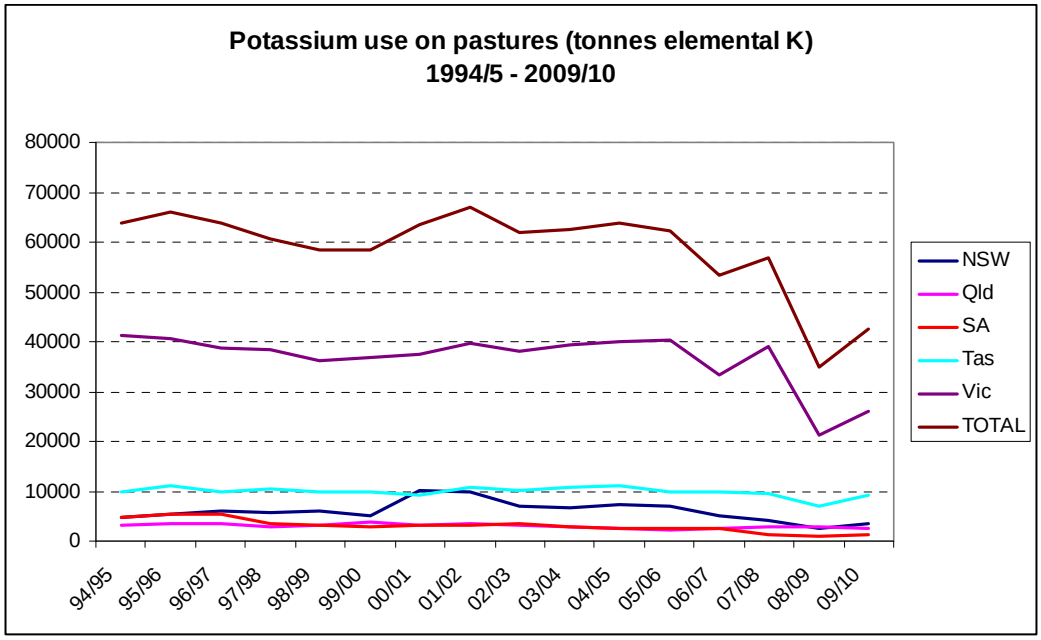


Figure 5: Potassium use on pastures 1994/5 to 2009/10 in the eastern states of Australia.

No data exist for the application frequency of significant trace elements such as molybdenum. It is highly likely that in the acid soil region, molybdenum deficiency is common. As an example, an extensive set of pasture test strips established between 1975 and 1985 in the Upper Murray area of Victoria showed that 60% of pastures were deficient in molybdenum (J Shovelton pers. comm.) It is unlikely that this situation has changed.

The data clearly show that potential exists to significantly increase red meat production through the correction of soil nutritional deficiencies and that inputs of fertilizer to pasture soils have declined dramatically. It is likely therefore, that levels of nutrient deficiencies have increased in recent years and that the potential to increase red meat production through the application of fertilizer has increased.

Appendix 3 Pasture renovation

There is no formalised collation and collection of pasture seed sales for southern Australia. Three sources of information are used in this section. Firstly, data were collected by the Rural Industries Research and Development Corporation (RIRDC) for the 2003 growing season. Secondly data were collected by Gout and Jones (2006) for the 2005/06 growing season and thirdly, data were collated by MLA (H Robinson Pers. Comm.) for the 2009/2010 season. It is not clear if standardised methodology was used but the data do provide broad guidelines about trends in pasture renovation.

Estimates of temperate seed sales for each of the three data sets are provided (Table 1). For the purpose of this study the seed sales have been averaged to provide an average annual seed sale quantity. The annual estimated renovation rate has been calculated from the total pasture area identified in the 2003 ABS census data for the Temperate Slopes and Plains, Wet Temperate Coast and Temperate Highlands agro-ecological regions and from assumed sowing rates of the various species.

Table 1: Seed sales of major temperate pasture species and estimated pasture renovation rates.

	Seed sold (t)			Average seed sales (t)	Sowing rate (kg/ha)	Estimated area sown since 2003 (ha/year)	Pasture sowing rate (%/year)
	2003	**2005**	**2009**				
Sub clover	2,300	1,700	1,902	1,967	1,935	327,889	0.55%
White clover	800	600	684	695	689	326,902	0.54%
Perennial Ryegrass	6,200	2,400	3,528	4,043	3,785	404,267	0.67%
Phalaris		180	156	112	134	44,800	0.07%
Cocksfoot		210	222	144	183	48,000	0.08%
Lucerne	2,500	2,100	2,838	2,479	2,659	550,963	0.92%
Tall fescue	450	650	846	649	747	76,314	0.13%

The clear indication is that there is a very low rate of pasture renewal. The percentage pasture sowing rate values are not likely to be additive. Phalaris, cocksfoot and ryegrass are likely to be sown with a legume so the estimate of total area sown is probably better reflected by the addition of the resowing rates for the legumes. Annual medics were not included in the latest study. Even if these are included the resowing rate is unlikely to exceed 2.5% of pastures each year. The data obviously do not account for failed sowings or the resowing of pastures that have failed to persist.

Hill and Donald (1996) identified the potential areas of adaptation of a range of species and cultivars which underpin the Australian pasture base. The broad areas of adaptability are therefore known. The impact of climate variability (increased temperatures, variable rainfall) may alter the suitability of current species in their current range.

Appendix 4: Feedbase Priority Survey

Meat and Livestock Australia have engaged a team led by Mike Stephens and Associates and AIMS Agriculture to consult with industry to develop priorities for investment in the feedbase for red meat production in southern Australia. The area covered by this project is shown in the following map. The feedbase covers all pasture species (introduced and native) as well as fodder crops and shrubs. This survey forms part of the consultation process and its completion is an important way of influencing future feedbase investment by MLA. Your views are important and we would appreciate you taking time to complete the questionnaire.

