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Prepared by: Peter R
Day Resource Strategies
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Mixed Farming Systems Program

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Mixed Farming Systems Program

(Grain & Graze II)

BUSINESS PLAN

December, 2009.

CARING FOR OUR COUNTRY

About this document.

This document presents a business plan for the Mixed Farming Systems (Grain & Graze II) program. It is for the benefit of all partners, but includes special attention to meat and livestock issues to inform investment decisions from that sector.

Prepared by: Peter R Day Resource Strategies
For: Grains Research & Development Corporation

Peter R Day Resource Strategies Pty Ltd

29A Yalanda St,
Eden Hills, SA 5050
www.resourcestrats.com.au

Business Plan Team:

- Peter R Day (Peter R Day Resource Strategies)
- Peter Chudleigh and Sarah Simpson (Agtrans Research)

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Mixed Farming Systems
(Grain & Graze II)
Business Plan

INDEX

Executive Summary 1
  About the Mixed Farming Systems Program 1
  Overview of the Program 4
Background 8
  Target Audiences 8
  Industry issues and trends 12
  On-farm issues 18
Research priorities 23
  Mixed farming research needs 23
  Alignment with other RD&E programs 26
  Conclusions 30
Program outline 31
  Business strategy 31
  Implementation 34
Business case 35
  Benefit:cost analysis 35
  Value proposition 37
References 40
Appendices 41
  Appendix 1. Indicators 41
  Appendix 2. Sub-Programs 42
  Appendix 3. Cost:Benefit Analysis 43

Mixed Farming Systems: BUSINESS PLAN

Executive Summary

About the Mixed Farming Systems Program

Objectives and targets

Mixed Farming Systems (Grain & Graze II) is a regionally based research and development program for mixed farmers. It is a formal collaboration between industry (led by the Grains Research & Development Corporation) and the Australian Government (through Caring for Our Country). Other industry partners (Meat & Livestock Australia) and regional natural resource management bodies (Catchment Management Authorities) are also key contributors.

The mission of the Mixed Farming Systems program is to develop:

- Knowledgeable, capable and confident managers of mixed farming systems, and
- Viable, sustainable and adaptive mixed farming systems.

Its key objectives are:

- Lower costs of production; improved gross margins
- More resilience through drought; both financially and environmentally
- Better use of rainfall; optimal production in variable seasons
- Environmental gains; more biodiversity and more carbon retention.

Specific targets include:

- Farm profitability will increase by an average of 6.8% ($38,650 per farm) for the 3,089 farmers and 1.3 million hectares involved.
- The gains in profit will come from increased crop and livestock production for the rainfall received (an 11kg/ha increase in crop yields and 0.48 DSE/ha increase in stocking rates), and reduced input costs for fertilisers and chemicals (a $1.06 million reduction across the program by using biological methods).
    - More crops will be grazed; an additional 465,568 hectares.
    - More perennials will be grazed to increase production; an additional 56,254 hectares.
    - The area under legumes will increase; by 47% or 120,851 hectares.
    - Whole farm stocking rate will increase; by 15% through better utilisation of the whole farm feed base.
    - More land will be managed according to full IPM principles; an additional 24,064 hectares.
    - More land will be grazed to control weeds as an alternative to herbicides; an additional 76,397 hectares.
    - More land will be managed to capture and store more rainfall; an additional 329,663 hectares.
- The environment will also benefit:
    - More native vegetation will be managed to enhance functionality and biodiversity; an additional 2,416 ha.
    - Groundcover will be managed to prevent soil erosion across 258,021 hectares.
    - An additional 221,400 additional hectares of stubble will be retained (that otherwise would have been burnt, cultivated or overgrazed)
- The carbon, greenhouse and water use implications of the substantive practice changes (stubble retention, crop rotations, use of perennials and increased stocking rate) will be determined

Between 2009 and 2013, Mixed Farming Systems (Grain & Graze II) aims to achieve improved management on over 3,000 farms, with an average improvement in profit of $38,650 per farm (ranging from $6,300 to $119,300 per farm in different regions).

Based on regional calculations and a CSIRO Water Use Efficiency model, across all participating regions, Mixed Farming Systems will result in:

- Increased crop yield; by 227,500 tonne
- Increased stock numbers; by 2,564,300 DSE
- Increased meat production; by 26,000 tonne
- Increased wool production; by 2,200 tonne.

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Structure and benefits

Mixed Farming Systems (Grain & Graze II) will invest in research, capacity building and partnerships, through six themes:

- **Adaptive Management** – applied research to build the capacity of producers and advisers to make complex decisions.
- **Landscapes (Land Capability)** – developing skills amongst producers and advisers to manage in accord with land capability.
- **Smooth Transitions** – better integration of, and movement between, cropping and pasture based enterprises.
- **Grow More Biomass** – increased capture and storage of soil moisture to grow more feed, higher yielding crops and retain more ground-cover (especially in times of high erosion risk).
- **Use More Biomass** – optimal use of all biomass, to increase profitability through better feed management and grazing cereals.
- **Biological Solutions** – developing and extending the application of biological alternatives to agricultural inputs.

It will result in:

- Better water use efficiency, making optimal use of rainfall.
- Lower costs of production, with more emphasis on biological solutions.
- Increased groundcover, including legumes and perennials; reducing environmental risks and lifting production.
- More efficient feed conversion, through better livestock and feed management.
- Better gross margins, through lower costs and higher returns.
- Smooth transitions between commodities, for more flexible farming.
- Land used to its capacity, for increased production and less environmental risk.
- New knowledge and better decision making, improving the management skills of producers.

The program is a strategic response to global, national and farm scale drivers with direct impact on farm management decisions. The drivers are summarized over-page and include global food demand, consumer expectations regarding environmental care and climate change.

It has an emphasis on engagement and extension, which will generate a significant return on investment for program funders. Based on regional estimates and targets, a $30 million program will have;

- a benefit:cost ratio of 5.2:1,
- a net present value (NPV) of nearly $130 million and
- an internal rate of return (IRR) of nearly 190%.

Foundations

The Mixed Farming Systems program builds upon the foundations laid by the Grain & Graze program and enhances it with several distinctive advances. Mixed Farming Systems (Grain & Graze II):

- Is based on a partnership between industry (via GRDC) and the Australian Government (DAFF – Caring for Our Country)
- Is managed by industry (GRDC) for mixed farmers across Australia
- Is designed as an adjunct to existing RDC investments;
    - Providing access to networks for the delivery of other programs, and
    - Providing a series of producer managed sites for trials and demonstrations.
- Has streamlined management and lean administration
- Targets investments for prescribed benefits based on pre-experimental modeling of adoption rates and impacts, for more confidence that the desired outcomes of better profit and resource management will occur.
- Aims to significantly increase the involvement of ag-advisors, further focusing the program on practical business issues and building stronger links with key delivery agents for enhanced adoption of research findings. Development of the advisor base will be a legacy from the program.

The program is addressing key issues about sustainable production for mixed farmers, in partnership with relevant stakeholders and investors. It is based strongly on producer involvement, beginning with regional scoping and project development, to ensure research is directed at practical issues. Support for the Mixed Farming Systems program will hasten the adoption process and increase the return on investment from previous investments.

Mixed Farming Systems: BUSINESS PLAN

Drivers	Consequences	Implications for farmers	Priorities for mixed farmers	Grain&Graze Themes
Global food crisis: • Increasing demand for food (driven by rising population and living standards). • Increased global trade and competition (e.g. South America). • Uneven ability of consumer markets to accept price increases. Global climate change: • Increased variability in production, and increased competition in water markets.	Greater volatility in supply, demand and prices in food markets.	Producers need flexible production systems to respond to opportunities and shifts in demand.	Strategies and tactics that enable ready transitions between crops and livestock.	**Smooth Transitions.**
Consumer preferences: • Greater demand for nutritious, healthy food. • Increased concern for demonstrable evidence of environmental care (including greenhouse emissions) and animal ethics.	Increased supply chain pressure for environmental accountability.	Producers need sound environmental credentials, and must be able to communicate them with assurance.	Sound management of traditional issues (soil, water and weeds), plus biodiversity, carbon and greenhouse emissions.	**Landscapes** **Biological Solutions**
Energy and Carbon pollution reduction: • Probable increase in fuel and (hence) other input costs. • Uncertainty about the nature and impact of Australian and international Carbon Pollution Reduction Schemes.	Changing (potentially increased) costs of production; and new 'carbon farming' options.	Producers need even better production efficiencies, and knowledge of carbon cycles.	Water use efficiency, efficiency in the conversion of feed to liveweight, and carbon accounting.	**Grow More** **Use More**
Climate change in Australia: • Increased climate variability in most regions. • Greater potential for extreme weather events; droughts and floods.	Increased variability in production (input to supply chains) and potential for soil erosion.	Farmers need production systems that can capitalize on good seasons and yet are resilient through drought (financially and environmentally) and stable in storms.	High levels of ground cover throughout the year; e.g. perennial plants.	**Grow More** **Biological Solutions** **Landscapes**
Flexible and resilient farming: • Farmers need flexible farming systems to accommodate variable seasons and market opportunities. • Farming systems that have lower costs, better management of weeds, pests and soil, efficient use of water and nutrients, and generate positive environmental outcomes.	Flexibility, diversity and competing goals bring added complexity for managers.	Farmers need enhanced production systems and the skills and confidence to manage complex enterprises; as do advisers in order to support mixed farmers.	Knowledge, capability and confidence to make complex management decisions. Farming systems that use biological processes to lower costs and optimize production.	**Adaptive Management** **Biological Solutions** **Grow More**
Regional farming system variations: • In the sub-tropics, there are opportunities to increase grazing intensity, with more use of native grasses and legumes. • In wet temperate areas, increased grazing would make better use of all crops and pastures grown. • In reliable temperate areas, croppers want easy-care stock back into their production systems. • In marginal cropping districts, lower cost options with more emphasis on perennial pastures and livestock.	There are common themes through-out mixed farming regions, but also regional variations and differences in emphasis.	Farmers need a range of management options; tailored to regional circumstances.	Resilient and flexible, low cost production strategies, which have high water use and production efficiencies; and positive environmental outcomes.	**Biological Solutions** **Grow More** **Use More** **Smooth Transitions**

Mixed Farming Systems: BUSINESS PLAN

Overview of the Program

Who is Mixed Farming Systems for?

Mixed Farming Systems (Grain & Graze II) is aimed at producers involved in both cropping and livestock production. They may be evenly balanced between the two enterprises ('mixed crop-livestock producers') or have a strong emphasis on either one. They have opportunities and challenges not faced by producers who are solely croppers or graziers. They occur in the traditional wheat-sheep zone and also extend into higher rainfall and subtropical areas. They pay levies to both GRDC and MLA; and in many cases, to AWI as well.

Mixed farmers are important contributors to national and industry productivity, and the profitability of the agriculture sector. Production statistics suggest mixed farmers account for **at least** 25 per cent of grain production, 30 per cent of sheep and wool production, and 10 per cent of beef sales (collectively around $4.25 billion) – and possibly, significantly more. They manage vast tracts of land (mixed farming occurs in regions covering around 25% of Australia's land mass) and contribute to production in other commodities and regions – e.g. providing grain to the dairy and feedlot industries and finishing livestock from pastoral country. They contribute to numerous industry value-chains (e.g. grains, sheep, beef, dairy, wool, pigs and poultry) and their farms provide environmental services such as the provision of clean water and maintaining biodiversity.

See 'Target Audiences' for more information.

What off-farm issues affect mixed farmers?

Mixed farmers face all the issues and opportunities faced by single commodity producers (e.g. climate change, global food demand, greenhouse and carbon accounting, energy and other input costs, changing consumer behaviour and regulatory requirements); plus those arising from the interactions between the components of their farming systems.

Mixed farmers will:

- Require systems that are flexible and resilient to accommodate within and between season variability and fluctuating returns from commodity markets
- Increasingly need to demonstrate sound environmental credentials for access to some markets
- Need to improve the management of Greenhouse emissions from pasture, cropping and particularly livestock activities
- Want to implement production systems that are efficient in the conversion of water and nutrients into produce and have lower costs per volume of produce.

Global and domestic drivers affect demand, supply and prices for produce, which in turn is driving changes in mixed farm production. Sheep numbers are declining nationally, but sheep sales and lamb production from mixed farmers have been steadily increasing as they convert from wool production to more emphasis on meat production. A third of grain growers prefer livestock to cropping and mixed farmers will have an important role in arresting the decline of sheep numbers and growing the meat sheep industry.

See 'Industry issues and trends' for more information.

What management issues affect mixed farmers?

The nature of mixed farming systems is both a challenge to manage and a source of great opportunity for increased profit and better resource management. A key issue is the balance between stock and crop (the synergies and trade-offs between the two) and how to manipulate production to make the most of variable seasons, markets and land capability.

Mixed Farming Systems: BUSINESS PLAN

The range of enterprise and management options available, and the factors to be considered, means that decision making on mixed farms is a complex art in itself. Managing the transitions between crop and livestock enterprises is an important aspect of fine tuning mixed farming systems.

See 'On-farm issues' for more information on the regional differences in management issues.

What research do mixed farmers need?

The critical issues for mixed farmers relate to the interactions between components of their farming system rather than the components themselves. It is about how to create and optimize synergies and ensure that total outcomes are greater than the sum of the parts. These issues are unique to mixed farmers.

Mixed farming systems need to be investigated as systems – not as individual components. Mixed farmers are looking for answers to mixed farming questions and expect their RDCs to collaborate for efficiency and effectiveness in addressing their needs. (Andrew et al, 2007).

Mixed farming systems differ across the country in response to climate, soil type, landform and access to services and markets. Mixed farmers likewise differ in aspirations, management capability, and financial standing. However, there are common research needs across all regions:

- improving water use efficiency – increasing the total production of biomass (pastures and crops) and its conversion into product (e.g. by improved livestock management, better feed budgeting or grazing cereals),
- increased resilience – matching landuse to its capacity, using crop – pasture rotations, and increasing the extent of perennial pastures (and hence increased livestock production),
- reducing input costs and financial risk, while increasing productivity - making more use of biological processes (e.g. integrated pest management, nitrogen from legumes and grazing for weed control), and
- improved environmental outcomes while achieving the above - carbon sequestration, more groundcover throughout the year, and the retention of biodiversity.

A key challenge is to improve the skills, knowledge and confidence of mixed farmers and their advisers working in a complex environment across a diverse range of expectations and capability.

See 'Research priorities' for more information on issues in different mixed farming systems.

How can Mixed Farming Systems fit with other RD&E?

Grain & Graze II – Mixed farming Systems will add value to existing, and former, industry research and extension; and it will benefit from contributions from those programs. It will help deliver commodity based extension to mixed farmers, it will provide a link for other commodity programs with natural resource managers, and it will generate knowledge that other programs may benefit from.

Trial sites and farmer groups involved in Mixed Farming Systems will value-add to and lever effort from research being conducted by the Future Farm Industries CRC. Extension initiatives managed by regional NRM bodies, farming systems groups and flagship programs such as Making More from Sheep, More Beef from Pastures and LeyGrain will be accessed, providing additional benefit to the farmers participating in Mixed Farming Systems – and helping to deliver those programs. These synergies will help GRDC and MLA to meet their strategic targets including improved productivity, gains in water use efficiency, lower costs of production and the adoption of practices that improve environmental outcomes.

See 'Alignment with other RD&E programs' for more information.

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What will Mixed Farming Systems achieve for mixed farmers?

Mixed Farming Systems aims to develop knowledgeable, capable and confident producers; operating viable, sustainable and adaptive farming systems. It will increase their profit (e.g. lower herbicide, pesticide and fertiliser costs without harming production), leave properties more resilient through drought (financially and environmentally, e.g. through more use of perennials), make better use of seasonal rainfall to increase total production, and generate environmental benefits (such as more biodiversity and more carbon).

It will develop techniques to make the transition between crop and stock easier, will help producers get the most out of different classes of land, and will ensure farmers, advisers and natural resource managers all develop a better understanding of the complexities of mixed farming and its interaction with the environment.

See the 'Business strategy' for more information

How are Mixed Farming Systems investments decided?

Investments in Mixed Farming Systems are thoroughly assessed before commencement. Models of typical regional farms are used to determine the likely implications of research outputs on crop yields, ground-cover, stocking rates, profit, soil carbon, soil water and water use efficiency (as gross margin/mm of rainfall) before funding is committed. The regional implications are also modeled based on the engagement levels proposed in project investment plans.

See 'Implementation' for more information.

Why is Mixed Farming Systems a good investment?

Addressing the complexities of mixed farming will provide significant benefits to industry and the broader Australian community. Mixed Farming Systems (Grain & Graze II) is tailor-made to meet the unique requirements of mixed farmers, in an efficient and effective manner.