*** 1. Please indicate which of the following categories to which you belong. (Multiple answers possible)**

- ☐ Producer
- ☐ Retail Sales and Advice
- ☐ State Department Researcher
- ☐ Private Consultant
- ☐ Plant Breeder
- ☐ University Researcher
- ☐ Government Extension Officer
- ☐ CSIRO Scientist
- ☐ Input Supplier Company (Agricultural chemical, fertilizer, etc. supplier.)
- ☐ Other (please specify)

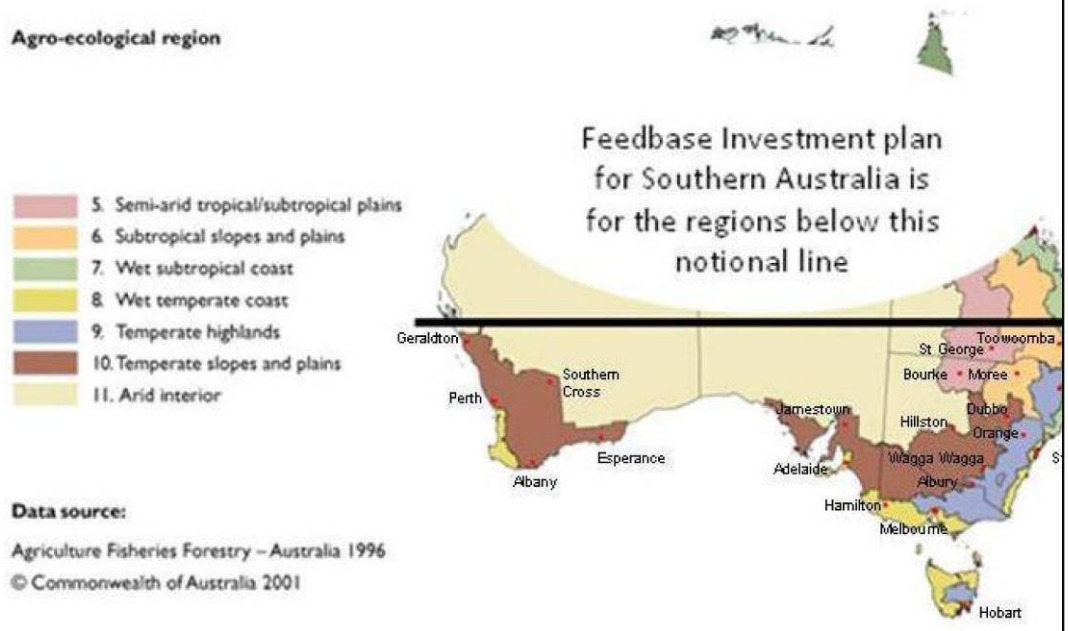
*** 2. In which State(s) do you operate? (Multiple answers possible)**

- ☐ South Australia
- ☐ Queensland
- ☐ Victoria
- ☐ New South Wales
- ☐ Tasmania
- ☐ Western Australia

3. Referring to the map below, in which agro-ecological zone(s) do you operate? (Wet subtropical coast not included in survey)

- ☐ Arid Interior
- ☐ Temperate Slopes and Plains
- ☐ Temperate Highlands
- ☐ Wet Temperate Coast
- ☐ Sub Tropical Slopes and Plains
- ☐ Semi Arid Sub Tropical Plains

Australian agro-ecological zones



4. What farming enterprises do you operate, provide services to, develop information for or undertake research for? (Multiple answers possible)

- ☐ Beef
- ☐ Meat sheep
- ☐ Wool Sheep
- ☐ Dual Purpose Sheep
- ☐ Cropping
- ☐ Goats
- ☐ Dairy

Please help us to understand which feedbase components are most limiting the profitability and production of red meat production systems and what needs to be done to overcome these limitations.

5. From your perspective, prioritise the following on-farm actions related to the feedbase, that could be undertaken to increase red meat production?

	Not a priority	Low priority	Moderate priority	High priority	Essential
Improved soil fertility	◯	◯	◯	◯	◯
Increased sown perennial grass content	◯	◯	◯	◯	◯
Increased use of grazing cereals, canola, etc.	◯	◯	◯	◯	◯
Increased legume content of pastures	◯	◯	◯	◯	◯
Correct soil pH	◯	◯	◯	◯	◯
Improved control of insect pests	◯	◯	◯	◯	◯
Improved grazing management	◯	◯	◯	◯	◯
Increased use of fodder crops	◯	◯	◯	◯	◯
Increased native perennial grass content	◯	◯	◯	◯	◯
Better management of pasture utilization	◯	◯	◯	◯	◯
Increased subdivisional fencing	◯	◯	◯	◯	◯
Improved control of weeds	◯	◯	◯	◯	◯
Increased use of short term pastures	◯	◯	◯	◯	◯
Better integration of crops with pastures	◯	◯	◯	◯	◯

Please provide comments here.

*** 6. From your perspective what is preventing the livestock industry from undertaking actions that will increase red meat production?**

	No impediment	Some impediment	Moderate impediment	Significant impediment	Major impediment
Lack of information	◯	◯	◯	◯	◯
Don't have the appropriate farm business skills	◯	◯	◯	◯	◯
Don't have the right technical skills	◯	◯	◯	◯	◯
Concerns about environmental effects from increased productivity	◯	◯	◯	◯	◯
Don't believe returns will cover costs	◯	◯	◯	◯	◯
Availability of labour to manage increased livestock numbers	◯	◯	◯	◯	◯
Lack of confidence in the local applicability of information	◯	◯	◯	◯	◯
Cash flow considerations	◯	◯	◯	◯	◯
Seasonal variability	◯	◯	◯	◯	◯
Infrastructure to manage increased livestock numbers	◯	◯	◯	◯	◯
Don't have access to contractors	◯	◯	◯	◯	◯
Risk of failure	◯	◯	◯	◯	◯

Please provide comments here.

7. There are three broad areas of the feedbase that MLA can invest in:

a. Research

b. Validating and packaging research for use by producers and other users (Examples of validating and packaging research data would be the field testing of new cultivars or the compilation of fertilizer trial data into a decision support tool), and

c. Extension and advice.

Please rate the importance of these three areas for investment in the feedbase.

	Not a priority	Low priority	Moderate priority	High priority	Essential
Investment in research	◯	◯	◯	◯	◯
Investment in validating and packaging	◯	◯	◯	◯	◯
Investment in extension and advice	◯	◯	◯	◯	◯

8. In which components of the feedbase would you like to see MLA invest in research to increase red meat production?
(Skip this question if you indicated research is not a priority)

	Not a priority	Low priority	Moderate priority	High priority	Essential
Improvement of fodder crops	◯	◯	◯	◯	◯
Improvement of legumes	◯	◯	◯	◯	◯
Improvement of annual / biennial grasses	◯	◯	◯	◯	◯
Soil biology	◯	◯	◯	◯	◯
Insect pest control	◯	◯	◯	◯	◯
Pasture establishment techniques	◯	◯	◯	◯	◯
New species	◯	◯	◯	◯	◯
Weed control	◯	◯	◯	◯	◯
Improvement of introduced perennial grasses	◯	◯	◯	◯	◯
Improvement of native species	◯	◯	◯	◯	◯
Soil fertility	◯	◯	◯	◯	◯
Grazing management	◯	◯	◯	◯	◯
Pasture utilization	◯	◯	◯	◯	◯
Farming systems	◯	◯	◯	◯	◯
Decision support systems	◯	◯	◯	◯	◯

Please provide comments here.

9. From your perspective, prioritise the following traits of importance to plant improvement programs that will support increases in red meat production

	Not a priority	Low priority	Moderate priority	High priority	Essential
Low risk of establishment failure	◯	◯	◯	◯	◯
Better grazing tolerance of dual purpose crops	◯	◯	◯	◯	◯
Tolerance of insect pests	◯	◯	◯	◯	◯
Tolerance of plant diseases	◯	◯	◯	◯	◯
Contain compounds with benefits for stock health	◯	◯	◯	◯	◯
Herbage quality	◯	◯	◯	◯	◯
Extended growing season	◯	◯	◯	◯	◯
Persistence under grazing	◯	◯	◯	◯	◯
Acid tolerance	◯	◯	◯	◯	◯
Increased total herbage production	◯	◯	◯	◯	◯
Out of season production	◯	◯	◯	◯	◯
Salt tolerance	◯	◯	◯	◯	◯
Low requirement for applied nutrients	◯	◯	◯	◯	◯
Contain compounds with benefits for human health	◯	◯	◯	◯	◯

Please provide comments here.

10. Which research outputs need validating and packaging for end users. (Skip this question if you indicated validating and packaging is not a priority)

	Not a priority	Low priority	Moderate priority	High priority	Essential
Pasture utilization	◯	◯	◯	◯	◯
Improvement of native species	◯	◯	◯	◯	◯
Weed contol	◯	◯	◯	◯	◯
Soil fertility	◯	◯	◯	◯	◯
Establishment techniques	◯	◯	◯	◯	◯
Grazing management	◯	◯	◯	◯	◯
Decision support systems	◯	◯	◯	◯	◯
Insect pest control	◯	◯	◯	◯	◯
Improvement of introduced species	◯	◯	◯	◯	◯
New species	◯	◯	◯	◯	◯
Independent regional evaluation of cultivars	◯	◯	◯	◯	◯
Farming systems	◯	◯	◯	◯	◯

Please provide comments here.

11. Which extension, training and advice areas would you like to see MLA investment directed to increase red meat production? (Skip this question if you indicated extension and advice is not a priority)

	Not a priority	Low priority	Moderate priority	High priority	Essential
Commercial opportunities for delivery of services	◯	◯	◯	◯	◯
Training opportunities for service providers	◯	◯	◯	◯	◯
Webinars	◯	◯	◯	◯	◯
Web forums	◯	◯	◯	◯	◯
Conferences	◯	◯	◯	◯	◯
Training opportunities for producers	◯	◯	◯	◯	◯
Email alerts	◯	◯	◯	◯	◯
More trained advisors	◯	◯	◯	◯	◯
More group activities with other farmers	◯	◯	◯	◯	◯
Access to a local farm demonstrating adoption of priority actions to increase red meat production	◯	◯	◯	◯	◯
Publications	◯	◯	◯	◯	◯
Web sites	◯	◯	◯	◯	◯
Field days	◯	◯	◯	◯	◯
Decision support tools	◯	◯	◯	◯	◯

Please provide comments here.

12. Should the following scenarios eventuate by 2020, what do you believe will be their impact on the feedbase for red meat production?

	Nil	Minor	Major
Higher energy costs	◯	◯	◯
Increased demands for 'clean and green' products	◯	◯	◯
Increased fertilizer costs	◯	◯	◯
Increased input costs	◯	◯	◯
Increased pests	◯	◯	◯
Increased rainfall variability	◯	◯	◯
Increased temperatures	◯	◯	◯
Increased weed pressure	◯	◯	◯
Lower quality feedbase	◯	◯	◯
Reduced annual rainfall	◯	◯	◯
Restriction of farming practices	◯	◯	◯
Restriction of GM technologies	◯	◯	◯

Please provide comments here.

13. Thank you for taking time to fill out this questionnaire. If you would like to make a more detailed comment, please enter in the box below.

Appendix 5: Producer - Advisor Survey

This is the data collection format for the detailed consultations with end users and next users

* 1. Contact details

Name:

Company:

City/Town:

Email Address:

Phone Number:

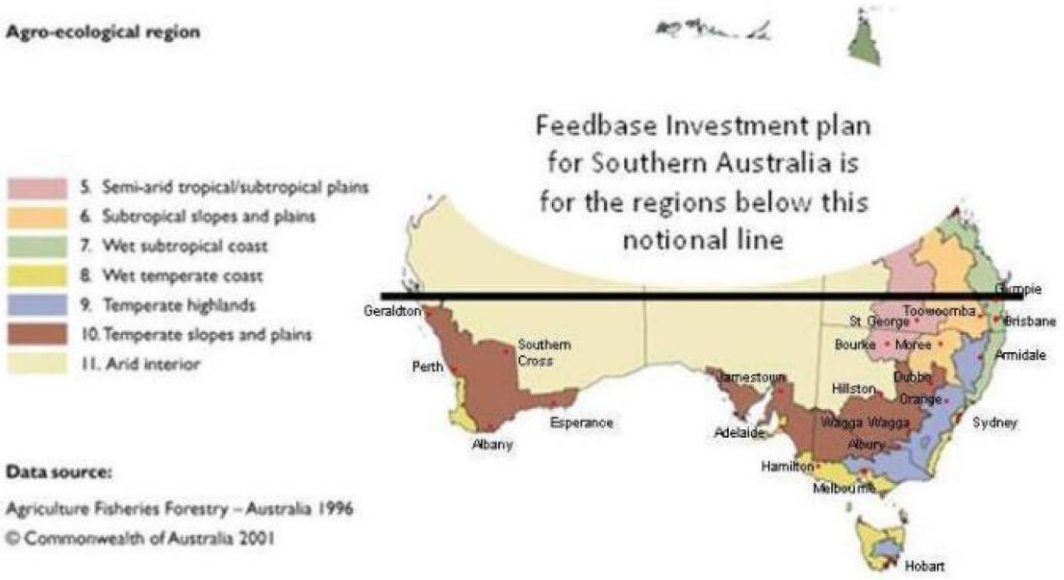
* 2. Please indicate which of the following categories to which you belong. (Multiple answers possible)

- ☐ Producer
- ☐ Retail Sales and Advice
- ☐ State Department Researcher
- ☐ Private Consultant
- ☐ Plant Breeder
- ☐ University Researcher
- ☐ Government Extension Officer
- ☐ CSIRO Scientist
- ☐ Input Supplier Company (Agricultural chemical, fertilizer, etc. supplier.)
- ☐ Other (please specify)

* 3. In which state and agro-ecological region do you operate? Map of agro-ecological regions provided below. Multiple responses possible.