Mixed Farming Systems will result in:

- Environmental gains – reduced risk of erosion or dryland salinity and improved biodiversity.
- Production gains – increased biomass and livestock production.
- Increased profit - better gross margins, through lower costs per unit of production and higher returns.
- More confident farmers and advisers with new knowledge and better decision making skills.

It will contribute to investor success in meeting their corporate targets, e.g.:

- Increasing water use efficiency by 10% (GRDC)
- Increasing the area of cropped land with retained stubble by 10% (GRDC)
- Increase productivity rates by 5% (MLA)
- Reduce the costs of production by 5% (MLA)
- Increase the awareness and management of environmental risks by 20% (MLA).

The program as a whole is a positive business proposition (as detailed in Appendix 3):

- Internal Rate of Return – 188%
- Benefit:Cost ratio – 5.2:1
- Average increase in profit per farm - $7,168
- Net Present Value - $129.65 million.

For individual investors, it represents exceptionally good value. For example, considering the MLA investment alone:

- Present value of benefits - $7.8 million
- Present value of costs - $1.49 million
- Net present value of investment - $6.31 million.

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Mixed Farming Systems (Grain & Graze II) enables commodities to leverage substantial additional government investment and to harness the combined capabilities and resources of the GRDC and MLA. It will lift profits for mixed farmers (largely by growing more feed and grain and by making better use of that biomass).

In contrast, not maintaining the momentum in mixed farming R&D generated by Grain & Graze will be a lost opportunity. A scoping study conducted prior to Mixed Farming Systems (Andrew et al, 2007) noted that:

If Grain & Graze is not extended into a second phase it will mean that:

- *The unique R&D needs of mixed farming businesses will not be adequately met.*
- *The R,D&E efficiencies that mixed farming businesses and the Australian Government expect will not be delivered.*
- *The gap between production thinking (through RDCs) on the one hand, and natural resource management thinking (through the Regional NRM Bodies) and integrated whole-farm management (by farmers) on the other hand, will not be bridged effectively.*
- *The structures and relationships established (at significant $$ and personal cost) through the first phase will be lost or damaged – giving a poor return on investment.*
- *The existing Grain & Graze program will be cut short before it could reasonably have been expected to have delivered all its potential.*

See the ‘Business case’ for more information.

Mixed Farming Systems: BUSINESS PLAN

Background

Target Audiences

Mixed Farming Systems has three target audiences:

- Mixed farmers – the key audience.
- Agricultural advisors – conduits to mixed farmers.
- Regional NRM Bodies – organisations who can channel funds for on-farm management.

Mixed farmers can be difficult to target through commodity specific programs, but they are important contributors to agricultural production. Programs that target them specifically, like Grain & Graze, can also link them into commodity specific extension.

Mixed farmers

The main clients for Grain & Graze II - Mixed Farming Systems are the Australian primary producers growing both grains and livestock on their properties; and their local industry networks like farming systems groups. The ratios of production range from largely grains in the northern agriculture region of WA to largely beef in subtropical Qld.

When conducting its census and surveys, the Australian Bureau of Statistics (ABS) considers farms with earnings of more than $5,000 and classes broadacre producers as either grain, sheep, beef cattle, sheep – beef cattle farming, or 'grain-sheep or grain-beef cattle farming' (numbering 13,782 in 2007). The Australian Bureau of Agricultural and Resource Economics (ABARE) also surveys farmers and 'mixed farmers' would fall in its category of 'mixed livestock crops industry'. ABARE also collates survey data to provide regional and zone averages. It uses three zones; the pastoral, the high rainfall and the 'wheat-sheep' zone (as shown in the map below). There are grain-sheep and grain-beef producers outside of the 'wheat-sheep' zone and not all farmers in the 'wheat-sheep' zone are mixed farmers.

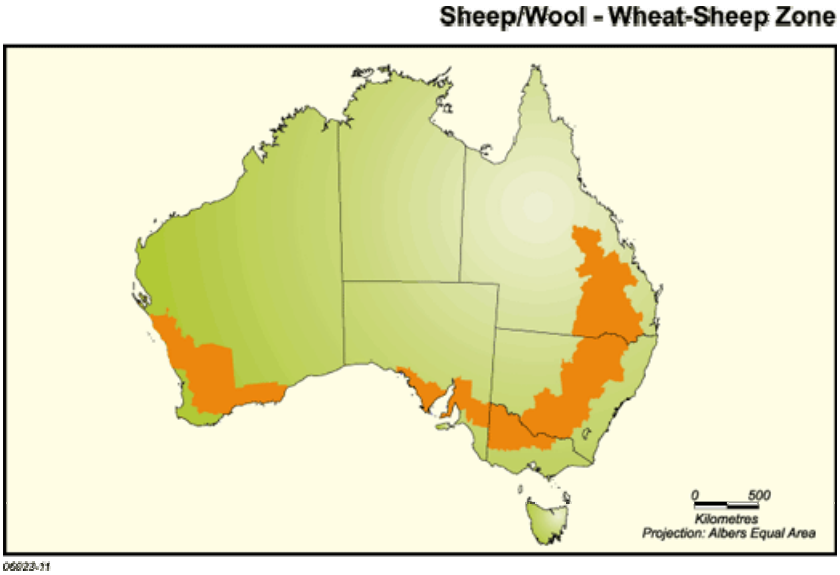

Fig 1. Australia's Wheat-Sheep Zone

Grain & Graze II - Mixed Farming Systems operates throughout the wheat-sheep zone and also into the high rainfall zone, in recognition of the increased cropping now occurring in that zone. It involves farmers and regional Natural Resource Management (NRM) bodies in western and south-eastern temperate, wet temperate and subtropical climate zones as per the following map.

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Fig 2. Grain & Graze Climate Zones

ABARE estimates that 32,300 of Australia's 57,700 broadacre producers were in the wheat-sheep zone in 2007-08, and there were 11,800 'mixed producers' in the nation. The number of farmers with at-least some cropping and some livestock would be greater than that given for 'mixed farmers'. The level of production from mixed livestock-crops producers, expressed as per farm averages, is presented below.

Profiles of average mixed livestock crops farms; 2007-08.

Mixed Livestock Crops Industry				**2007-08**			
	Unit	NSW	Vic	Qld	WA	SA	Aus
Estimated number of farms	no.	4 430	2 144	1 099	2 352	1 751	11 793
Estimated per farm averages							
Farm area at 30 June	ha	2 208	941	4 785	2 421	1 190	2 114
Wheat sown	ha	363	137	175	420	206	292
Sheep flock at 30 June	no.	1 660	2 124	299	4 145	1 459	2 090
Beef herd at 30 June	no.	144	29	375	38	19	105
Area harvested – wheat	ha	256	126	118	348	201	230
– barley	ha	76	103	31	231	150	118
– grain legumes	ha	32	19	25	45	26	30
– other crops	ha	67	93	210	174	49	104
Wheat produced	t	214	262	200	628	240	308
Sheep sold	no.	1 226	1 000	52	1 830	752	1 127
Beef cattle sold	no.	90	12	153	21	15	57
Sheep and lambs shorn	no.	1 921	2 122	225	4 864	1 596	2 344
Wool produced	kg	9 083	9 454	817	19 455	7 751	10 272

Source: *ABARE Physical Estimates Tables – AgSurf fixed data*.

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Total production levels may be estimated by multiplying average production per farm by the number of farms, as per the next table.

Estimated total production from mixed livestock crops producers; 2007-08.

Total Production (Estimated)	Australia - Broadacre	Wheat - Sheep Zone	Mixed Livestock – Crops Producers	Mixed as a % of Aus Broadacre	Mixed as a % of Wheat - Sheep
Estimated number of farms	57,701	32,337	11,793		
Farm area at 30 June (ha)	401,799,140	89,903,549	24,935,949	6%	28%
Wheat sown (ha)	13,141,832	12,538,436	3,442,039	26%	27%
Sheep flock at 30 June	80,278,509	46,486,857	24,648,457	31%	53%
Beef herd at 30 June	20,924,727	6,695,047	1,239,002	6%	19%
Area harvested (ha) – wheat	11,411,262	10,906,351	2,707,456	24%	25%
– barley	4,277,870	3,920,850	1,397,107	33%	36%
– grain legumes	1,511,610	1,385,329	359,405	24%	26%
– other crops	3,488,688	2,689,288	1,222,134	35%	45%
Wheat produced (tonne)	13,706,806	12,645,963	3,629,806	26%	29%
Sheep sold	42,793,396	26,789,305	13,287,363	31%	50%
Beef cattle sold	8,500,575	3,102,049	670,517	8%	22%
Sheep and lambs shorn	90,338,664	51,124,570	27,648,067	31%	54%
Wool produced (kg)	384,011,028	227,014,176	121,142,019	32%	53%

Rounding the estimates off, mixed farming accounts for **at least:**

- 25 per cent of grain production ($2.125 billion out of $8.5 billion),
- 30 per cent of sheep and wool production ($1.35 billion out of $4.5 billion), and
- 10 per cent of beef sales ($0.74 billion out of $7.4 billion) (ABS, 2009).

That equates to around $4.25 billion of production per annum.

Extension programs targeted at individual commodities can miss mixed farmer audiences. Commodity specific information is not always immediately relevant to mixed farmers, they can have different networks for communication, and they have management issues that single commodity enterprises do not have.

For more information see:

Australian Commodity Statistics 2008 (ABARE):
http://www.abare.gov.au/publications_html/data/data/data.html

ABS (2009) Australian Farming in Brief 7106.0
http://www.abs.gov.au/Ausstats/abs@.nsf/mf/7106.0/

ABS (2008) data on commodities on a Regional NRM Body basis:
http://www.abs.gov.au/AUSSTATS/abs@.nsf/ProductsbyCatalogue/950D33073DC81695CA25745F00205C9A?OpenDocument

ABARE (2009) AgSurf data – per farm averages:
http://www.abareconomics.com/ame/agsurf/agsurf.asp

Advisers

Agricultural advisers and consultants that interact with farmers are critical target audiences and collaborators for Mixed Farming Systems. The involvement of farmers, farming systems groups and advisers means the program will address the practical needs of mixed farmers, that projects will benefit from the contribution of their knowledge and experience, and that findings from trials will be promptly shared and applied.

Regional NRM Bodies

There are fifty six regional Natural Resource Management (NRM) bodies across Australia. The regional NRM bodies play a key role in implementing the Australian Government's resource management initiatives such as Caring for Our Country, and work closely with (or in some cases, within) State Governments. They develop plans and targets for the condition of natural resources and its management and manage programs (including incentives and assistance for farmers) to achieve those targets.

Caring for Our Country promotes increased adoption of sustainable farm management practices (e.g. soil, water, biodiversity, weed and salinity management), as well as improving the knowledge and skills of farmers and land managers.

Grain & Graze (2003 – 2008) developed relationships with all the regional bodies in the areas in which it was active during the first phase. Mixed Farming Systems (Grain & Graze II) will cover a larger area and involve even more (over half of all) Regional NRM Bodies.

Mixed Farming Systems epitomizes the recommendations of an independent review that concluded that the alignment of industry and regional body programs was critical for industry (Bently & Katos, 2006). Collaboration will result in targets and programs that suit farmers, increased support for farmers, and greater government and community confidence in rural industries and producers.

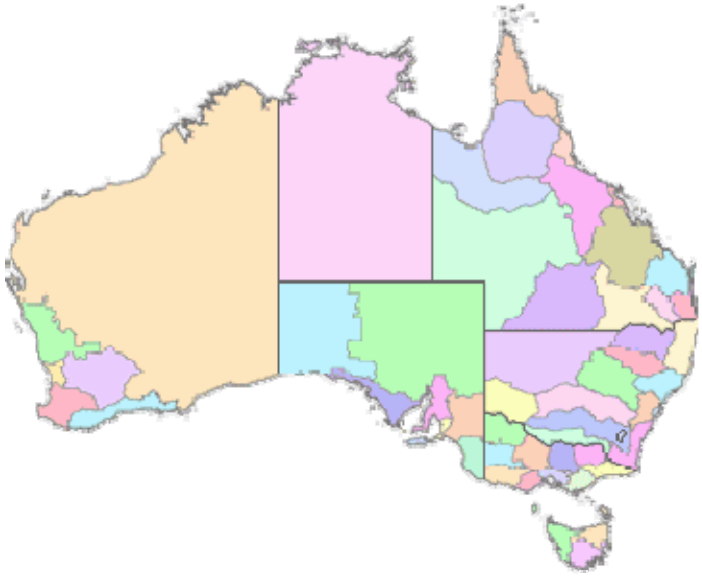

Fig 3. Map of Regional NRM Bodies

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Industry issues and trends

Mixed Farming Systems responds to:

- Global challenges and opportunities – the demand for meat and cereal products is forecast to rise, although there may be volatility in supply, demand and prices.
- Environmental issues – farmers must manage resources sustainably (including the impact of climate change, carbon and greenhouse emissions), and be acknowledged as sound managers.
- Production trends in Australia – there are clear trends of increasing grain and beef production, with a decline in sheep numbers which (with the impact of drought) mask an increase in lamb production that is gaining momentum, particularly amongst mixed farmers.

Global challenges and opportunities

Australian producers are part of the global economy. In the longer term, they are facing high demand for food stuffs; although the limited ability of some consumers to pay, along with global competition, may mute prices. Changing market and trade infrastructure may also have an influence. Although the overall picture regarding demand and prices in domestic and international markets is positive, price volatility is likely to be a feature of the near future (DAFF Food Policy Division, 2008). Farmers will need more flexibility to survive.

To cater for high-end markets there may need to be increased reporting and positive performance in terms of environmental management and the clean and safe quality of Australian produce, e.g. to retain market share for beef into Korea (Kin *et al*, 2009). Increased consumer demand for non-mulesed wool, the coming withdrawal of broad spectrum chemicals (endosulfan), and food-safety concerns over kangaroo meat into Russia are current examples of the importance of industry being on the front-foot in telling their story and building confidence in their commitment to environmental issues and product quality. Programs like Mixed Farming Systems provide a mechanism for industry to record and promote their environmental credentials.

There is also an evolving carbon economy that will change the cost of inputs and establish a new business environment for producers. The exact nature of those changes is not yet certain with diverse views amongst industry, environmental and political groups (e.g. a proposal by the Climate Institute (2009) to introduce a levy on nitrogen fertilisers and livestock sales). It seems imperative for producers to understand the carbon cycle that they manage and to quantify emissions and carbon sequestration from their farming systems. Questions about emissions will be particularly important for the meat industry in order to retain consumer confidence.

'*Meat is a wasteful use of water and creates a lot of greenhouse gases. It puts enormous pressure on the world's resources. A vegetarian diet is better*.' Lord Nicholas Stern (author of the Stern Review on the economics of climate change).

'*I think there is a significant increase in people eating less meat. There is definitely an environmental factor to it. It has a positive effect on the environment, and potentially on their health*.' Sarah Johnson (Australian Conservation Foundation's GreenHome education manager).

Cited by Asa Wahlquist, The Weekend Australian. August 31, 2009.

Uncertainty over the impact of climate change and experiences from recent droughts leave producers looking for ways to optimize production per mm of rainfall, minimize losses in drought and to optimize profits in good seasons. For many mixed farming regions climate change models predict a drying of seasons and yet (especially in northern regions) an increase in the intensity of rainfall events. Droughts and flooding rains may become even more a part of the operating environment; shifting the focus of production and restating the importance of groundcover for erosion control.

For further information on the above see summaries in DAFF Food Policy Section (2008) and Campbell (2008).

Environmental factors

A Bureau of Rural Sciences (2001) assessment of environmental factors affecting livestock industries noted the following as priorities:

- **Greenhouse gas emissions** – especially from vegetation clearance and livestock. Cropping raises issues of cultivation and additional fertiliser and energy use that also have greenhouse implications.
- **Soil carbon** – a complex and dynamic characteristic that may be built-up or run-down by alternative farming practices; providing net benefits or costs to production and the environment.
- **Soil acidity** – due to increased use of fertilisers, legumes and the removal of crop and pasture products; reducing the productivity of land and the range of plants that thrive.
- **Dryland salinity** – due to rising water tables as rainfall penetrates beyond the root zone; affecting production and 'downstream' areas of catchments.
- **Soil structure decline** – cultivation and compaction (from farm equipment or livestock) can harm soil structure and reduce its ability to cycle water and support plant life.
- **Water resources** – impacts on run-off, stream flow and ground-water as well as on water quality from sediments and contaminants eroding from farmed land.
- **Erosion** – wind and water erosion from soils exposed by management or mis-use.
- **Weeds** – a challenge to manage on properties; sometimes with unintended off-site impacts and a potential to spread to neighbours or contaminate produce.
- **Native vegetation** – the clearance and management of native vegetation; the need to maintain biodiversity and threatened species.