	Semi-arid tropical plains	Subtropical slopes and plains	Wet temperate coast	Temperate highlands	Temperate slopes and plains	Arid interior
Queensland	☐	☐	☐	☐	☐	☐
New South Wales	☐	☐	☐	☐	☐	☐
Victoria	☐	☐	☐	☐	☐	☐
South Australia	☐	☐	☐	☐	☐	☐
Tasmania	☐	☐	☐	☐	☐	☐
Western Australia	☐	☐	☐	☐	☐	☐

Australian agro-ecological zones



4. What farming enterprises do you operate or provide with services? (Multiple answers possible)

- [ ] Beef
- [ ] Meat sheep
- [ ] Wool Sheep
- [ ] Dual Purpose Sheep
- [ ] Cropping
- [ ] Goats
- [ ] Dairy

5. What are the three most important feedbase opportunites for increasing redmeat production, for the majority of producers, that could be addressed with current information/technologies?

1
2
3

6. If the feedbase technologies identified in the top three priorities were successful and adopted by livestock producers what do you think would be the likely change in red meat profitability and sustainability in the regions for which the research was relevant?

	Profitability	Sustainability
Priority 1		
Priority 2		
Priority 3		

Provide comments here

7. What is needed to get greater adoption of current information/technologies to address the first opportunity identified in the previous question.

	Limited impact	Moderate impact	Major impact
More financial information on the costs, benefits and risks of new practices	☐	☐	☐
More work on integrating new information and practices into the farming system	☐	☐	☐
Local demonstration of results	☐	☐	☐
Peer support	☐	☐	☐
Decision support tools	☐	☐	☐
Field days	☐	☐	☐
Press releases	☐	☐	☐
One to one advice-DPI	☐	☐	☐
One to one advice-consultants	☐	☐	☐
One to one advice-retail	☐	☐	☐
Brochures	☐	☐	☐
Web based information	☐	☐	☐

Other comments

8. What is needed to get greater adoption of current information/technologies to address the second opportunity identified in the previous question.

	Limited impact	Moderate impact	Major impact
More financial information on the costs, benefits and risks of new practices	☐	☐	☐
More work on integrating new information and practices into the farming system	☐	☐	☐
Local demonstration of results	☐	☐	☐
Peer support	☐	☐	☐
Decision support tools	☐	☐	☐
Field days	☐	☐	☐
Press releases	☐	☐	☐
One to one advice-DPI	☐	☐	☐
One to one advice-consultants	☐	☐	☐
One to one advice-retail	☐	☐	☐
Brochures	☐	☐	☐
Web based information	☐	☐	☐

Other comments

9. What is needed to get greater adoption of current information/technologies to address the third opportunity identified in the previous question.

	Limited impact	Moderate impact	Major impact
More financial information on the costs, benefits and risks of new practices	☐	☐	☐
More work on integrating new information and practices into the farming system	☐	☐	☐
Local demonstration of results	☐	☐	☐
Peer support	☐	☐	☐
Decision support tools	☐	☐	☐
Field days	☐	☐	☐
Press releases	☐	☐	☐
One to one advice-DPI	☐	☐	☐
One to one advice-consultants	☐	☐	☐
One to one advice-retail	☐	☐	☐
Brochures	☐	☐	☐
Web based information	☐	☐	☐

Other comments

10. What feedbase research is required to increase red meat production in the future?

Priority 1

Priority 2

Priority 3

11. Other comments

12. What level of interaction do you have with the following feedbase supply chain organisations/groups?

	No interaction	Low level	Moderate level	High level
Producers	☐	☐	☐	☐
Producer groups	☐	☐	☐	☐
MLA	☐	☐	☐	☐
Industry organisations	☐	☐	☐	☐
Private consultants	☐	☐	☐	☐
Public sector extension staff	☐	☐	☐	☐
State department researchers	☐	☐	☐	☐
Universities	☐	☐	☐	☐
Retail sector	☐	☐	☐	☐
Private plant breeders	☐	☐	☐	☐
Input suppliers (fertilizer, chemical companies, etc.)	☐	☐	☐	☐
CSIRO	☐	☐	☐	☐

Provide comments here

13. What are the three actions that could be undertaken to improve collaboration within the feedbase supply chain?

Action 1

Action 2

Action 3

14. Enter further comments below

Appendix 6: Researcher Survey

This survey is the data collection format for research programs.

*** 1. Enter name, organisation/company and state**

Name:

Company:

State/Province:

Email Address:

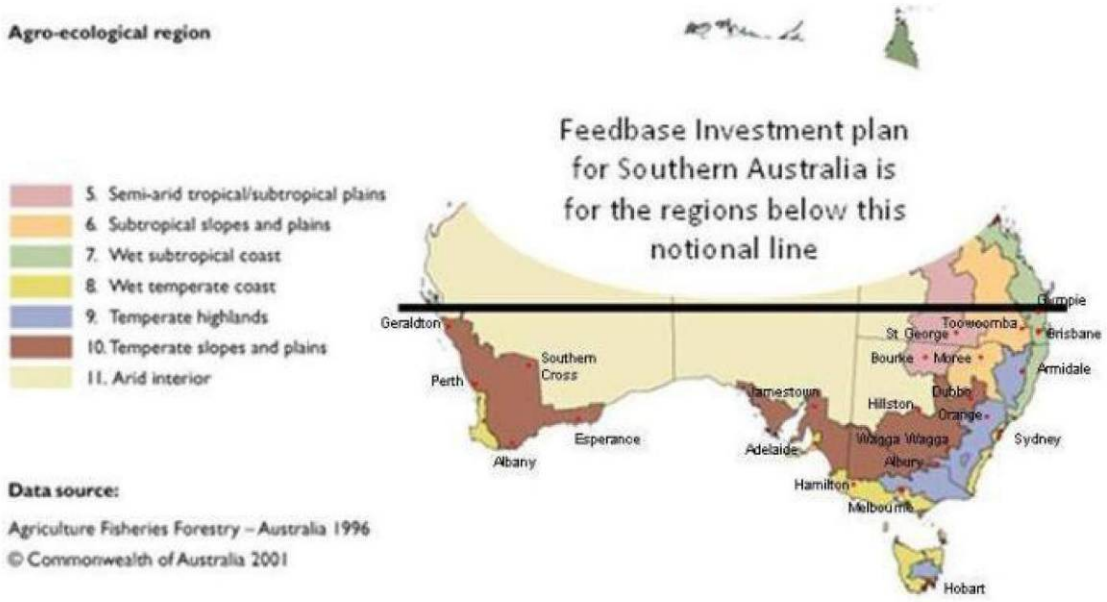
Phone Number:

*** 2. For which agro-ecological regions in each state is your research relevant? Map of agro-ecological regions provided below. (Multiple responses possible)**

	Semi-arid tropical plains	Subtropical slopes and plains	Wet temperate coast	Temperate highlands	Temperate slopes and plains	Arid interior	N/A
Western Australia	☐	☐	☐	☐	☐	☐	☐
South Australia	☐	☐	☐	☐	☐	☐	☐
Tasmania	☐	☐	☐	☐	☐	☐	☐
Victoria	☐	☐	☐	☐	☐	☐	☐
New South Wales	☐	☐	☐	☐	☐	☐	☐
Queensland	☐	☐	☐	☐	☐	☐	☐

Provide comments here.

Agro-ecological regions



3. What are your top three research priorities for feedbase investment to increase red meat production?

Priority 1

Priority 2

Priority 3

4. For your first priority research area, describe the likely outputs

5. For your second priority research area, describe the likely outputs

6. For your third priority research area, describe the likely outputs

10. What level of investment would be required for successful completion of your listed research priorities?

	Level of investment ($AUD)
Priority 1	
Priority 2	
Priority 3	

Provide comments here

11. What expertise would be required to successfully complete the research activities listed in your priorities?

	Currently available in your organisation	Currently available in Australia but not in your organisation	Not currently available in Australia
Conventional breeding	☐	☐	☐
System modelling	☐	☐	☐
Molecular genetics	☐	☐	☐
Merit testing	☐	☐	☐
Species selection and introduction	☐	☐	☐
Weed ecology	☐	☐	☐
Weed management	☐	☐	☐
Pasture pathogens (fungi, bacteria, nematodes, viruses)	☐	☐	☐
Rhizobia	☐	☐	☐
Pasture pest ecology and management	☐	☐	☐
Plant nutrition/soil fertility	☐	☐	☐
Dual purpose crops	☐	☐	☐
Soil biology	☐	☐	☐
Feed quality	☐	☐	☐
Grazing management	☐	☐	☐
Farm systems	☐	☐	☐

Provide comments here

12. What level of interaction do you have with the following feedbase supply chain organisations/groups?

	No interaction	Low level	Moderate level	High level
Producers	◯	◯	◯	◯
Producer groups	◯	◯	◯	◯
MLA	◯	◯	◯	◯
Industry organisations	◯	◯	◯	◯
Private consultants	◯	◯	◯	◯
Public sector extension staff	◯	◯	◯	◯
State department researchers	◯	◯	◯	◯
Universities	◯	◯	◯	◯
Retail sector	◯	◯	◯	◯
Private plant breeders	◯	◯	◯	◯
Input suppliers (fertilizer, chemical companies, etc.)	◯	◯	◯	◯
CSIRO	◯	◯	◯	◯

Provide comments here

13. What are the three actions that could be undertaken to improve collaboration within the feedbase supply chain?

Action 1

Action 2

Action 3

14. Further comments

Appendix 7: RD&E Provider Survey

Meat and Livestock Australia have engaged a team led by Mike Stephens and Associates and AIMS Agriculture to consult with industry to develop priorities for investment in the feedbase for red meat production in southern Australia. The area covered by this project is shown in the map later in this survey. The feedbase covers all pasture species (introduced and native) as well as fodder crops and shrubs. This survey forms part of the consultation process with providers of research, development, extension and feedbase inputs and it will complement an earlier survey we launched seeking to identify feedbse priorities. Completion of this questionaire is an important way of influencing future feedbase investment by MLA. Your views are important and we would appreciate you taking time to complete the questionnaire.

*** 1. Please indicate to which of the following categories your organisation/business belongs. (Multiple answers possible)**