A recent international comparison of agriculture (OECD, 2008) re-affirmed these issues, noting that soil, water and biodiversity resources were important issues for Australian agriculture. The report also concluded that 'taking action to raise the efficiency of nitrogen use in crop and livestock agriculture would bring production, greenhouse and environmental benefits'. It also commented that livestock grazing 'continues to place heavy pressure on the environment, especially in some sensitive areas'.

Issues like these are important to individual producers and to regional NRM bodies. The latter will often set targets related to these issues (e.g. the percentage ground cover required to alleviate soil erosion) – and producers and the NRM bodies will need to collaborate if those targets are to be met.

In today's social and political climate there is increasing scrutiny of greenhouse emissions from livestock, which are often supported by interest groups opposed to the farming of livestock for food. Globally, livestock have been cited as a priority for 'environmental policy' due to their 'deep and wide-ranging environmental impacts' (Steinfeld et al, 2006). The impacts recorded included significant land degradation and biodiversity loss, water pollution and high levels of water use (both directly and indirectly – e.g. the irrigation of feed crops). Livestock are also claimed to effectively (directly and indirectly) contribute 18% of global greenhouse gas emissions; more than the transport sector.

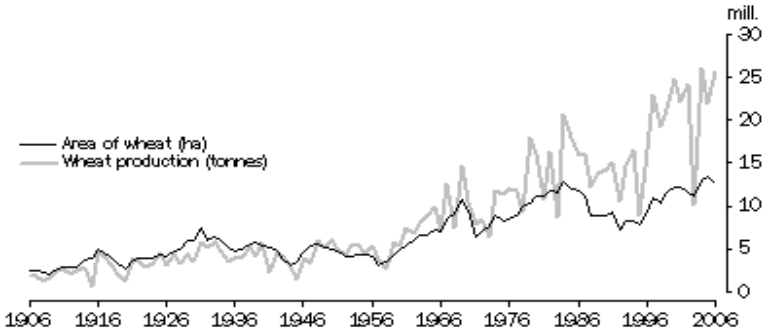
Production trends

The main features of dryland farming production (ABS, 2008), are summarized in Figures 4-6:

- Grain production is increasing (the area cropped is at an all time high) - and yields have been increasing even faster than the area cropped
- Beef production is increasing
- Sheep numbers are falling (down to levels from the 1920's) – although sheep meat production is increasing.

Mixed Farming Systems: BUSINESS PLAN

Fig 4. Wheat production - 1906 to 2006



(a) Due to the scale of this graph breaks in the time series have not been noted.

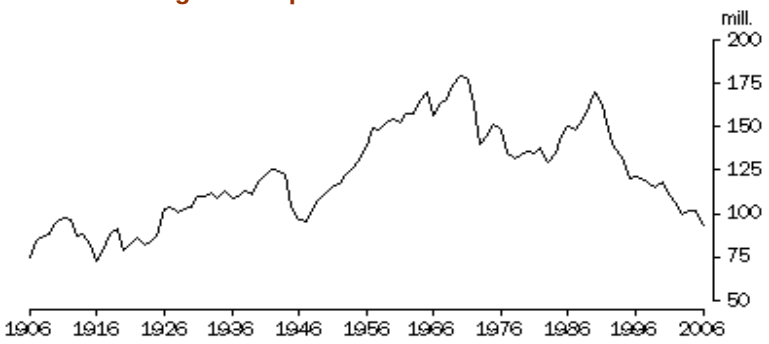
Source: Historical Selected Agriculture Commodities, by State (7124.0).

Fig 5. Cattle - 1886 to 2006

(a) Milk and meat cattle.

Source: Historical Selected Agriculture Commodities, by State (7124.0).

Fig 6. Sheep and lambs - 1906 to 2006



(a) Due to the scale of this graph, breaks in time series have not been noted.

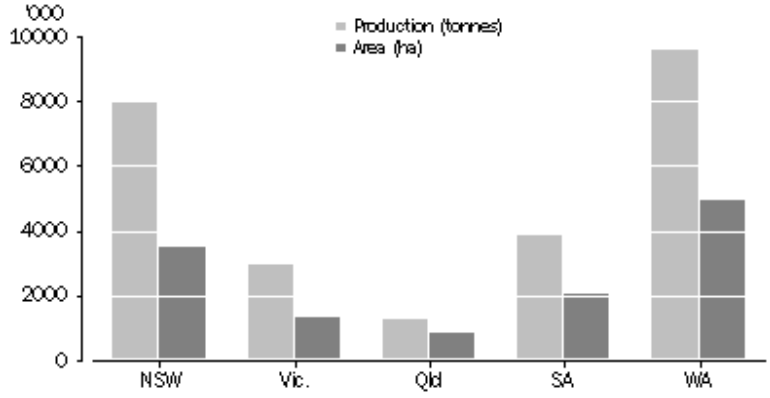
Source: Historical Selected Agriculture Commodities, by State (7124.0).

Cropping

In 2005-06, farmers planted 12.7 Mha to wheat and harvested 25.7 Mt. About 60% of Australia's wheat was exported for human consumption. A small proportion of production is used domestically for human consumption, with lower quality grain being used for domestic stock feed.

Mixed Farming Systems: BUSINESS PLAN

Fig 7. Wheat production and area, by state - 2005-06

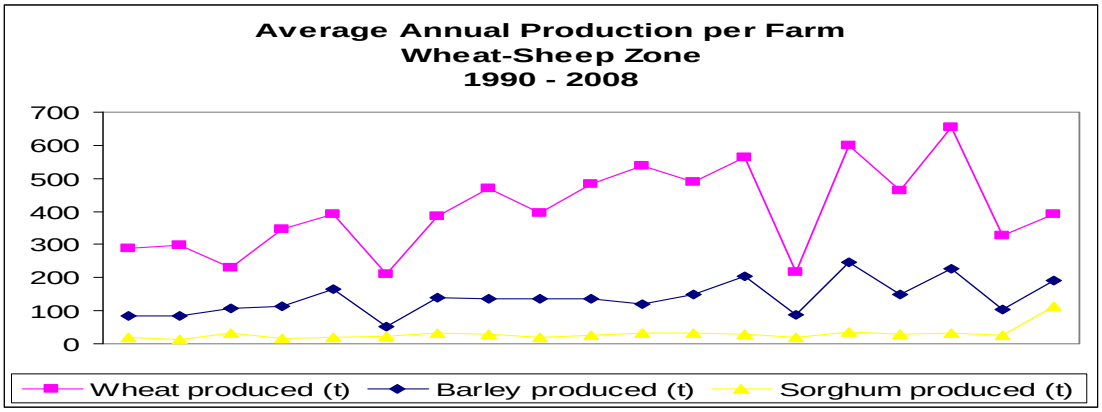


Source: Selected Agricultural Commodities, Australia, Preliminary (7112.0).

The development of winter wheat varieties which, like oats, allow grazing of the plant prior to harvest, have become very popular in some areas (ABS, 2008). Mixed farmers can opportunistically graze cereals, increasing livestock production while also spelling pastures to maintain ground cover and boost production later in the season.

ABARE surveys of farmers in the Wheat-Sheep Zone show that wheat and barley are the main crops produced, and in 2008, there was a sharp increase in sorghum production (ABARE AgSurf database, 2009).

Fig 8. Average Annual Production per Farm



Australian Crop Production 2005-06 (ABS, 2008)

Crop	Area (,000 ha)	Production (,000 tonne)
Barley	4,481	9,641
Sorghum	792	1,999
Maize	69	370
Oats	945	1,723
Rice	100	982
Wheat	12,703	25,704
Lupins	853	1,357

Mixed Farming Systems: BUSINESS PLAN

Livestock

Livestock Holdings (,000) June 30, 2006. (ABS, 2008)

	NSW	Vic.	Qld	SA	WA	Tas.	NT	Aust.
Cattle								
Milk	346	1 753	206	169	122	197	-	2 793
Meat	5 846	2 679	11 764	1 219	2 350	505	1 674	26 054
Total	***6 192***	***4 432***	***11 970***	***1 388***	***2 472***	***702***	***1 674***	***28 846***
Sheep								
Sheep	22 928	13 401	3 754	8 181	16 961	2 241	* -	67 552
Lambs	8 737	4 868	1 012	3 525	6 298	713	*1	25 176
Total	***31 665***	***18 269***	***4 765***	***11 706***	***23 258***	***2 953***	****1***	***92 728***

Beef cattle form the majority of Australia's cattle herd.

Both beef and lamb production have been rising steadily over recent decades. Beef production rose from 1.7 million tonnes (carcase weight) in 1990 to 2.1 million in 2008. Lamb rose from 0.29 million tonnes to 0.41 million in the same period. A rise in lamb production (and rising annual sheep sales) during a strong trend of falling sheep numbers shows a swing from wool production to meat production. Since 1990 the average number of sheep sold per farm in the wheat-sheep zone has risen steadily from 600 to over 800, supporting growth in lamb and meat production.

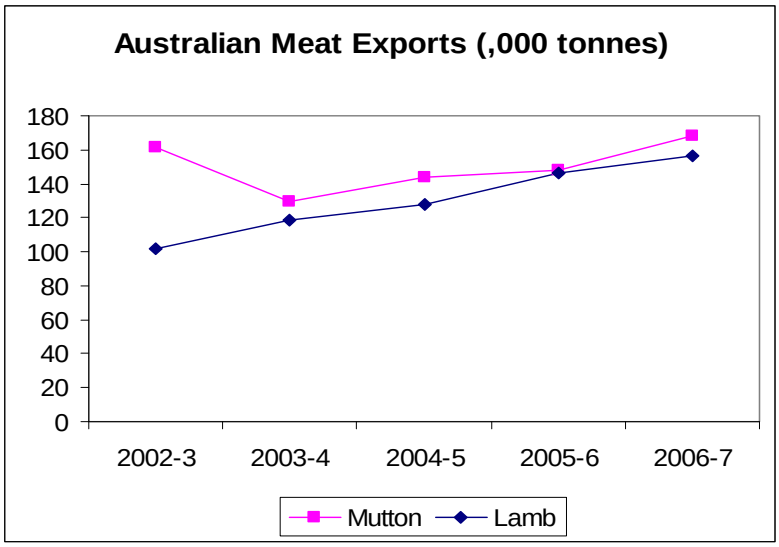
A 50% increase in lamb exports in recent years typifies the benefits of a sophisticated 'whole-of-value-chain' approach supported by MLA. It has involved sheep genetics, pasture improvement, better stock management, and improved marketing and supply chain management (e.g. product promotion and access to markets in the US). There has been an emphasis on lowering the cost of production while moving to heavier, leaner lambs; being produced to market specifications.

Meat Exports (,000 tonnes)				
	Beef	Veal	Mutton	Lamb
2002-3	931.9	10.1	161.6	102.0
2003-4	884.5	9.2	129.2	118.8
2004-5	1,004.0	9.1	143.5	128.2
2005-6	942.8	9.1	148.4	146.0
2006-7	1,025.7	9.5	167.9	156.7
Source: ABS Livestock Products, Australia (7215.0)				

A recent ABARE report on livestock productivity (Nossal et al, 2008) suggests that an increase in sheep industry productivity is underway, masked by the impacts of drought. The shift is associated with small farms, typically engaged in mixed operations and features: farmers returning to the sheep industry, expanded production levels, a focus on finishing lambs to slaughter weight, improved pastures, supplementary feeding, and improved genetics. These farmers are prime targets for Mixed Farming Systems.

Mixed Farming Systems: BUSINESS PLAN

Fig 10. Graph of Rising Lamb Exports



Conclusions

Drivers	Consequences	Implications for farmers	Priorities for mixed farmers
Global food crisis: • Increasing demand for food (driven by rising population and living standards). • Increased global trade and competition (e.g. South America). • Uneven ability of consumer markets to accept price increases. Global climate change: • Increased variability in production, and increased competition in water markets.	Greater volatility in supply, demand and prices in food markets.	Producers need flexible production systems to respond to opportunities and shifts in demand.	Strategies and tactics that enable ready transitions between crops and livestock.
Consumer preferences: • Greater demand for nutritious, healthy food. • Increased concern for demonstrable evidence of environmental care (including greenhouse emissions) and animal ethics.	Increased supply chain pressure for environmental accountability.	Producers need sound environmental credentials, and must be able to communicate them.	Sound management of traditional issues (soil, water and weeds), plus biodiversity, carbon and greenhouse emissions.
Energy and Carbon pollution reduction: • Probable increase in fuel and (hence) other input costs. • Uncertainty about the nature and impact of Australian and international Carbon Pollution Reduction Schemes.	Changing (potentially increased) costs of production; and new 'carbon farming' options.	Producers need even better production efficiencies, and knowledge of carbon cycles.	Water use efficiency, efficiency in the conversion of feed to liveweight, and carbon accounting.
Climate change in Australia: • Increased climate variability in most regions. • Greater potential for extreme weather events; droughts and floods.	Increased variability in production (input to supply chains) and potential for soil erosion.	Farmers need production systems that can capitalize on good seasons and yet are resilient through drought (financially and environmentally) and stable in storms.	High levels of ground cover throughout the year; e.g. perennial plants.

Mixed Farming Systems: BUSINESS PLAN

On-farm issues

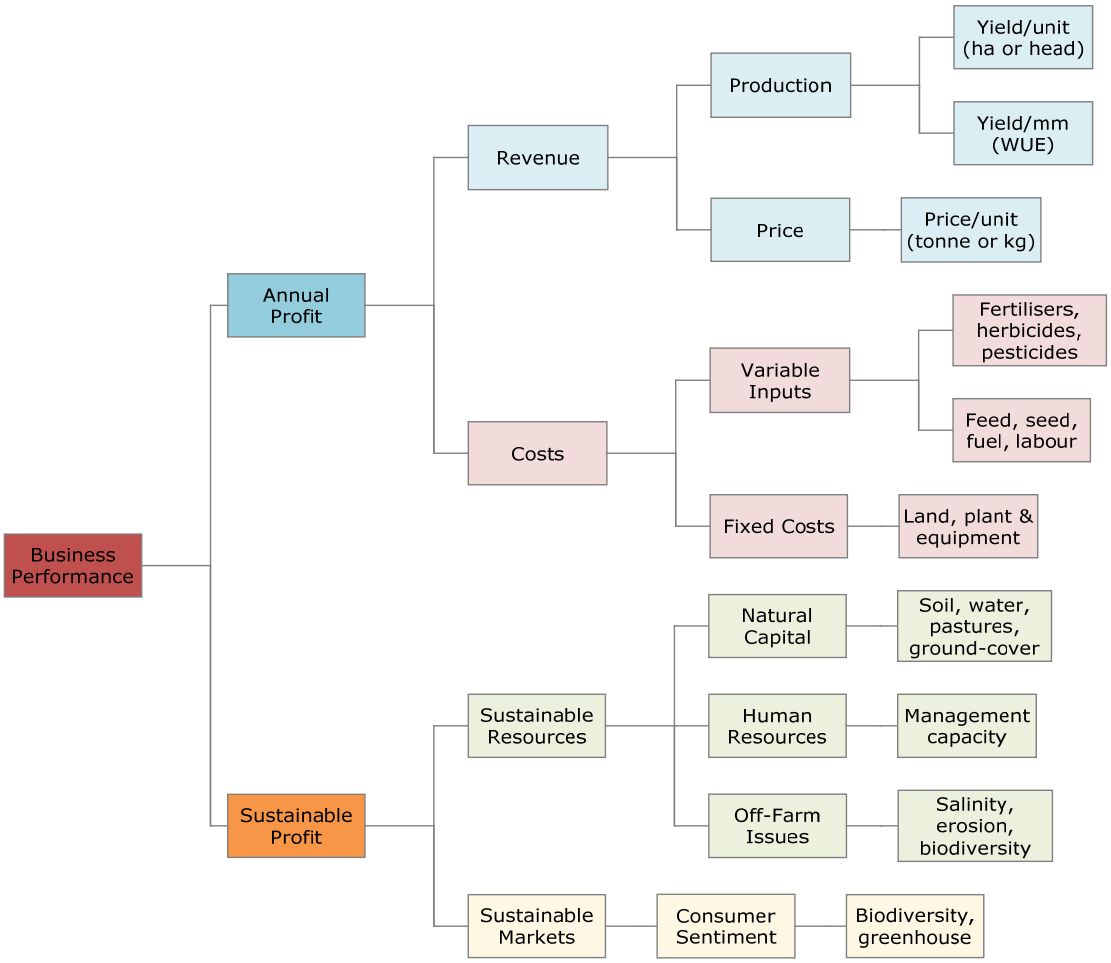
At the farm level, issues driving Grain & Graze include:

- Synergies to lower costs and increase resilience. Mixed farms have scope to improve their business performance by optimising the use of land (farming lands of different capability for different uses) and exploiting synergies to increase production, lower costs and provide more financial and environmental resilience.
- Market and management advantages. Although sheep numbers have declined (in line with returns from wool) and cropping has increased, there is now a trend back to livestock due to profits and their contribution to farming systems. Beef and lamb production is rising steadily, with mixed farms being noted for their role in sheep meat production.
- Management decisions. Making sound decisions amongst complex options is a hallmark of management excellence in mixed farming systems.

Drivers of business performance

The following chart of business performance drivers is based on charts applied in the R&D Strategies of MLA and GRDC, tailored with reference to Mixed Farming Systems.

Fig 13. Business Performance Drivers



Mixed Farming Systems: BUSINESS PLAN

Mixed Farming Systems can target production efficiencies (growing and using more biomass – both pastures and crops – per hectare and mm of rainfall), reducing variable input costs (through the application of biological solutions in lieu of chemical inputs), building the capacity of producers to manage profitable and sustainable businesses, and maintaining consumer sentiment (through addressing issues such as biodiversity, greenhouse and carbon cycles).

By recognising and optimising the capability of their land (by matching capability with use) producers will maximise their returns against their fixed asset, the capital value of their land. By working with regional NRM bodies, Mixed Farming Systems can also help lever assistance for farmers in maintaining and building the natural capital of their properties to improve the environment (while also enhancing production and resilience). Linkages with those bodies will be essential to achieve this potential.

Farming practices

There has been an increase in the area cropped and a reduction in sheep numbers since 1990. The move to cropping has been supported by increased adoption of measures like no-till and precision farming. The reduction in sheep numbers has masked a shift from wool to meat production (which is increasing). Nearly 80% of grain growers now adopt no-till practices, although the figure varies across regions (Llewellyn & D'Emden, 2009).

Characteristics of Australian grain growers, 2008.

Region	Growers with some sheep	Growers with some cattle	Growers preferring cropping to livestock	Growers burning some cereal stubble	Portion of farm prone to erosion if not carefully managed	Growers with herbicide resistant weed populations
NSW Central West	75	30	47	33	32	14
NSW Mallee	55	36	73	0	30	9
NSW Northern Mallee	32	67	58	10	44	32
NSW Southern	83	27	58	47	44	44
Qld Southern	8	60	59	7	37	27
SA Central	62	20	67	23	39	68
SA Lower EP	72	10	78	38	40	54
SA Mallee	85	29	58	9	51	34
SA Upper EP	82	5	68	2	48	36
SA Western EP	88	13	68	3	32	25
Vic Loddon	89	14	61	30	38	35
Vic Mallee	56	15	83	9	47	25
Vic Wimmera	64	7	74	33	33	63
WA Central-East	89	12	83	33	26	51
WA Midlands	79	21	85	35	50	53
WA Northern	68	16	96	24	52	74
WA SE Central	86	8	76	23	34	47
WA Upper Great Sth	97	8	51	32	25	65
WA West Central	93	12	55	55	12	28
	All figures in percentages (**%**)					
Source: Llewellyn & D'Emden, 2009.						

Although the total flock has halved, the number of sheep sold annually from an average farm in the wheat-sheep zone remains steady and is higher now than it was in 1990 (828 in 2008,

compared to 593 in 1990). According to ABARE surveys, cattle numbers and sales have remained stable, though tending upward in the same period (with herds rising from 136 to 207 on average across the wheat-sheep zone). Hooper (2009) notes that mixed farms are significant contributors to slaughter lamb production with a trend to first cross speciality meat breeds. Sheep numbers on farms breeding lambs for meat are expected to rise by 3% in 2008-09.

However, there are challenges with some cropping systems including management issues like herbicide resistance and stubble management. A recent (2008) survey of 1,172 grain growers across the grain belt provides a snap shot of their management, issues and preferences (Llewellyn & D'Emden, 2009).

Nationally, 65% of grain growers prefer cropping to stock, while the remaining 35% have a stated preference for livestock. In many cases farmers with stock have put more emphasis on staying abreast of cropping technologies than livestock management.

Some farmers have moved out of livestock to focus on cropping but others have retained stock, using them to manage stubbles and weeds, in a no-till system – although in some regions there is increased tillage for weed control in response to increased costs for herbicides. There is room for more focus on feed conversion and utilization (not just fodder production) through more emphasis on livestock management such as more intense rotational grazing, supplements and animal health (e.g. vitamins and trace elements). Stock managers are seeking increased feed production, higher stocking rates and faster growth.

A further problem arises from the combination of high crop input costs and poor seasons which is crippling some producers. The Northern and Central Victoria Grain & Graze proposal cites evidence (Campbell, 2008) that, in any year, the top 10% of Australia's farmers produce 50% of the Gross Value of Agricultural Produce; while the bottom 50% produce only 10%, and are unprofitable with rising debts. The cost of fertiliser rose 90% in two years and the cost of diesel was up 70% over five years. In many districts there are farmers in urgent need of production systems that lower their costs and lower their risks.

Droughts over much of the wheat-sheep belt have resulted in large areas being declared to be under 'exceptional circumstances', which has focused farmers' attention on the prospect of climate change. If climate change proceeds as predicted it will result in drier conditions in many regions and also an increase in storm and intense rainfall events. Lands of 'marginal' cropping value may become even more marginal and wind and water erosion may become major issues. No matter what the form of production, it will be important to improve the efficiency of resource use to maximize the production of grain and meat per mm of rainfall (Water Use Efficiency – WUE) while con-currently maximizing ground cover.

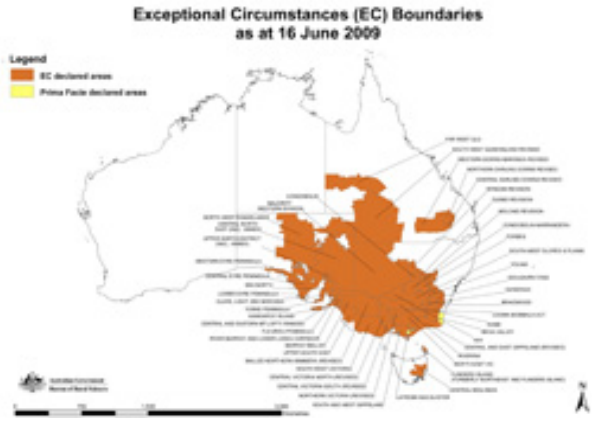


Fig 11. June 2009 Exceptional Circumstances Boundaries

Mixed Farming Systems: BUSINESS PLAN

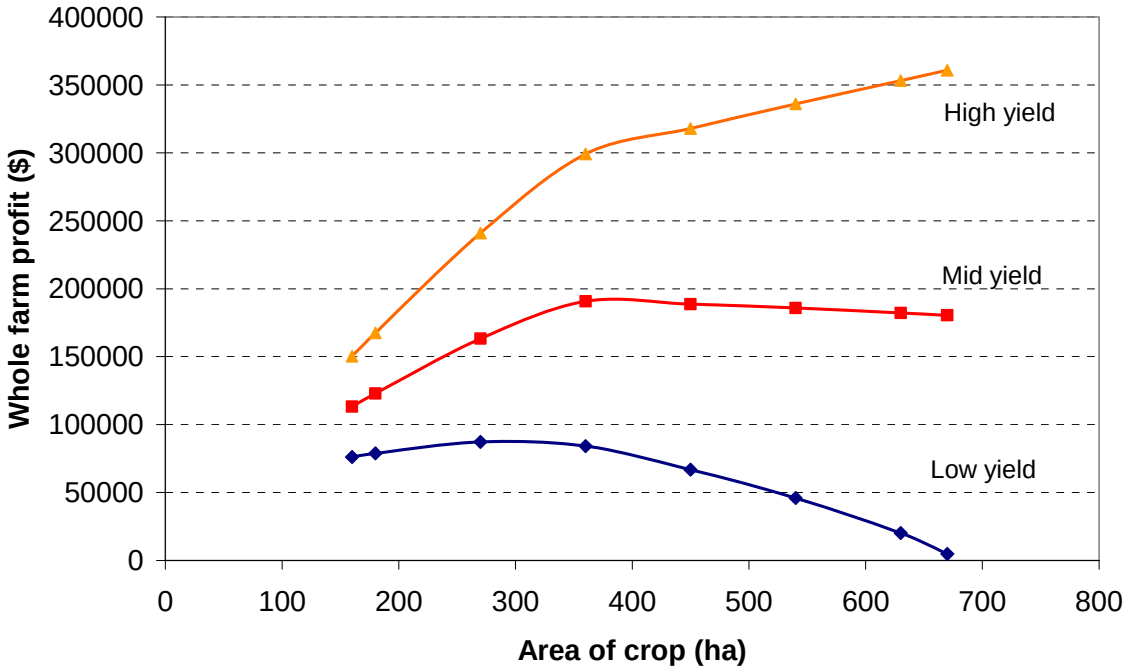
Opportunities and trade-offs

Mixed farming enables producers to optimize production from lands of differing capability and to make use of synergies between livestock, pastures and cropping. Its diversity provides flexibility to change production as markets shift and (up to a limit) the addition of livestock provides more secure income during droughts. In good and average seasons, cropping may be profitable, but high input costs mean more risk of significant loss in drought.

Mixed farms also have great potential to make positive contributions to the retention and promotion of biodiversity and other environmental services, as part of the farming system. They may harbor remnant vegetation, manage native pastures, incorporate native fauna into integrated pest management, enhance riparian areas as biodiversity refuges, and manage salinity to maintain the quality of water in rural catchments.

Diversification spreads risks across enterprises, however it can also mean foregoing potentially greater profits in good seasons through specialization and the production of high returning crops. In addition, mixed enterprises may be more complex to manage and require more decision making by producers. Dual enterprises also carry the capital cost of dual infrastructure.

Fig 12. Profit: as a Factor of Crop Proportion under Different Scenarios



The above graph shows whole farm profit for farms with different proportions of crop, for three yield scenarios (representing different climatic conditions) (Bathgate, 2008). Farms with a higher proportion of land under crop have high profits in good years, but least profit in poor (low yield) years.

'A mixed farming system is not about optimisation in the short term, but building a farming system over the long term that reduces the financial and environmental peaks and troughs'.

There are numerous variables and many 'right options' in mixed farming systems, making management a complex matter (McGuckian, 2006).

Mixed Farming Systems: BUSINESS PLAN

Conclusions

Drivers	Consequences	Implications for farmers	Priorities for mixed farmers
Flexible and resilient farming: • Farmers need flexible farming systems to accommodate variable seasons and market opportunities. • Farming systems that have lower costs, better management of weeds, pests and soil, efficient use of water and nutrients, and generate positive environmental outcomes.	Flexibility, diversity and competing goals bring added complexity for managers.	Farmers need enhanced production systems and the skills and confidence to manage complex enterprises; as do advisers in order to support mixed farmers.	Knowledge, capability and confidence to make complex management decisions. Farming systems that use biological processes to lower costs and optimize production.

Mixed Farming Systems: BUSINESS PLAN

Research priorities

Mixed farming research needs

Mixed farmers have some unique research needs:

- Systems research. An integrated approach is needed to explore the synergies and trade-offs within alternative farming systems.
- Building resilience. Exploring alternative mixes and harnessing biological principles to reduce input costs and enhance sustainability.
- Themes within regional variations. Although priorities differ between regions, there are common themes such as improved water use efficiency, drought management, positive environmental outcomes and lower costs of production.

Farming systems

A scoping study towards the conclusion of the first phase of Grain & Graze (Andrew *et al*, 2007) noted that:

'Mixed farming is a significant contributor to Australian dryland production. It is driven by a farming system in which the synergies between the parts has been shown to create a total that is bigger than the sum of the parts.'

It also concluded that:

'Mixed farming systems need to be investigated as systems – not as individual components. It is often the interaction between components that presents most challenge to farmers and generates the synergies that optimise the value of the approach. Mixed farmers are looking for answers to mixed farming questions and expect the RDCs, to which they pay levies, to collaborate for efficiency and effectiveness in addressing their needs. They do not want to get competing or repetitive information and advice from their different RDCs focused on individual enterprise components of the farming system.'

Some of the emerging RD&E needs identified were:

- Optimising integrated business and environmental performance; finding the balance and catalysts for synergy and professional skill development in the management of complex systems
- Building resilient farming systems for a changing and variable climate
- The role of perennials in farm resilience, soil protection and regional water balances
- Understanding carbon, energy, water and nutrient cycles and production efficiency
- Exploring relationships between soils > single and multi-purpose crops or pastures > plant nutrient status > stock performance
- Integrated Pest Management (IPM)
- Reconciling mixed farming businesses and regional conservation of biodiversity
- Alternative business models; promoting easier management and the enjoyment of farming.

The priorities of GRDC (e.g. improved water use efficiency, sustainable resource management, integrated farming practices and technologies, and capacity building) and MLA (e.g. improved productivity, healthy environments, and building knowledge and capacity) are captured and reinforced by these needs.

Mixed Farming Systems: BUSINESS PLAN

Regional priorities

There is a commonality in issues and research questions across the mixed farming regions, however, the diversity of their environments means that each region places different emphasis on different issues. The issues manifest themselves differently between regions and have been described in regional profiles prepared in the design of Mixed Farming Systems (Grain & Graze II).

In the **wet temperate** (high rainfall) zone, the main priority is increasing the intensity of systems to make better use of the high quality feeds available, e.g. through grazing crops or additional emphasis on the role of legumes. There may be some further growth in cropping and yields, but greater use of available feed will result in increased meat production from the region and greater profit.

In **reliable temperate cropping areas** the emphasis is strongly on cropping, but growers increasingly want to get better at managing stock and to make use of them to deal with cropping challenges such as herbicide resistance. They are seeking basic stock management skills and 'easy care' stock; and want help in working out how to best incorporate stock in their systems.

In the less reliable, **more marginal, cropping areas** growers are under great pressure to reduce the financial risks they face from cropping. Lower cost cropping is a goal, along with systems that provide secure feed for stock (i.e. perennials) – and those pasture systems will also better manage environmental risks such as erosion. Using land to capability will result in increasing water use efficiency, ground cover and soil carbon; and an increase in stock numbers and reduced, but more stable, crop production.

Subtropical areas also want to increase grazing intensity, getting more production from native pastures through grazing management, and to increase the role of legumes in their systems. There is scope for increased cropping and higher yields, but much of the gains will come from increased stock returns and through protecting and enhancing soil condition.

There are differences in emphasis across the regions, but there are also several recurring themes:

- Better use of rainfall (improved water use efficiency)
- Increased resilience through drought (risk management and system flexibility)
- Positive environmental outcomes (groundcover, stability and biodiversity)
- Lower costs of production (and, for many, increased meat production)

Options

There are several options to explore in mixed farming systems to address those themes.

Water use efficiency

Water use efficiency can be increased by growing more biomass (crops or pastures) and by using it better (through better crop and stock management). Having a mix of plants that can respond to rainfall at any time and maintain ground-cover throughout the year is a first step. This often involves the use of perennials but also depends on ready transitions between pasture and cropping phases.

Resilience

Surviving droughts and market down-turns requires stable systems (e.g. high water use efficiency and perennial cover), along with sound planning (e.g. using land to its capability; precision cropping or grazing perennials on marginal cropping land). Diversification can also help by spreading the risk as, within limits, stock may be less profitable in good seasons but have lower costs and be more reliable in dry seasons.

Sound decision making is also required. Grain & Graze has highlighted the complexity of decisions confronting mixed farmers and the importance of adaptive management as a way to deal with it. A 'simple' decision like the management of stubble is an example – involving trade-offs between stock-feed, ease of subsequent sowing, weed management, water retention, soil structure and erosion, soil biology, carbon storage, greenhouse emissions and pest control.

Environmental outcomes

Measures like zero till and the use of perennials will increase groundcover – and may provide gains for regional biodiversity. There may also be opportunities to consciously sequester carbon or to combat dryland salinity. The potential environmental benefits from perennials (even though they provide fodder value) will be attractive to regional NRM bodies who may able to provide incentives (such as payments for the provision of environmental services) to producers interested in such options. Their support may shift the balance in favour of some production systems that will be beneficial to producers, but are not economically viable without additional income streams or help with capital investments, like fencing, that are needed at commencement.

Lower costs

Biological solutions are feasible as one way to lower costs in cropping and grazing systems. Examples are the use of legumes to provide nitrogen, using stock and rotations to control weeds and diseases, managing pastures to increase levels of soil organic matter and carbon, and adopting Integrated Pest Management (IPM) to further reduce the use of chemicals and control pests. These approaches have a whole-of-industry benefit as well. As an example, the progress in IPM through programs such as Grain & Graze has already been reported in the media. It shows how industry bodies can add value to farm-based research to maintain community confidence in their commitment to the environment.