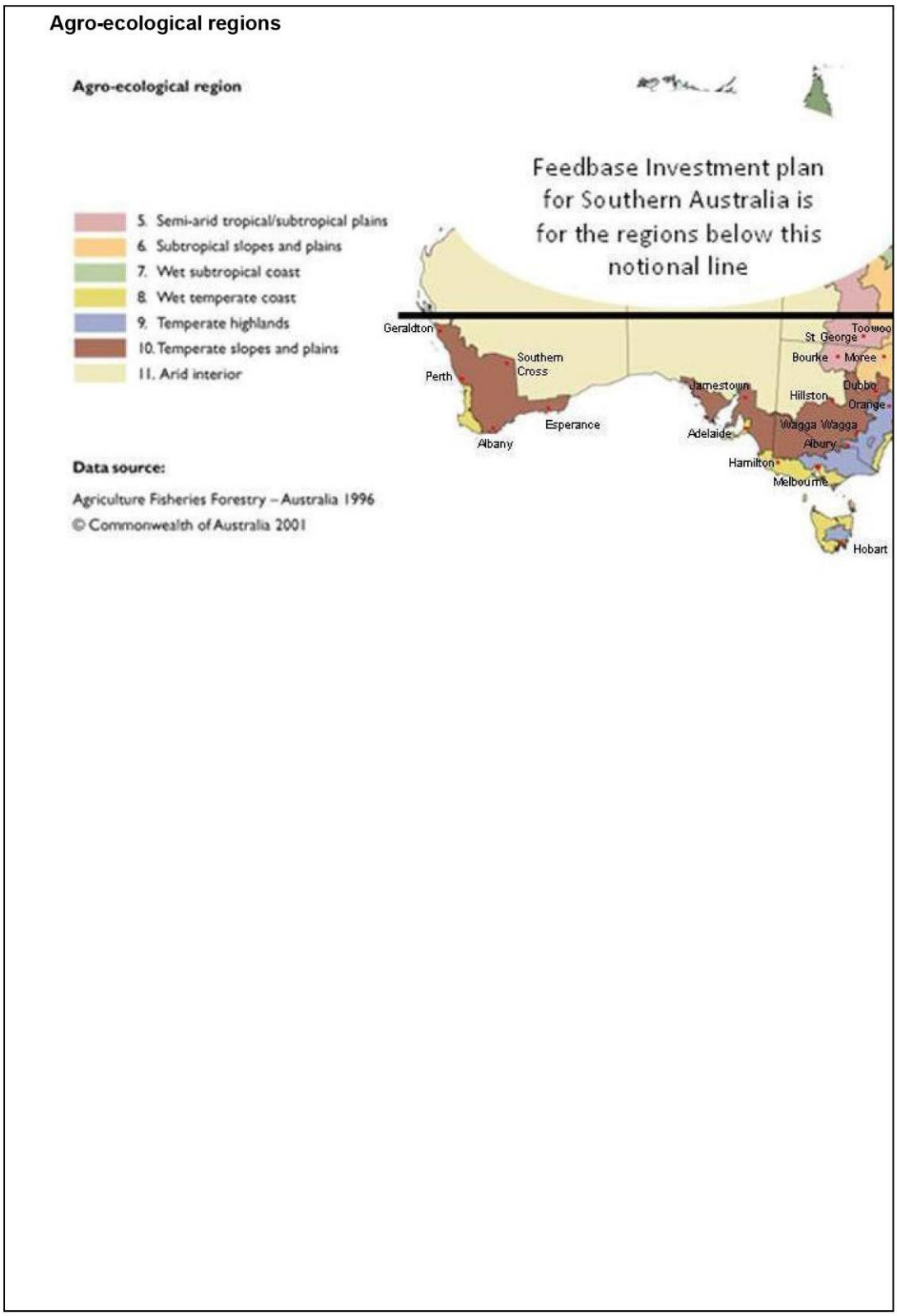
- ☐ Cooperative Research Centre
- ☐ Retail Sales and Advice
- ☐ State Department
- ☐ Private Research
- ☐ Input Supplier (e.g. fertiliser, seed supply, chemicals, etc)
- ☐ CSIRO
- ☐ University

Other (please specify)

*** 2. RESEARCH: Indicate the agro-ecological regions within each state for which your organisation conducts research. A map of the agro-ecological regions is provided below. (Multiple responses possible)**

	Semi-arid tropical plains	Subtropical slopes and plains	Wet temperate coast	Temperate highlands	Temperate slopes and plains	Arid interior	N/A
Western Australia	☐	☐	☐	☐	☐	☐	☐
South Australia	☐	☐	☐	☐	☐	☐	☐
Tasmania	☐	☐	☐	☐	☐	☐	☐
Victoria	☐	☐	☐	☐	☐	☐	☐
New South Wales	☐	☐	☐	☐	☐	☐	☐
Queensland	☐	☐	☐	☐	☐	☐	☐

Provide comments here.


Agro-ecological regions
Agro-ecological region
5. Semi-arid tropical/subtropical plains
6. Subtropical slopes and plains
7. Wet subtropical coast
8. Wet temperate coast
9. Temperate highlands
10. Temperate slopes and plains
11. Arid interior
Feedbase Investment plan for Southern Australia is for the regions below this notional line
Geraldton
Perth
Southern Cross
Esperance
Albany
Jamestown
Adelaide
Hillston
Bourke
St George
Toowoo
Moree
Dubbo
Orange
Wagga Wagga
Albury
Hamilton
Melbourne
Hobart
Data source:
Agriculture Fisheries Forestry – Australia 1996
© Commonwealth of Australia 2001

3. RESEARCH: What are the current areas of feedbase research undertaken by your organisation for the various agro-ecological regions? (Skip question if your organisation does not undertake research)

	Semi-arid tropical plains	Subtropical slopes and plains	Wet temperate coast	Temperate highlands	Temperate slopes and plains	Arid interior
Legume improvement	☐	☐	☐	☐	☐	☐
Grass improvement	☐	☐	☐	☐	☐	☐
Dual purpose crops	☐	☐	☐	☐	☐	☐
New species introduction	☐	☐	☐	☐	☐	☐
Weeds	☐	☐	☐	☐	☐	☐
Soil biology	☐	☐	☐	☐	☐	☐
Soil fertility	☐	☐	☐	☐	☐	☐
Soil acidity	☐	☐	☐	☐	☐	☐
Pasture establishment	☐	☐	☐	☐	☐	☐
Diseases	☐	☐	☐	☐	☐	☐
Pests	☐	☐	☐	☐	☐	☐
Grazing management	☐	☐	☐	☐	☐	☐
Decision support systems	☐	☐	☐	☐	☐	☐
Farm systems	☐	☐	☐	☐	☐	☐
Retail product development	☐	☐	☐	☐	☐	☐

Provide comments here.

*** 4. RESEARCH: How many staff (in units of full-time equivalents; FTE) are currently engaged in the following research areas?**

	Research Staff	Technical and Support Staff
Legume improvement		
Grass improvement		
Dual purpose crops		
New species introduction		
Weeds		
Soil biology		
Soil fertility		
Soil acidity		
Pasture establishment		
Diseases		
Pests		
Grazing management		
Decision support systems		
Farm systems		

Provide comments here.

*** 5. RESEARCH: Please enter the current budget ($AUD per annum) you have allocated to each feedbase component.**

Plant improvement legumes	
Plant improvement grasses/forages	
Establishment	
Weeds	
Feedbase management	
Grazing system	
Soil and water management	
Total budget	
N/A	

6. RESEARCH: What current feedbase research expertise exists within your organisation?

	Currently involved in feedbase research	Currently involved in other research areas
Conventional breeding	☐	☐
System modelling	☐	☐
Molecular genetics	☐	☐
Merit testing	☐	☐
Species selection and introduction	☐	☐
Weed ecology	☐	☐
Weed management	☐	☐
Pasture pathogens (fungi, bacteria, nematodes, viruses)	☐	☐
Rhizobia	☐	☐
Pasture pest ecology and management	☐	☐
Plant nutrition/soil fertility	☐	☐
Dual purpose crops	☐	☐
Soil biology	☐	☐
Feed quality	☐	☐
Grazing management	☐	☐
Farm systems	☐	☐

Provide comments here.