Placing more emphasis on livestock (which have lower input costs than cropping) is another option to lower the risk of financial loss. This will often come with increased interest in perennials – which will be of benefit to regional NRM bodies due to their environmental contributions.

Conclusions

Drivers	Consequences	Implications for farmers	Priorities for mixed farmers
Regional farming system variations: • In the sub-tropics, there are opportunities to increase grazing intensity, with more use of native grasses and legumes. • In wet temperate areas, increased grazing would make better use of all crops and pastures grown. • In reliable temperate areas, croppers want easy-care stock back into their production systems. • In marginal cropping districts, producers seek lower cost options with more emphasis on perennial pastures and livestock.	There are common themes through-out mixed farming regions, but also regional variations and differences in emphasis.	Farmers need a range of management options; tailored to regional circumstances.	Resilient and flexible, low cost production strategies, which have high water use and production efficiencies; and positive environmental outcomes.

Mixed Farming Systems: BUSINESS PLAN

Alignment with other RD&E programs

Mixed Farming Systems is well placed to help deliver other RDC programs to mixed farmers and to both draw on them and contribute new knowledge to them:

- Sound foundation. It builds upon the regional relationships forged between industry and regional NRM bodies in the first Grain & Graze program and on its research highlights (e.g. grazing cereals and Integrated Pest Management).
- Positive return on investment. Without Mixed Farming Systems the investments in the first program will under-perform, and relationships and reputations may suffer.
- Alignment. Mixed Farming Systems will help deliver other RDC programs to a hard to reach segment of producers and help the RDCs to hit the performance targets in their R&D strategies and Operational Plans.

Foundations

The Grain & Graze program commenced in 2003-04 as a five year program to provide mixed farmers with new knowledge and the capacity to increase profitability by 10%, while maintaining or enhancing their natural environment. It brought together the three commodity R&D corporations receiving levies from mixed farmers (Australian Wool Innovation, Grains RDC and Meat & Livestock Australia) and Land & Water Australia – a move that, in itself, was seen as positive by many levy payers.

> *Collaboration with other RDCs through co-investment, coordination and communication to increase the effectiveness and efficiency of R&D investments (by eliminating duplication and fragmentation*) is a corporate strategy of GRDC*.*

By working with farmer networks (e.g. farming systems groups) and regional natural resource management (NRM) bodies (e.g. Catchment Management Authorities - CMAs) Grain & Graze established nearly 300 trial sites and involved more than 8,000 participants across Australia. A key theme was the integration of production, environmental and social factors to benefit producers and the community groups they relate with.

The program examined the question of 'what mix, or combination of livestock, pastures, crops and vegetation, will deliver a 10% increase in profit while addressing regional natural resource management issues?' It concluded that it wasn't the mix that was as important as management and the flexibility to adjust to seasons, markets, land capability etc.. It also highlighted the complexity of management decisions faced by mixed farmers.

Key achievements within the life of the program were:

- A 9% increase in profit for 1,100 producers, largely through improved decision-making.
- Increased adoption of sustainable farming practices (e.g. grazing cereals and feedlots).
- Over 5,000 farmers actively trialing activities and 3,200 farmers adopting new practices.
- Likely improvements in water quality, biodiversity and the protection of soil resources.
- Increased confidence amongst 3,750 producers and increased pride amongst many.
- Over 100 research papers and 200 publications.

Additional benefits are likely in subsequent years (Read & Petersen, 2008 and Price).

Evaluation of the program (Read & Petersen, 2008) shows a return on investment for the partners of 3.4:1.

A significant achievement from the first phase of Grain & Graze was the improvement in relationships between industry and the regional NRM bodies (through which much of the Commonwealth's investment in on-farm change is channeled). The program forged new, and enhanced existing, relationships to develop a platform for collaboration and co-investment.

These initiatives were often difficult to commence and not all achieved a satisfactory level – but all relationships were improved compared to where they were prior to Grain & Graze.

The program also developed operating procedures to marry regional activities into cross-regional and national initiatives for better efficiency and improved outcomes. These relationships and procedures still require development but a foundation has been established and should not be undervalued.

The first phase of Grain & Graze achieved substantial success (Read & Petersen, 2008). While its regional delivery model (involving industry and NRM bodies) and the melding of regional and national initiatives were uneven in effectiveness, they were successful overall and form a valuable base for future work.

A 'scoping study' for a new phase of Grain & Graze (Andrew et al, 2007) concluded that not extending the program into a second phase would, in effect, reduce the potential benefit of the first phase, because:

- The structures and relationships established (at significant $$ and personal cost) through the first phase will be lost or damaged – giving a poor return on investment.
- The enthusiasm of regional partners for cooperative RD&E will be damaged, along with a concomitant loss of confidence in the RDCs.
- The Grain & Graze program will be cut short before it could reasonably have been expected to have delivered its potential.

It also noted that not investing in a further phase would result in:

- The unique R&D needs of mixed farming businesses not being adequately met.
- The gap between production thinking (through RDCs), natural resource management thinking (through the Regional NRM Bodies) and integrated whole-farm management (by farmers), not being bridged effectively.

Lessons

The first phase of Grain & Graze was very successful in building the decision making capacity of producers and that has been noted in evaluations as one of the major 'value-adds' from the program. The social research that explained and emphasized the complex nature of decision making for farmers helped to define the program and has wide applications (McGuckian, 2006). It is a strength that should be further built upon – and Mixed Farming Systems will do that with a focus on adaptive management and the development of strategies and tactics to provide mixed farmers with flexible farming systems and the skills, knowledge and capacity to manage them.

Although foundations were established, there were shortcomings in building stronger adaptive management models (engaging with regional NRM bodies and in ongoing evaluation and response) and (in some regions) engaging with producers and advisers. These gaps were considered to retard the overall levels of on-farm adoption from the program. They are challenges to be grasped to generate uniformly high returns on investment through a new Grain & Graze program.

Grain & Graze showed the gains to be had by greater attention to managing the links between developed pastures, livestock, cropping and other vegetation. It also identified that there was a limited number of advisors who could present sound information on pasture and livestock production interactions; and even less who could help regarding interactions between pasture, livestock and cropping.

Two focal areas for further investment are therefore:

- Developing the underpinning knowledge (across regions) about mixed farming systems, and
- Increasing the skills, knowledge and confidence of producers and advisors to improve production in mixed farming enterprises.

Mixed Farming Systems: BUSINESS PLAN

The Gain & Graze niche may be further developed by a program that:

- Researches environmentally based technologies that help make production systems efficient, resilient and opportunistic; optimizing synergies between pastures, livestock, crops and other biodiversity,
- Researches and develops the capacity of producers and their advisers to make complex decisions and to manage mixed production systems,
- Enhances partnerships with producers, researchers, advisors and regional NRM bodies for increased on-farm adoption of new technologies.

Doing so will add further value to the previous investments in Grain & Graze, as well as being sound investments in their own right.

Adding value to existing programs

Mixed Farming Systems will add value to existing R&D programs, e.g.:

MLA Strategies (from the MLA Annual Operating Plan 2008-09):

Growing demand:

- Promoting industry integrity – Build awareness of the role the industry plays in managing the environment across large parts of Australia.

Enhancing competitiveness and sustainability:

- Increasing cost efficiency and productivity on-farm – Conduct research to improve the feedbase and feed utilisation, deliver alternative (improved) grazing systems, and evaluate new pasture species.
- Ensuring sustainability – Develop tools for growers to manage their natural resources while improving productivity, assess natural resource risks and demonstrate environmental credentials, and address increased risks and opportunities due to climate change.

Increasing industry capability:

- Increasing adoption of R&D outcomes – Deliver tools and learning opportunities with clear benefits to individuals, and collaborate with other organisations that can influence adoption.
- Building world-class skills and innovation capability – Build producer knowledge and skills.

Key ***MLA delivery programs*** (and associated tools) will be linked into Mixed Farming Systems. Its network of farming systems groups and regional coordination will provide a marketing force for programs such as:

- More Beef from Pastures,
- Making More from Sheep,
- Producer Demonstration Sites.

Mixed Farming Systems will provide access to new networks for the delivery of these programs to clients that are otherwise difficult to contact, yet are well placed to increase meat production through better livestock management skills.

Mixed Farming Systems will provide new knowledge for incorporation in updates of the Making More From Sheep manual and will increase producer awareness of the manual and encourage greater adoption of its key management principles. Of the 260 Making More from Sheep events run from January 2008 to June 2009, just less than half (45%) were run in the mixed farming zone.

Mixed Farming Systems and these programs (and their lead into the EDGE*network* and PROGRAZE etc) will make producers familiar with numerous livestock management tools such as:

- MLA's Feed Demand Calculator
- Cost of Production Calculators
- BeefSpecs calculator
- Rainfall and Pasture Growth Outlook tool.

Mixed Farming Systems will also provide trial and demonstration sites, and communication networks, to support other research investments such as:

- ENRICH – developing new perennial pastures with FFI CRC
- Evergraze – more livestock from exotic and native perennials
- Pastures Australia – better pasture varieties
- Other Future Farm Industries CRC projects.

Key GRDC programs to link with will be:

- LeyGrain – ley pastures for cropping systems
- Farming Systems – regional research
- National Invertebrate Pest Initiative – Integrated Pest Management.

Meeting industry R&D targets

Mixed Farming Systems has the potential to help MLA and GRDC meet their corporate targets. Examples include:

Grains industry performance indicators from the ***GRDC Strategic Plan***:

- Water use efficiency increases by 10%
- The area of cropping land with retained stubble increases by 10%
- The proportion of growers with improved confidence in managing pests, weeds and diseases averages 90%
- The number of growers participating in field days etc increases by 10%
- The proportion of growers adopting new or improved practices increases from 20% to 40%
- The proportion of growers actively monitoring dryland salinity increases from 24% to 30%
- The number of growers minimising nutrient loss through nutrient budgeting increases from 54% to 60%
- The number of favourable mentions of GRDC in the media increases
- The number and value of co-funding arrangements with other RDCs increases.

Meat industry targets from the ***MLA Strategic Plan***:

- Increase productivity rates by 5%
- Reduce age at sale by 10%
- Reduce cost of production by 5%
- Increase awareness of environmental risks and encourage relevant management practices by 20%
- Increase skills, knowledge and confidence of producers by 10%.

Mixed Farming Systems: BUSINESS PLAN

Conclusions

Research themes

To improve the business and environmental performance of mixed farmers, Mixed Farming Systems will invest in:

- **Grow more biomass**; increasing pasture production and crop yield, while also increasing ground cover.
- **Use more biomass**; making more use of additional feed (improving pasture utilisation and feed efficiency via more use of feed budgeting, grazing cereals and better livestock management) to increase stocking rates, yields/head, and reducing the age of stock at sale.
- **Biological solutions**; reducing the cost of production by using less fertiliser (growing more legumes), less herbicide and fewer pesticides – transforming cropping costs into stock benefits.
- **Smooth transitions**; shifting more easily and efficiently between crops and pastures to maintain ground cover, fill feed gaps and optimise water use efficiency.
- **Landscape (land capability);** assessing land capability and managing land to capability for optimal production (e.g. precision agriculture).
- **Adaptive management**; helping mixed farmers to understand risk and their profit drivers, and to enhance their skills in managing complex, integrated farming systems.

Those investment themes align with several of the key drivers of improved on-farm business performance; as demonstrated in the following chart.

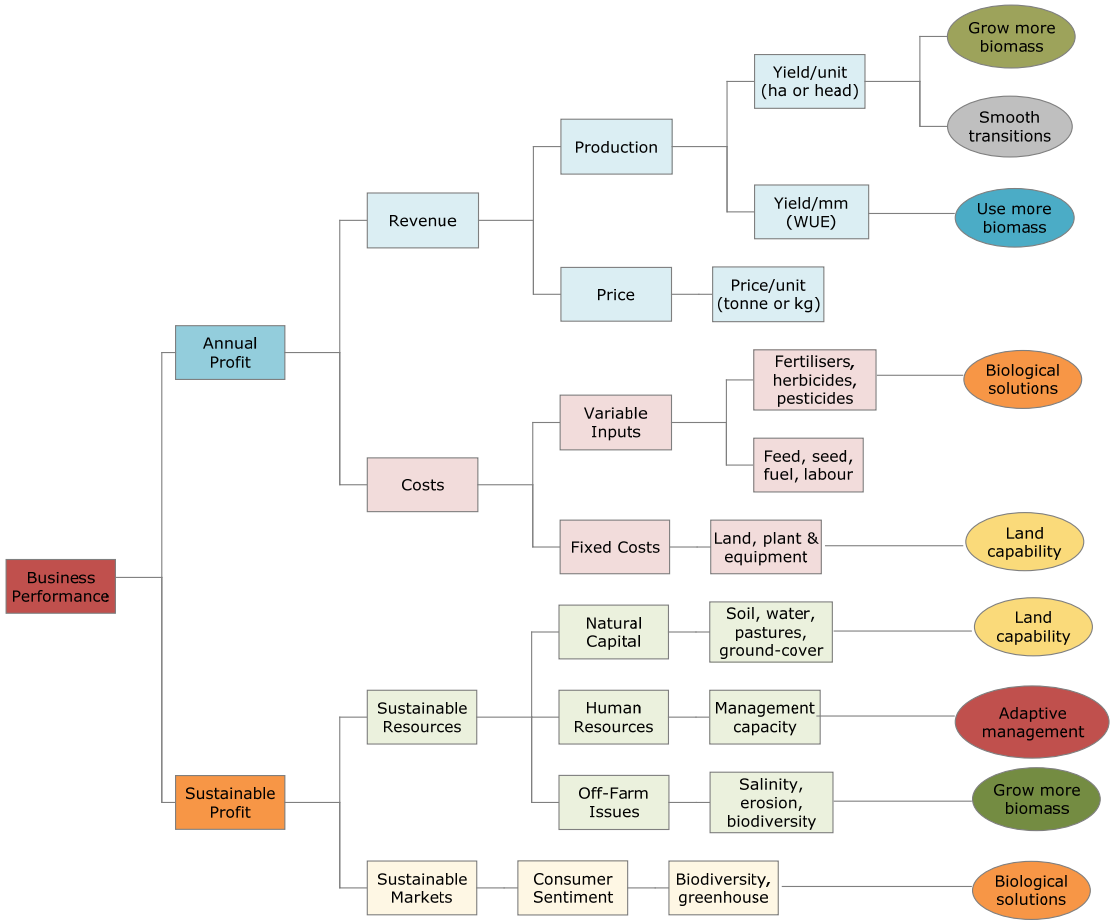


Fig 14. Alignment of Mixed Farming Systems investments with performance drivers.

Mixed Farming Systems: BUSINESS PLAN

Program outline

Business strategy

Mission

- Knowledgeable, capable & confident managers of mixed farming systems;
- Viable, sustainable & adaptive mixed farming systems.

Objectives

- Lower costs of production; better gross margins
- More resilient through drought; financially and environmentally
- Better use of rainfall; optimal production from seasonal falls
- Environmental gains; more biodiversity and more carbon

Investment themes

Investing in research, capacity building and partnerships, for:

- Adaptive Management – applied research to build the capacity of producers and advisers to make complex decisions
- Landscapes (Land Capability) – developing skills amongst producers and advisers to manage in accord with land capability
- Biological Solutions – developing and extending the application of biological alternatives to agricultural inputs
- Grow More Biomass – increased capture and storage of soil moisture to grow more feed, higher yielding crops and retain more ground-cover (especially in times of high erosion risk)
- Use More Biomass – optimal use of all biomass, with emphasis on feed-budgeting and low risk techniques to graze cereals
- Smooth Transitions – better integration of, and movement between, cropping and pasture based enterprises

Goals & indicators

The Goals for each investment theme are represented below:

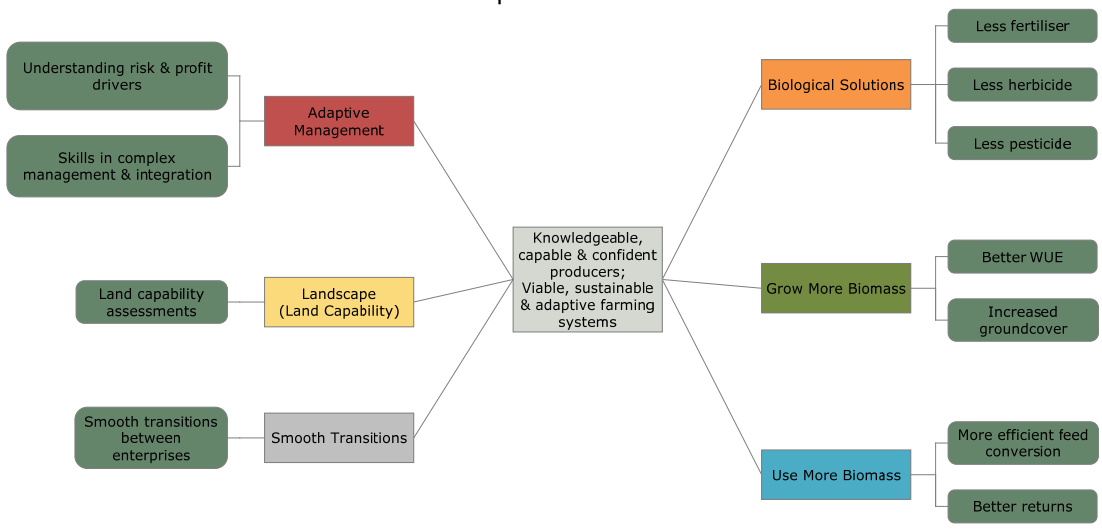


Fig 15. Mixed Farming Systems – goals and investment themes

Indicators of achievement are represented in the appended INDICATORS diagram.

Mixed Farming Systems: BUSINESS PLAN

Practice Change Targets

The Mixed Farming Systems program has the following targets:

Land use to land class:

- 985 farmers use improved land class knowledge to adopt practices and enterprise mixes that are more appropriate for the land class and climatic conditions (increased % of all crop grown on more suitable crop land)

Stubble retention:

- 221,400 additional ha of stubble is retained that contribute to regional groundcover targets (that otherwise would have been burnt, cultivated or overgrazed)
- 258,021 ha managed for groundcover through the stubble retention, use of novel cover crops and rotations.

Crop rotation with pasture, oilseeds and pulses:

- 465.568 ha increase in crops grazed
- 1,071 farmers using guidelines for grazing winter crops, equating to 465,568 ha
- 47% increase in the amount of annual or perennial legume equating to 120,851 ha

Biological methods minimise external inputs to reduce costs and chemical use:

- 24,064 ha of farm land is managed according to full IPM principles
- 76,397 ha of farm land is grazed to control weeds as an alternative to herbicides

Use of perennials in systems:

- 56,254 ha of climate and landscape suitable perennials are established that improve stocking rate and whole farm profitability
- 76% of all climate suitable perennials are established on land deemed marginal or inappropriate for cropping
- 56,254 ha of perennial are grazed to increase production

Stocking rate / intensity:

- 15% increase in whole farm stocking rate though increased utilisation of the whole farm feed base (crops, rotation species, perennial shrubs)
- 786 farmers adjust livestock numbers, duration, intensity of grazing and using other feeding regimes (containment areas) to improve profit while maintaining groundcover targets

Water budgeting:

- 27 farmers use knowledge of moisture status (and irrigation water) to make tactical and strategic management decisions that optimise fodder production and profit

Greenhouse:

- The carbon, greenhouse and water use implications of the substantive practice changes (stubble retention, crop rotations, use of perennials and stocking rate) are determined

Outcomes

Those practice changes will result in whole farm profit being optimised for the rainfall received, while concurrently enhancing the natural resources through biomass management and utilization. Across the Mixed Farming Systems program:

- Farm profitability will increase by an average of 6.8% ($38,650 per farm) for the 3,089 farmers and 1.3 million hectares involved.
- The gains in profit will come from increased crop and livestock production for the rainfall received (an 11kg/ha increase in crop yields and 0.48 DSE/ha increase in stocking rates), and reduced input (fertiliser and chemical) costs (a $1.06 million reduction across the program by using biological methods). An additional 465,568 hectares of crops will be grazed.
- Concurrently, the environment will benefit from the active management of native vegetation to enhance functionality and biodiversity across an additional 2,416 ha and groundcover will be managed to prevent soil erosion across 258,021 hectares.

Mixed Farming Systems: BUSINESS PLAN

- In comparison to 2009:
    - Enterprise selection, location and interaction will be informed by land capability assessment over an extra 584,480 ha
    - An additional 42,669 ha of perennial species will be grown on marginal cropping land or as part of a crop rotation
    - 329,663 ha of land will be managed to enhance the capture and storage of rainfall through the use of cover crops, agronomic practices, innovative crop pasture transition methods and grazing techniques
    - The area under legumes will increase by 120,851 hectares.
    - The carbon and greenhouse gas implications of the mixed farming system will be known

Mixed Farming Systems: BUSINESS PLAN

Implementation

Program development has occurred in 2009 and implementation will progress until 30/6/2013.

Research, development and extension investments

The core budget for Mixed Farming Systems is $12 million; with half each from GRDC and the Australian Government's Caring for Our Country program. A preliminary allocation to programs is:

Themes	In-principle GRDC commitment ($)	Indicative Caring for our Country ($)	TOTAL ($)
Adaptive management	$1,500,000	250,000	1,750 ,000
Growing biomass	800,000	1,600,000	2,400,000
Using biomass	$1,500,000	2,500,000	4,000,000
Biological solutions	$500,000	500,000	1,000,000
Transition	$900,000	1,000,000	1,900,000
Where in the landscape	$800,000	150,000	950,000
TOTAL	**$6,000,000**	**$6,000,000**	**$12,000,000**

Investment clusters (subprograms) are represented in the appended subprograms diagram.

An investment of $1.6 million by MLA will add to the overall core investment, lifting it to $13.6 million. An additional investment of $529,000 is also now proposed by GRDC. Based on previous experience, a further $18.8 million is expected to come from Regional NRM bodies, State agencies, research providers and others (in cash and in kind). The program will run for four years.

Year	GRDC (cash) ($)	Caring for our Country (cash) ($)	MLA (cash) ($)	CMAs and others (cash and in-kind)[1]	Total ($)
1	1,632,250	1,500,000	400,000	4,682,285	8,214,535
2	1,632,250	1,500,000	400,000	4,682,285	8,214,535
3	1,632,250	1,500,000	400,000	4,682,285	8,214,535
4	1,632,250	1,500,000	400,000	4,682,285	8,214,535
TOTAL	**6,529,000**	**6,000,000**	**1,600,000**	**18,729,140**	**32,858,140**

1. Calculated based on the leverage rate of Grain & Graze.

Additional investments (e.g. that by MLA) have been incorporated as investments to the program overall, and not to individual components within it. However, all project investments within Gain & Graze II are assessed through pre-experimental modeling. 'Typical' farms have been described in each region and the production, financial and environmental implications of changed management can be calculated. Regional adoption rates are also predicted, reflecting the relative attractiveness and adoptability of practices and the extension programs to be run, enabling the regional implications to be determined. An economic assessment is then possible, determining the benefit to cost ratio and return on investment.

Operations

The program will be implemented through regional projects administered by regional coordinators, overseen by regional steering committees (involving mixed farmers, researchers and local investors such as regional NRM bodies). The Grains Research & Development Corporation will manage the program. Communications, monitoring and evaluation will be built into each project.

Mixed Farming Systems: BUSINESS PLAN

Business case

Benefit:cost analysis

Financial

Mixed Farming Systems is designed to generate significant improvements in gross margins for participating farmers (totaling 3,089); summing to over $22 million per annum. See Appendix 3, Cost-Benefit Analysis, for more information.

Estimated improvements in gross margins due to Mixed Farming Systems

Sub-Region	Annual improvement in gross margin per farm ($)	Adoption of assumed practice changes (number of farms)	Total annual improvement in gross margin ($)
WA - Binnu	12,374	267	3,299,600
WA - Kojonup	61,634	280	17,257,440
East SA - LRZ	119,330	59	7,000,693
East SA - MRZ	9,733	283	2,751,169
East SA - HRZ	28,190	96	2,706,240
EP upper	78,439	324	25,393,363
EP lower	51,804	159	8,261,016
Nth Vic - Mallee	41,938	435	18,260,432
Nth Vic - irrigation	49,741	17	835,645
Sth Vic	25,264	473	11,959,469
Sth NSW - Condobolin	6,362	123	779,586
Sth NSW - Wagga	9,445	104	981,811
Northern	47,182	469	22,144,000

Based on regional calculations and a CSIRO Water Use Efficiency model, across all participating regions, Mixed Farming Systems will result in:

- Increased crop yield; by 227,500 tonne
- Increased stock numbers; by 2,564,300 DSE
- Increased meat production; by 26,000 tonne
- Increased wool production; by 2,200 tonne.

Those estimated gains generate a very compelling investment scenario, with a benefit to cost ratio of 5.2 to one at the end of the four year program – and those benefits will grow over time.

Summary of the benefits and costs of Mixed Farming Systems

	Benefits captured to end of program (end of year 4)	Benefits captured after 15 years (end of year 15)	Benefits captured after 30 years (end of year 30)
Present value of benefits (PVB) ($m)	160.23	1,032.98	1,670.02
Present value of costs (PVC) ($m)	30.58	30.58	30.58
Net present value (NPV) ($m)	129.65	1,002.39	1,640.03
Benefit:cost ratio	5.2 to 1	33.8 to 1	54.6 to 1
Internal rate of return (IRR) (%)	188.2	214.0	214.0

Mixed Farming Systems: BUSINESS PLAN

Regional modeling of adoption rates and gross margins has assumed that investors contribute in the same ratio to all projects. Hence the benefit:cost ration (5.2 to 1.0) and IRR (188.2%) are the same for all investors. See the discussion under Table 5, Appendix 3 for more information.

Environmental

The 'grow more biomass' theme of Mixed Farming Systems will help promote the maintenance of ground cover, reducing the risk of soil erosion and flowing through to benefits for biodiversity (e.g. soil biota and some insectivores) and carbon retention. It will result in an additional 258,000 hectares of retained stubble and novel cover crops – including stubbles that would otherwise have been burnt or cultivated (which would have resulted in carbon emissions).

The emphasis on using land to its capability will see nearly 1,000 farmers improve the mix of land uses to better match land class and climatic conditions. A bigger percentage of cropping will occur on suitable land and more 'at-risk' land will be under perennial vegetation. Not only will there be an increase in groundcover, it will be targeted to the lands most in need of it. Of the 56,000 hectares of perennials established to improve stocking rate and profitability, around 75% will be on land deemed marginal or inappropriate for cropping.

Biological methods (e.g. integrated pest management and grazing to control weeds) will help reduce costs per unit of production, and will also provide environmental benefits such as reduced chemical use and increased biodiversity. Due to Grain & Graze II, an additional 25,000 hectares will be managed under IPM and more than 76,000 hectares will have stock replace herbicides for weed control.

Risks and sensitivity

The attractiveness of investment in Mixed Farming Systems is driven by high adoption rates and sound gains in gross margins. In assessing the sensitivity of benefits to those risks (see the sensitivity analysis in Appendix 3) it is apparent that considerable value would still be achieved even if high adoption rates did not eventuate, e.g. due to drought. The investment would break-even if just 19% of the anticipated adoption occurred.

If only half the anticipated gain in gross margins occurred the net present value of Mixed Farming Systems would drop to around 40% of the base, the benefit:cost ratio would fall to 2.6 to 1.0, and the IRR would move from 187.4% to 97.8%.

If regional NRM bodies and other stakeholders are not able to invest to the levels anticipated, it will reduce the scope of the program. The analysis has had to assume that each incremental dollar of investment achieves the same return, and therefore if one investor were to withdraw their investment, the value of the benefits would decrease in the same proportion due to either less adoption, or reduced gross margin improvements. Therefore the other investors would still be achieving the same rate of return (5.2 to 1 benefit:cost ratio) but the investment would achieve a lower overall net present value.

If a reduction in spend was not spread evenly across the board and, instead, specific projects were omitted, then regional advice would be required on the impact that would have on adoption levels. The CSIRO WUE model could then calculate the impact on gross margins etc and, through an additional Agtrans module in the spreadsheet model, new economic indicators would be generated automatically.

Counterfactual case

The scoping study conducted prior to Mixed Farming Systems (Andrew et al, 2007) noted that:

If Grain & Graze is not extended into a second phase it will mean that:

- *The unique R&D needs of mixed farming businesses will not be adequately met.*
- *The R,D&E efficiencies that mixed farming businesses and the Australian Government expect will not be delivered.*
- *The gap between production thinking (through RDCs) on the one hand, and natural resource management thinking (through the Regional NRM Bodies) and integrated whole-farm management (by farmers) on the other hand, will not be bridged effectively.*
- *The structures and relationships established (at significant $$ and personal cost) through the first phase will be lost or damaged – giving a poor return on investment.*
- *There will be no opportunity to value-add to existing investment in mixed farming systems research through the CRC for Future Farming Industries.*
- *The enthusiasm of regional partners for cooperative R,D&E will be damaged, along with a concomitant loss of confidence in the RDCs.*
- *The existing Grain & Graze program will be cut short before it could reasonably have been expected to have delivered all its potential.*

Regional information has not been provided on likely adoption levels if Grain & Graze did not proceed. The methodology applied to estimate adoption has focused on change due to the program.

Value proposition

Key features

Grain & Graze II – Mixed Farming Systems brings together production, ecological and social research. It deals with profit and the environment from a farmers' perspective to produce practical management solutions.

It focuses on the strategic and tactical management issues that confront mixed farmers, who are levy payers to GRDC and MLA. This is the only program dedicated to their needs – and it will do it in an effective and efficient manner.

Mixed Farming Systems (Grain & Graze II) provides another avenue for other commodity based programs to communicate with levy payers who are mixed farmers. Mixed Farming Systems can add value to existing investments through engagement with mixed farmers and any tailoring of products required to meet their specific needs.

It is a collaboration between industry, the Australian Government and regional NRM bodies which will result in regional NRM programs that are more favourable to industry, better and greater assistance to producers and better outcomes for regional communities in terms of sustainable production and the environment.

It is a national collaboration between grains and livestock industries and the Australian Government (through the Caring for our Country program). Industry contributes $7.6 million (GRDC $6 million and MLA $1.6 million) and the Government $6 million.

Mixed Farming Systems will build on foundations established by the first phase of Grain & Graze. Considerable effort went into the difficult task of developing relationships and understanding in that phase – building on that base will generate a better return on previous investments.

Mixed Farming Systems: BUSINESS PLAN

Strategic benefits

- **Clients:** The program aims at mixed farmers – producers who pay levies to MLA and GRDC. It is an efficient and effective means for both organisations to service their member's needs.

- **Expectations:** There are expectations amongst levy payers and the Australian Government that RDC's will collaborate to generate the best returns on their investments. Grain & Graze was a prime example of that occurring – and walking away from it would be seen as a lost opportunity by many and, potentially, an indictment on Australia's system of R&D funding.

- **Shifting emphasis:** The trend to increased cropping and reducing sheep numbers may be easing. The losses incurred in cropping country with marginal returns will force producers to seek lower cost, lower risk options such as livestock. Increased use of perennials is also being advocated in these areas for environmental reasons – and, under current policy settings, they can only be profitable if they are grazed. There will be increased interest in meat sheep and cattle, particularly in less reliable mixed farming areas.

- **Increased meat production:** Mixed farmers need to be part of the meat industry's 'whole-of-value-chain' approach to production and marketing, especially if meat production increases. Grain & Graze II will be able to link mixed farmers with other MLA initiatives to ensure a coordinated industry approach and add value to existing MLA programs.

- **Regional NRM Bodies**: Many of the management goals of this program align with those of regional Natural Resource Management bodies (who are collaborators in regional projects). The program provides a vehicle for communication and the joint design of incentives and assistance programs for mixed farmers.

- **On-farm Research:** The regional farming systems trials that will be undertaken through Mixed Farming Systems provide a nucleus for other research. Whether the programs be from Pastures Australia, the Meat CRC, GRDC or MLA, the existence of trial sites and farmer management groups provide a ready site for field testing (or promotion) of new technologies.

- **Community and consumer confidence:** Many 'good news stories' emerge from programs like Mixed Farming Systems (e.g. via 'biological solutions'). The projects and new technologies will be advocates for broadacre industries telling the story of sound environmental management and building confidence that will help allay fears and deflect potential market or regulatory impediments.

MLA

An investment of $1.6 million provides excellent leverage for MLA, making it an influential partner in a $32.8 million program that will directly progress their corporate goals and influence the production decisions of mixed farmer livestock producers. In addition, many of the gains for producers from the program will come from enhanced livestock production.

It is estimated that Mixed Farming Systems will result in a 15% increase in regional stocking rates (rising from 16.75 million to 19.3 million DSE).

This will assist the meat industry in plans for development and stable growth. Mixed Farming Systems offers itself as a portal for communication with mixed producers to ensure they gain maximum benefit from other MLA programs and for mixed farmers to make optimal contribution to the industry, including sheep meat production.

Mixed Farming Systems: BUSINESS PLAN

Investment options.