*** 7. RESEARCH: Over the next ten years, what are the likely changes in your organisation's research investment in the feedbase activities listed below?**

	Decrease	No change	Increase	Don't know	N/A
Legume improvement	◯	◯	◯	◯	◯
Grass improvement	◯	◯	◯	◯	◯
Dual purpose crops	◯	◯	◯	◯	◯
New species introduction	◯	◯	◯	◯	◯
Weeds	◯	◯	◯	◯	◯
Soil biology	◯	◯	◯	◯	◯
Soil fertility	◯	◯	◯	◯	◯
Soil acidity	◯	◯	◯	◯	◯
Pasture establishment	◯	◯	◯	◯	◯
Diseases	◯	◯	◯	◯	◯
Pests	◯	◯	◯	◯	◯
Grazing management	◯	◯	◯	◯	◯
Decision support systems	◯	◯	◯	◯	◯
Farm systems	◯	◯	◯	◯	◯
Input product development	◯	◯	◯	◯	◯

Provide comments here.

8. Please enter the top three research priorites for feedbase investment to increase the profitability and/or sustainability of red meat production over the next ten years.

Priority 1

Priority 2

Priority 3

*** 9. If the research identified in the top three priorities was successful and fully adopted by livestock producers, what do you think would be the likely change in red meat profitability and sustainability in the areas for which the research was relevant? (Options provided in the drop down menus)**

	Profitability	Sustainability
Priority 1		
Priority 2		
Priority 3		

Provide comments here.

*** 10. ADVICE & EXTENSION: Indicate the agro-ecological regions within each state in which your organisation provides extension/consultancy/advice services. A map of agro-ecological regions is shown above. (Multiple responses possible)**

	Semi-arid tropical plains	Subtropical slopes and plains	Wet temperate coast	Temperate highlands	Temperate slopes and plains	Arid interior	N/A
Western Australia	☐	☐	☐	☐	☐	☐	☐
South Australia	☐	☐	☐	☐	☐	☐	☐
Tasmania	☐	☐	☐	☐	☐	☐	☐
Victoria	☐	☐	☐	☐	☐	☐	☐
New South Wales	☐	☐	☐	☐	☐	☐	☐
Queensland	☐	☐	☐	☐	☐	☐	☐

Provide comments here.

11. ADVICE and EXTENSION: What feedbase advice is provided by your organisation in the various agro-ecological regions? (Skip question if your organisation is not involved in providing Advice or Extension). If "Whole farm management" is selected, no other responses are required.

	Semi-arid tropical plains	Subtropical slopes and plains	Wet temperate coast	Temperate highlands	Temperate slopes and plains	Arid interior
Whole farm management	☐	☐	☐	☐	☐	☐
Pasture establishment	☐	☐	☐	☐	☐	☐
Weed management	☐	☐	☐	☐	☐	☐
Soil fertility management	☐	☐	☐	☐	☐	☐
Soil acidity	☐	☐	☐	☐	☐	☐
Diseases management	☐	☐	☐	☐	☐	☐
Farm financial management	☐	☐	☐	☐	☐	☐
Pest management	☐	☐	☐	☐	☐	☐
Grazing management	☐	☐	☐	☐	☐	☐

Provide comments here.

*** 12. ADVICE & EXTENSION:**

Please enter the number of staff (full-time equivalents) providing advice on feedbase issues?	

13. ADVICE & EXTENSION: Is it likely that your activities in the feedbase components will change over the next 10 years?

	Decrease	No change	Increase	Don't know	N/A
Whole farm management	◯	◯	◯	◯	◯
Pasture establishment	◯	◯	◯	◯	◯
Weed management	◯	◯	◯	◯	◯
Soil fertility management	◯	◯	◯	◯	◯
Soil acidity	◯	◯	◯	◯	◯
Diseases management	◯	◯	◯	◯	◯
Farm financial management	◯	◯	◯	◯	◯
Pest management	◯	◯	◯	◯	◯
Grazing management	◯	◯	◯	◯	◯

Provide comments here.

14. Please enter the top three advice and extension priorities for feedbase investment to increase the profitability and/or sustainability of red meat production over the next ten years.

Priority 1

Priority 2

Priority 3

* **15. If your advice/product was fully adopted by livestock producers, by what extent would you expect red meat profitability and sustainability to increase in the areas for which the advice/product was relevant? (Options provided in the drop down menus)**

	Profitability	Sustainability
Priority 1		
Priority 2		
Priority 3		

Provide comments here.

16. Thank you for taking the time to fill out this questionaire. If you would like to make a more detailed comment, please enter in the box below.

Appendix 8. Organisations and individuals consulted for the Producer – Advisor, Researcher and RD&E Provider surveys

Name	Sector	Company	State
Peter Johnston	Admin	DEEDI	QLD
Simon Maddocks	Admin	SARDI	SA
Robin Thompson	Admin	DPIWE	TAS
Andrew Rice	Consultant	Ivey	NSW
Graeme Hand	Consultant	STIPA	NSW
Judi Earl	Consultant	Agricultural Information & Monitoring Services	NSW
Mark Gardner	Consultant	Vanguard Business services	NSW
Mick Duncan	Consultant	Northern Agriculture	NSW
Robert Freebairn	Consultant	RD&S Freebairn	NSW
Robert Patterson	Consultant	Patterson Lott	NSW
Sandy McEachern	Consultant	HAS	NSW
David Lloyd	Consultant		QLD
Matt Ahern	Consultant		QLD
Alan Mayfield	Consultant	Alan Mayfield and Associates	SA
Bill Long	Consultant	AgConsulting	SA
Gerald Martin	Consultant	Agresults	SA
Ian Evans	Consultant		SA
Ken Solley	Consultant		SA
Mick Falkner	Consultant		SA
Peter Cousins	Consultant	Cousy Consulting	SA
San Jolley	Consultant		SA
Andrew Spiers	Consultant	MS&A	VIC
Ben Jones	Consultant	Mallee Focus	VIC
Cam Nicholson	Consultant	Nicon P/L	VIC
Danny Conlan	Consultant	Dodgshun Medlin	VIC
David Hudson	Consultant	SGA Solutions	VIC
Geoff Saul	Consultant	PSA Consulting Services	VIC
Graham Lean	Consultant	G Lean & Associates	VIC
Jason Trompf	Consultant	JT Agri - Source	VIC
John Webbware	Consultant	Mckinnon Project	VIC
Kent Wooding	Consultant	Agrivision	VIC
Kevin Smith	Consultant	Abacusbio	VIC
Lisa Warn	Consultant	Mckinnon Project	VIC
Nathan Scott	Consultant	MS&A	VIC
P O'Sullivan	Consultant		VIC
Stuart Kemp	Consultant		VIC
Tim Ekberg	Consultant	Farming Answers	VIC
Alan Peggs	Consultant		WA
Ashley Herbert	Consultant		WA
Bob Hall	Consultant	RJ Hall & Co	WA
Eric Nankivell	Consultant		WA
Rory Coffey	Consultant		WA
Doug Alcock	Extension	I&I NSW	NSW
Jeff Lowien	Extension	I&I NSW	NSW