MLA may invest across all themes in the program or focus on a few; or choose to place more emphasis on either research or delivery. The overall program aims to increase stocking rates by 15% but the detail of all individual projects is not yet available. However, on the information to hand to date, MLA could confidently invest in:

- Building the capacity of producers and advisers to incorporate livestock into mixed farming businesses; e.g. advisor training, Leygrain and Prograze extension, and Adaptive Management theme activities - to improve the skills, knowledge and confidence of producer.
- Regional projects; e.g. the Landscapes and Growing and Using more biomass themes (increasing ground cover, managing stock in no-till cropping systems, and grazing cereals and brassicas) - to generate new knowledge and predictive tools to support decision making.
- The integration of theme outputs; e.g. modeling across the Landscapes and Growing and Using more biomass themes - to generate new knowledge and support decision making.

GRDC

Mixed Farming Systems will help lift profits for mixed farmer grain growers and will add stability to their enterprises. It will increase grain yields by 277,555 tonnes and more value will be gained from crops (e.g. via grazing cereals) while production costs per tonne will be reduced. It will also help industry to address environmental issues and to develop the capacity of farmers and advisers to manage the complexity and diversity of mixed enterprises – as well as enhancing relationships with regional NRM bodies.

Australian Government

Investing in Mixed Farming Systems enables the Australian Government to attract additional industry funding to its research priorities such as responding to climate change and variability, overcoming soil loss, water use efficiency and sustaining biodiversity. It ensures contemporary environmental issues are imbedded into industry programs and provides ready-made networks and delivery channels for communication with farmers. Their investment will promote on-farm change for enhanced environmental outcomes.

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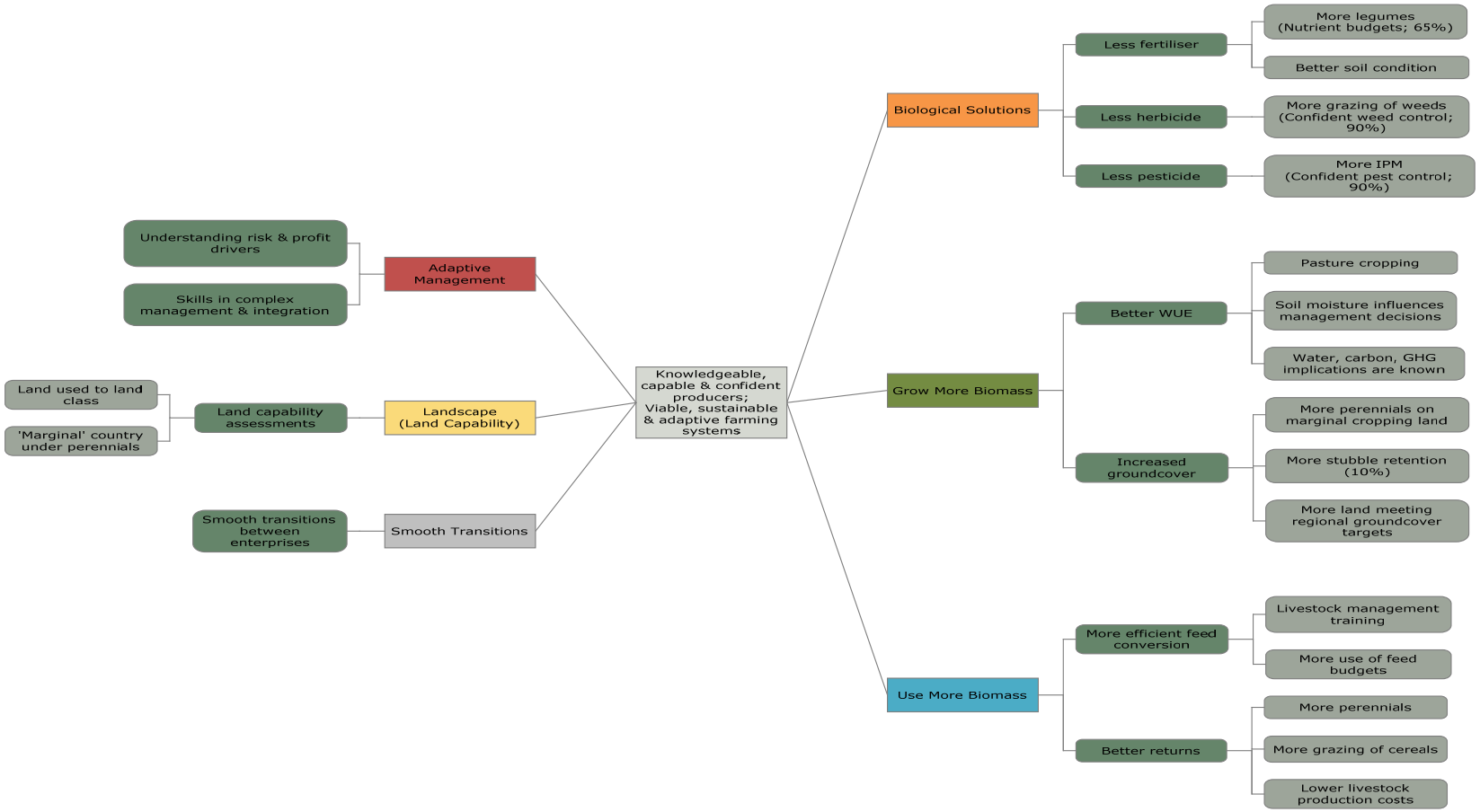
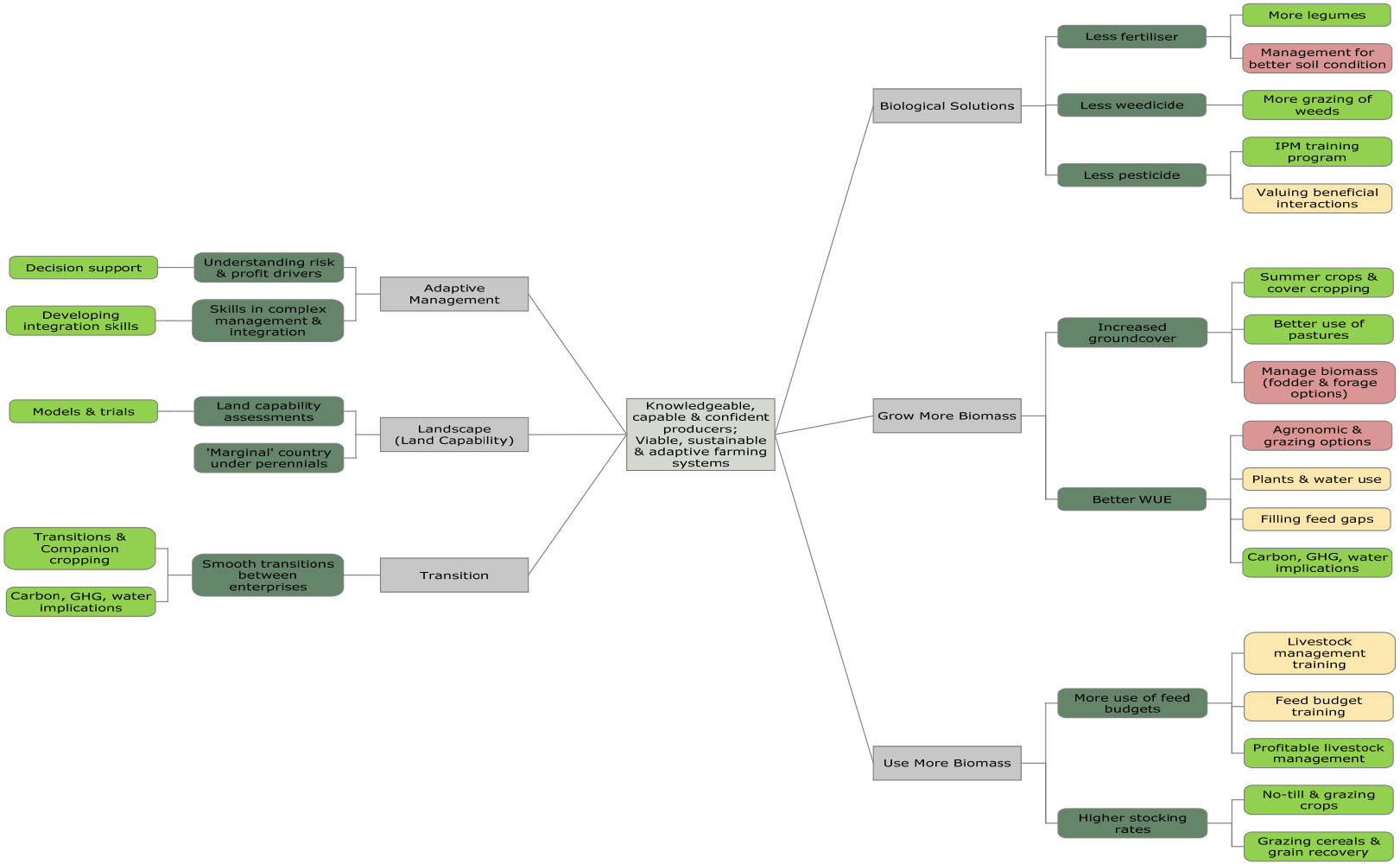
Appendices

Appendix 1. Indicators



Appendix 2. Sub-Programs



Appendix 3. Cost:Benefit Analysis

Cost-Benefit Analysis of Proposed Mixed Farming Systems Investment (2009/10 to 2012/13)

By Agtrans Research, November 2009

Executive Summary

A cost-benefit analysis was carried out on the proposed investment in a Mixed Farming Systems R&D Program. Investors in the program include the Grains Research & Development Corporation (GRDC), the Australian Government through Caring for Our Country, and potentially Meat & Livestock Australia (MLA) and a range of other community and industry investors who may provide cash and in-kind support.

Key assumptions for the analysis were developed by those in the regions who will be involved with the proposed program, and a CSIRO Water Use Efficiency (WUE) model was then used by the regions to calculate adoption estimates and improvements in gross margins that can be attributed to the program.

Agtrans Research then took these assumptions and developed a cost-benefit analysis (CBA) model to calculate the present values of the costs and benefits associated with the program, and to estimate investment criteria such as net present value, benefit:cost ratio and internal rate of return. This CBA model has been incorporated into the CSIRO WUE model to enable changes to the investment criteria to be calculated quickly, in response to changes to specific adoption and practice change assumptions over the life of the program.

The resulting investment criteria are high, with an estimate of a benefit:cost ratio of 5.2:1 and a net present value of almost $130 million by the end of the program. The reason for such a high return by the end of the program is due to assumptions that significant adoption will occur during the life of the program, due to the nature of the program with its high level of localised farmer involvement.

Approach and Methods

Input Data – Assumptions by the Program Team

A process for developing key assumptions relating to the potential impact of the proposed investment in the Mixed Farming Systems Research and Development (R&D) Program was developed and implemented by those involved with the potential research program, with this process coordinated by Cam Nicholson. Assumptions were developed by those in each region who will have a role in the projects and program. All of the assumptions were combined in a CSIRO WUE Framework, and it is assumptions featured in this Framework that form the basis of the assumptions used in this Cost-Benefit Analysis (CBA).

Adoption assumptions

Key adoption assumptions were: the expected level of engagement, the likely adoption speed, the likely peak adoption level and the year in which adoption starts. Such adoption assumptions were made for each sub-region, and for a number of proposed practice changes within each sub-region. The proposed practices varied from region to region, and were based on the planned R&D activities for each region. These assumption adoptions are the number of farmers who will adopt directly due to this program investment, over and above any who may have adopted similar technologies even without this Mixed Farming Investment occurring. The baseline, or 'without program' adoption assumptions are not provided. A summary of the adoption assumptions developed by those involved in the Program for each sub-region are presented in Appendix 1.

The CSIRO WUE framework analysis considers only the benefits flowing from adoption that occurs by the end of the four year program. This is calculated by taking the expected maximum adoption (% of those engaged) and dividing it by the number of years to maximum adoption to obtain an annual adoption figure (assumes linear adoption) expressed as a % of those engaged. Also assumptions were made on the year of first adoption, so allowing an estimate of those engaged who have adopted by the end of the program.

Practice change impact assumptions

Assumptions were also developed by those involved in the program for each practice and sub-region relating to the potential change in gross margin from adopting the practice. Assumptions made include suitable area per farm for the practice, the proportion of this area over which the adoption would occur, and changes in crop yields, stocking rates, fertiliser, weed and insect costs, meat production and wool production stemming from the adoption of the practice.

These assumptions were then combined in the CSIRO WUE framework model to estimate changes in gross margin per hectare, and per farm and region for each practice. The gross margins per farm are reported here, and used as the basis for the analysis. As stated, these are the improvements in gross margin attributable to the program. Baseline average gross margins per farm are reported in the model, but not reported in this report. Any possible improvements to gross margins over the life of the program due to changes made not related to this program are not estimated.

Calculating investment criteria

These foregoing assumptions were taken forward by Agtrans to develop a cost-benefit analysis (CBA) model that incorporates adoption and cash flows over time, and applies discount rates in order to calculate the present value of benefits. The proposed annual investment in the R&D program by the various partners is also discounted, to calculate a present value of costs. The present value of benefits (PVB) and present value of costs (PVC) were used to estimate investment criteria of Net Present Value (NPV), Benefit-Cost Ratio (B/C Ratio) and Internal Rate of Return (IRR) at a discount rate of 5%. The PVB and PVC are the sums of the discounted streams of benefits and costs. The discounting is used to allow for the time value of money. All dollar costs and benefits

were expressed in 2008/09 dollar terms and discounted to the year 0, with the first year of investment in the program being year 1. The benefits are calculated to the end of the program, and at 15 and 30 year periods. It should be noted that some additional adoption that can be at least partially attributed to the program will occur after year 4, but the benefits from those adopters are not counted here.

The development of the CBA has been incorporated as an add-on to the WUE framework, so that as the Mixed Farming Systems R&D program progresses, changes to the investment criteria from updated adoption and impact assumptions can be easily calculated by those involved with the program. This will be a significant added value to Grain & Graze II and will enable quick updating as estimates of engagement, adoption and gross margin change during the program's execution.

Investment Costs

Table 1 presents the proposed investment in the Mixed Farming Systems R&D Program by year, for GRDC, Caring for our Country and MLA. It also presents the potential cash and in-kind investment that might be expected from Catchment Management Authorities (CMAs) and other contributors. This amount is unknown, but has been calculated based on the leverage that was received from these groups during the previous Grain and Graze Program. For that Program, 43% of the total investment was Grain and Graze cash (Viv Read and Associates), with the remainder being contributed through the CMAs and others. This same proportion has also been applied here to calculate the CMA and total figures.

Table 1: Mixed Farming Systems – Annual Investment (nominal $ terms)

Year	GRDC (cash) ($)	Caring for our Country (cash) ($)	MLA (cash) ($)	CMAs and others (cash and in-kind)	Total ($)
1	1,632,250	1,500,000	400,000	4,682,285	8,214,535
2	1,632,250	1,500,000	400,000	4,682,285	8,214,535
3	1,632,250	1,500,000	400,000	4,682,285	8,214,535
4	1,632,250	1,500,000	400,000	4,682,285	8,214,535
Total	6,529,000	6,000,000	1,600,000	18,729,140	32,858,140

Benefit Assumptions

The basic assumptions used in relation to adoption and gross margin changes for each sub-region are presented in Table 2. It should be noted that each of these basic assumptions is derived from a more complex set of assumptions and modeling. Appendix 1 teases out the origins of the adoption assumptions further. However, there are still significantly more assumptions involved in the model than can be presented in Appendix 1, and the WUE Framework should be used to interrogate any of these assumptions further if required.

Table 2: Basic gross margin and adoption assumptions

Sub-Region	Annual improvement in gross margin per farm due to adoption of assumed practice changes ($)	Adoption of assumed practice changes by end of program (June 2013) (number of farms)	Total annual improvement in gross margin per region due to adoption of assumed practice changes ($)
WA - Binnu	12,374	267	3,299,600
WA - Kojonup	61,634	280	17,257,440
East SA - LRZ	119,330	59	7,000,693
East SA - MRZ	9,733	283	2,751,169
East SA - HRZ	28,190	96	2,706,240
EP upper	78,439	324	25,393,363
EP lower	51,804	159	8,261,016
Nth Vic - Mallee	41,938	435	18,260,432
Nth Vic - irrigation	49,741	17	835,645
Sth Vic	25,264	473	11,959,469
Sth NSW - Condobolin	6,362	123	779,586
Sth NSW - Wagga	9,445	104	981,811
Northern	47,182	469	22,144,000

The adoption numbers are based on differing rates of adoption for a number of practices in each region. For some practices, it was assumed that adoption occurred in the second year of the four year program, and therefore three years of adoption are assumed, while for others, adoption was not assumed to occur until year 4, and therefore only one year of adoption has occurred. The adoption numbers above take account of these differences, however in the ROI spreadsheet, a simplistic assumption was used that adoption for all regions commences in year 3, and therefore adoption occurs over 2 years (years 3 and 4 of the investment).