Luke Pope	Extension	I&I NSW	NSW
Phil Graham	Extension	I&I NSW	NSW
David Lawrence	Extension	DEEDI	QLD
Gavin Peck	Extension	DEEDI	QLD
Barry Mudge	Extension	Rural Solutions	SA
Charlton Jeisman	Extension	Rural Solutions	SA
Linden Masters	Extension	Rural Solutions	SA
Michael Wurst	Extension	Rural Solutions	SA
Tim Prance	Extension	Rural Solutions	SA
Kate Sargeant	Extension	Vic DPI	VIC
Roger Sneath	Extension	DEEDI	QLD
David Schuppan	Extension	Rural Solutions	SA
Benalla Bestwool/Bestlamb Maldon	Farm Group		VIC
Bestwool/Bestlamb	Farm Group		VIC
Jim Laycock	Input Supplier	Incitec Pivot Ltd	NSW
Mike Gout	Input Supplier	Seedforce	NSW
Cam Conboy	Input Supplier	Planttech	VIC
Lee Menhennet	Input Supplier	Incitec Pivot Ltd	VIC
Paul Bird	Input Supplier	Vicseeds	VIC
Neil Ballard	Input Supplier	Ballard Seeds	WA
Anthony Leddin	Plant Breeder	Valley Seeds	VIC
Donald Coles	Plant Breeder	Valley Seeds	VIC
Reg Hill	Plant breeder	PGG Wrightson	VIC
Grant Burbidge	Producer		NSW
Lucinda Corrigan	Producer		NSW
Charles Nason	Producer		QLD
Rick Hemming	Producer		QLD
Steve Thompson	Producer		QLD
Steve Wilkins	Producer		QLD
Stuart Taylor	Producer		QLD
Bentley Foulis	Producer		SA
Bruce Heddle	Producer		SA
Ed Hunt	Producer		SA
Jim Heaslip	Producer		SA
Millie Nicholls	Producer	Mid North Grasslands Working Group	SA
Paul Kaden	Producer		SA
Peter Kuhlmann	Producer		SA
Simon Ballinger	Producer		SA
Simon Geurin	Producer		SA
Adam Inchbold	Producer		VIC
Georgina Gubbins	Producer		VIC
John Ferrier	Producer		VIC
Mick Pole	Producer		VIC
Rob Christie	Producer		VIC
Russell Pattinson	Producer		VIC

Simon Brady	Producer		VIC
David Bredbrook	Producer		WA
Garren Knell	Producer		WA
Max Watts	Producer		WA
Andrew Moore	Researcher	CSIRO	ACT
Hugh Dove	Researcher	CSIRO	ACT
Mark Norton	Researcher	I&I NSW	ACT
Richard Culvenor	Researcher	CSIRO	ACT
Richard Simpson	Researcher	CSIRO	ACT
Sue McIntyre	Researcher	CSIRO	ACT
Brian Dear	Researcher	NSW I&I	NSW
Brian Sindel	Researcher	UNE	NSW
Carol Harris	Researcher	I&I NSW	NSW
Chris Guppy	Researcher	UNE	NSW
Clare Edwards	Researcher	I&I NSW	NSW
Clive Francis	Researcher	UWA	NSW
David Kemp	Researcher	CSU	NSW
Ted Wolfe	Researcher	EH Graham Centre (CSU/NSW I&I)	NSW
Graeme Sandral	Researcher	NSW I&I	NSW
Graham Donald	Researcher	CSIRO	NSW
Greg Lodge	Researcher	I&I NSW	NSW
Jim Virgona	Researcher	CSU	NSW
Malcom Mcphee	Researcher	I&I NSW	NSW
Mark Conyers	Researcher	I&I NSW	NSW
Michael Friend	Researcher	CSU	NSW
Ron Hacker	Researcher	I&I NSW	NSW
Sean Murphy	Researcher	I&I NSW	NSW
Sue Boschma	Researcher	I&I NSW	NSW
Brian Johnson	Researcher	DEEDI	QLD
Lindsay Bell	Researcher	CSIRO	QLD
Richard Silcock	Researcher	DEEDI	QLD
Stuart Buck	Researcher	DEEDI	QLD
Eyre Peninsula Research Foundation	Research/Producer group		SA
Jake Howie	Researcher	SARDI	SA
Jason Emms	Researcher	SARDI	SA
Mike McLaughlin	Researcher	CSIRO	SA
Nigel Wilhelm	Researcher	SARDI	SA
Rick Lewellyn	Researcher	CSIRO	SA
Ross Ballard	Researcher	SARDI	SA
Roy Latta	Researcher	SARDI	SA
Kerry Bridle	Researcher	TIAR/UTAS	TAS
Peter Lane	Researcher	University of Tasmania	TAS
Angela Avery	Researcher	VIC DPI	VIC
Anna Roberts	Researcher	VIC DPI	VIC
Kevin Reed	Researcher	RPS	VIC
Malcolm McCaskill	Researcher	DPI	VIC
Peter Sale	Researcher	La Trobe University	VIC

Rohan Davies	Researcher	Incitec Pivot Ltd	VIC
Dean Thomas	Researcher	CSIRO	WA
Hayley Norman	Researcher	CSIRO	WA
John Howieson	Researcher	Murdoch University	WA
M Robertson	Researcher	CSIRO	WA
Mark Sweetingham	Researcher	DAFWA	WA
Mike Ewing	Researcher	DAFWA	WA
Mark Evans	Retail	Ruralco	NSW
Rob Eccles	Retail	Purkiss Rural	NSW
Bruce Cairns	Retail	Landmark	VIC

RD&E Organisations Consulted

Charles Sturt University
La Trobe University
New England University
University of Adelaide
Curtin University of Technology
University Western Australia
Murdoch University
University of Queensland
University of Tasmania
CSIRO

Industry & Innovation NSW
DAFWA
SARDI
DEEDI Queensland
DPIWE Tasmania
DPI, Victoria

RIRDC
AWI

Purkiss Rural
Heritage Seeds
Valley Seeds
CSBP
IncitecPivot