Results

Table 3 presents the investment criteria for the program as a whole, for the end of program, 15 years and 30 years.

Table 3: Investment Criteria for Proposed Mixed Farming Systems Program (all investment) (discount rate 5%)

	Benefits captured to end of program (end of year 4)	Benefits captured after 15 years (end of year 15)	Benefits captured after 30 years (end of year 30)
Present value of benefits ($m)	160.23	1,032.98	1,670.02
Present value of costs ($m)	30.58	30.58	30.58
Net present value ($m)	129.65	1,002.39	1,640.03
Benefit:cost ratio	5.2 to 1	33.8 to 1	54.6 to 1
Internal rate of return (%)	188.2	214.0	214.0

Table 4 presents the present value of benefits (PVB) by region for benefits captured at the end of the program, after 15 years and after 30 years. The proportion of the total PVB attributable to each region is also presented. Please note due to the uniform assumptions relating to timing of adoption, this does not change regardless of the time period over which the PVB is estimated.

Table 4: Size and proportion of present value of benefits (PVB) attributable to each region (discount rate of 6%)

Region	PVB (end of program) ($m)	PVB (15 years) ($m)	PVB (30 years) ($m)	Proportion of total PVB attributable to region (%)
WA	27.08	174.59	282.35	16.9
East SA	16.41	105.80	171.11	10.2
EP	44.33	285.82	462.25	27.7
Nth Vic	25.16	162.18	262.29	15.7
Sth Vic	15.75	101.57	164.27	9.8
Sth NSW	2.32	14.96	24.19	1.4
Northern	29.17	188.06	304.15	18.2
Total	160.23	1,032.98	1,670.62	100

Table 5 presents the investment criteria for each of the investors in the program, counting only benefits captured by the end of the program. This is calculated simply by attributing the proportion of the benefits to each investor, using the proportion of the total investment they have contributed. It does not seek to identify the return to each investor by distinguishing between benefits to each enterprise type.

Table 5: Investment criteria for each investor at the end of the program (discount rate 5%)

Investor	GRDC	Caring for Our Country	MLA	Other	Total
Present value of benefits ($m)	31.83	29.26	7.80	91.33	160.23
Present value of costs ($m)	6.08	5.58	1.49	17.43	30.58
Net present value ($m)	25.76	23.67	6.31	73.90	129.65
Benefit:cost ratio	5.2 to 1	5.2 to 1	5.2 to 1	5.2 to 1	5.2 to 1
Internal rate of return (%)	188.2	188.2	188.2	188.2	188.2

The analysis in Table 5 assumes that each incremental dollar of investment achieves the same return, and therefore if one investor were to withdraw their investment, the value of the benefits would decrease in the same proportion due to either less adoption, or reduced gross margin improvements. Therefore the other investors would still be achieving the same rate of return (5.2 to 1 benefit:cost ratio) but the investment would achieve a lower overall net present value.

More specific assumptions were not made as to how adoption and gross margin improvement improvements might actually change if the total funding were reduced. For example, if the MLA component of the funding were not available, or the assumed 'other' investment is less than calculated, it is not known how the assumed adoption levels might be affected, or how the gross margin improvements might change. In order to make these assumptions, some estimate would have to be made of what parts of the planned program would not be undertaken, and how this would affect a range of assumptions in each region. The CBA model is set up in such a way that if such assumptions can be made by those involved with the program, revised investment criteria could be calculated.

Likewise, manipulation of very specific base level assumptions in the CSIRO WUE framework model may allow some indication to be made of the contribution to the PVB from various aspects of the enterprise (e.g. crops versus sheep). However, further interrogation of the model would be required to determine if this is possible, and significant time may be involved in changing the necessary assumptions.

Sensitivity Analyses

Sensitivity analyses are carried out in order to demonstrate the sensitivity of the investment criteria to the key assumptions. The two key assumptions are the level of adoption, and the level of improvement in gross margin per farm.

The adoption rates have been developed by the consistent application of a logical methodology by each region to generate targets they are confident in achieving. It is, however, noted by the analysts, that the anticipated engagement and adoption targets seem ambitious, given past experience with rates of adoption from previous programs. There may be some risks associated with achieving the regional targets, such as adverse seasonal conditions or other external issues that result in lower than average incomes for farmers, and therefore reluctance to adopt new practices or technologies.

Table 6 presents the sensitivity of the investment criteria (end of program) to adoption levels assumed, and it shows that if it is assumed that only 25% of the base adoption occurs by the end of the program, then the investment still achieves a rate of return of 1.3 to 1. The investment would break-even by the end of the program, if 19% of the anticipated adoption occurs (if it occurs in the same relativity between regions and practices as using the base assumptions).

Table 6: Sensitivity of investment criteria to adoption assumptions

	25% of base adoption	Base adoption	150% of base adoption
Present value of benefits ($m)	40.06	160.23	240.35
Present value of costs ($m)	30.58	30.58	30.58
Net present value ($m)	9.47	129.65	209.76
Benefit:cost ratio	1.3 to 1	5.2 to 1	7.9 to 1
Internal rate of return (%)	28.8	187.4	254.2

Table 7 presents the sensitivity of the investment criteria (end of program) to the level of gross margin improvements assumed.

Table 7: Sensitivity of investment criteria to assumed gross margin improvements

	50% of base gross margin improvements	Base gross margin improvements	150% of base gross margin improvements
Present value of benefits ($m)	80.12	160.23	240.35
Present value of costs ($m)	30.58	30.58	30.58
Net present value ($m)	49.53	129.65	209.76
Benefit:cost ratio	2.6 to 1	5.2 to 1	7.9 to 1
Internal rate of return (%)	98.4	188.2	254.2

As the final columns in Tables 6 and 7 demonstrate, the same proportional change in either the impact or adoption assumptions will have the same impact on the investment criteria.

Environmental and Social Benefits

This analysis has considered and quantified the potential economic impacts of the potential outcomes of the proposed program on mixed farmers in seven regions. In addition to these economic impacts, there will be a number of environmental and social benefits that may also result from the program. The CSIRO WUE Framework model also has the capacity to report the expected number of hectares over which a number of practices will be adopted that will aid in achieving improved environmental management. Table 8 presents a summary of these anticipated outcomes in terms of the areas over which relevant practice changes are expected to be made. These outcomes are the additional levels of adoption due to the proposed program. The baseline areas of current adoption of such practices are not provided.

Examples of potential benefits that might flow from such practice changes include improved biodiversity on and potentially off-farm, reduced wind and water erosion with subsequent impacts on air and water quality, and enhanced capture and storage of rainfall in the soil so reducing run-off with lower levels of nutrients and sediment exported, and potentially reducing dryland salinity in wet years.

The potential public and private environmental benefits have not been valued in this analysis due to difficulties in making the necessary connections between the assumed practice changes, and subsequent impacts that are not already captured in the economic component of the study.

If adoption and some level of environmental impact from practice change can be demonstrated, it would be possible in the future to quantify such benefits using benefit transfer of 'willingness to pay' estimates from choice modeling studies.

The difficulties of quantifying environmental benefits in such analyses are well documented, and in summary, the two key difficulties in attempting to value such benefits are:

- Measuring and attributing environmental change to practice change.
- Valuing the benefits of environmental change (though, is it possible to achieve this through benefit transfer techniques).

Table 8: Summary of potential environmental outcomes

	WA	East SA	EP	Nth Vic	Sth Vic	NSW	Northern	Total
Groundcover managed to prevent erosion (ha)	120,000	51,823	0	0	864	0	85,333	258,021
Active management of native vegetation to enhance functionality and biodiversity (ha)	0	0	0	2,416	0	0	0	2,416
Enterprise selection, location and interaction informed using land capability assessment (ha)	168,000	23,360	198,773	9,600	0	0	184,747	584,480
Perennial species grown on marginal cropping land as part of a crop rotation (ha)	0	120	38,933	2,416	0	1,200	0	42,669
Land managed to enhance the capture and storage of rainfall in the soil (ha)	1,500	76,760	159,840	22,240	1,204	33,685	17,600	326,428
Number of farms regularly using biomass budgeting to achieve livestock and groundcover targets	0	0	0	0	0	21	0	21

It is also noted in the CSIRO WUE Framework that the carbon and greenhouse gas implications of the mixed farming system are unknown. A potential social benefit reported in the Framework is the increased skills of those in the advisory community, who will be supporting farmers to make complicated decisions on growing and grazing biomass.

Conclusions

The cost-benefit analysis shows, that given the assumptions made by the program with respect to potential adoption and improvements in gross margin, the planned investment will achieve a high rate of return, with a benefit:cost ratio of 5.2 to 1 by the end of the program. If the benefits over a 15 year period are considered, the benefit:cost ratio increases to 34:1, and over 30 years, 55 to 1.

This rate of return refers to private economic benefits only, and does not include the potential value of any environmental and social benefits that are also anticipated to flow from the program. It does also not include the benefits that might flow from any adoption that occurs after the completion of the program, and which could be partially attributed to the investment in this program.

As noted during the sensitivity analyses, a potential risk of the investment is that the anticipated levels of adoption may not be achieved due to seasonal (climate) risks, or risks of other issues occurring affecting farm income and therefore impacting on the level of interest in adoption. It was found that the level of adoption for which the investment will break-even by the end of the program is 19% of the base assumption (assuming all other assumptions remain unchanged).

Appendix 1

Table 1: WA – Binnu

Practice	Engagement target	Max adoption rate (% of engagement target)	No. of years to max adoption	Annual adoption rate (%)	Year of first adoption	No. of years of adoption prior to end of program	Adoption rate by end of program (%)	No. of adopters by end of program	Increase in annual gross margin per farm ($)
No stubble grazing + oats	1,000	40	7.5	5.3	3	2	10.7	107	23,580
Pasture cropping	0	40	15	2.7	4	1	2.7	0	5,562
Grazing crops in winter	1,000	40	7.5	5.3	3	2	10.7	107	6,645
Twin sowing	500	40	7.5	5.3	3	2	10.7	53	1,418
Low labour meat sheep (Dorpers)	0	80	7.5	10.7	3	2	21.3	0	8,100
Total	2500							267	12,374

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Table 2: WA – Kojonup

Practice	Engagement target	Max adoption rate (% of engagement target)	No. of years to max adoption	Annual adoption rate (%)	Year of first adoption	No. of years of adoption prior to end of program	Adoption rate by end of program (%)	No. of adopters by end of program	Increase in annual gross margin per farm ($)
No stubble grazing + oats	1,000	40	7.5	5.3	3	2	10.7	107	48,135
Pasture cropping	500	40	15	2.7	4	1	2.7	13	14,298
Grazing crops in winter	1,000	40	7.5	5.3	3	2	10.7	107	92,708
Twin sowing	500	40	7.5	5.3	3	2	10.7	53	38,318
Low labour meat sheep (Dorpers)	0	80	7.5	10.7	3	2	21.3	0	13,215
Total	3,000							280	61,634

Table 3: East SA – LRZ

Practice	Engagement target	Max adoption rate (% of engagement target)	No. of years to max adoption	Annual adoption rate (%)	Year of first adoption	No. of years of adoption prior to end of program	Adoption rate by end of program (%)	No. of adopters by end of program	Increase in annual gross margin per farm ($)
LRZ - legume/ brassica	275	80	7.5	10.7	3	2	21.3	59	119,330
Total	275							59	119,330

Table 4: East SA – MRZ

Practice	Engagement target	Max adoption rate (% of engagement target)	No. of years to max adoption	Annual adoption rate (%)	Year of first adoption	No. of years of adoption prior to end of program	Adoption rate by end of program (%)	No. of adopters by end of program	Increase in annual gross margin per farm ($)
MRZ - legume / brassica	300	80	7.5	10.7	3	2	21.3	64	3,603
MRZ - Dual purpose cereals	300	80	7.5	10.7	2	3	32.0	96	14,764
MRZ - perennial pastures	100	40	15	2.7	4	1	2.7	3	1,175
MRZ - resistant weeds	450	80	7.5	10.7	3	2	21.3	96	100
MRZ - anti-erosion perennials	90	80	7.5	10.7	4	1	10.7	10	-2,640
MRZ - precision ag	300	40	25	1.6	2	3	4.8	14	77,490
Total	1,540							283	9,733

Mixed Farming Systems: BUSINESS PLAN

Table 5: East SA – HRZ

Practice	Engagement target	Max adoption rate (% of engagement target)	No. of years to max adoption	Annual adoption rate (%)	Year of first adoption	No. of years of adoption prior to end of program	Adoption rate by end of program (%)	No. of adopters by end of program	Increase in annual gross margin per farm ($)
HRZ – stubble management	150	80	2.5	32.0	3	2	64.0	96	28,190
Total	150							96	28,190

Table 6: EP - Upper

Practice	Engagement target	Max adoption rate (% of engagement target)	No. of years to max adoption	Annual adoption rate (%)	Year of first adoption	No. of years of adoption prior to end of program	Adoption rate by end of program (%)	No. of adopters by end of program	Increase in annual gross margin per farm ($)
Perennials - Upper EP	800	80	15	5.3	3	2	10.7	85	66,960
Strategic grazing	745	80	7.5	10.7	2	3	32.0	238	82,548
Total	1,545							324	78,439

Table 7: EP - Lower

Practice	Engagement target	Max adoption rate (% of engagement target)	No. of years to max adoption	Annual adoption rate (%)	Year of first adoption	No. of years of adoption prior to end of program	Adoption rate by end of program (%)	No. of adopters by end of program	Increase in annual gross margin per farm ($)
Perennials - Lower EP	400	80	15	5.3	3	2	10.7	43	100,283
Strategic grazing	365	80	7.5	10.7	2	3	32.0	117	34,095
Total	765							159	51,804

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Table 8: Nth Vic - Mallee

Practice	Engagement target	Max adoption rate (% of engagement target)	No. of years to max adoption	Annual adoption rate (%)	Year of first adoption	No. of years of adoption prior to end of program	Adoption rate by end of program (%)	No. of adopters by end of program	Increase in annual gross margin per farm ($)
Livestock in no till. 4	919	80	7.5	10.7	4	1	10.7	98	84,720
Feed supply / qualitty trade offs. 6	603	40	15	2.7	3	2	5.3	32	27,136
Forages for a new climate. 8	1080	40	15	2.7	3	2	5.3	58	22,560
New technology expos. 11	200	40	15	2.7	1	4	10.7	21	16,490
Livestock in whole farm risk - no model	-	-	-	-	-	-	-	-	-
Grazing large paddocks. 13	200	40	7.5	5.3	2	3	16.0	32	12,942
Containment concepts. 16	0	80	7.5	10.7	1	4	42.7	0	143,820
Pasture / crop termination. 20	140	40	15	2.7	4	1	2.7	4	14,775
Systems for intensive crop feedbase. 23	0	40	7.5	5.3	3	2	10.7	0	77,490
Livestock management & marketing. 25	780	40	7.5	5.3	1	4	21.3	166	41,312
Native grass resilience. 28	510	40	25	1.6	4	1	1.6	8	4,850

Perennials in mixed farming. 30	300	40	15	10.7	3	2	5.3	16	3,030
Total	4,732							435	41,938

Table 9: North Vic – irrigation

Practice	Engagement target	Max adoption rate (% of engagement target)	No. of years to max adoption	Annual adoption rate (%)	Year of first adoption	No. of years of adoption prior to end of program	Adoption rate by end of program (%)	No. of adopters by end of program	Increase in annual gross margin per farm ($)
Irrigation water conversion	630	40	15	2.7	4	1	2.7	17	49,741
Total	630							17	49,741

Table 10: South Vic

Practice	Engagement target	Max adoption rate (% of engagement target)	No. of years to max adoption	Annual adoption rate (%)	Year of first adoption	No. of years of adoption prior to end of program	Adoption rate by end of program (%)	No. of adopters by end of program	Increase in annual gross margin per farm ($)
Lucerne	377	80	7.5	10.7	1	4	42.7	161	39,555
Lucerne + pellets	50	80	2.5	32.0	3	2	64.0	32	15,642
Grazing crops	1193	40	7.5	5.3	2	3	16.0	191	17,296
Companion cropping	1020	40	25	1.6	3	2	3.2	33	7,976
Transition cropping	505	40	15	2.7	3	2	5.3	27	8,355
IPM	282	40	15	2.7	1	4	10.7	30	43,536
Total	3,427							473	25,264

Table 11: South NSW - Condobolin

Practice	Engagement target	Max adoption rate (% of engagement target)	No. of years to max adoption	Annual adoption rate (%)	Year of first adoption	No. of years of adoption prior to end of program	Adoption rate by end of program (%)	No. of adopters by end of program	Increase in annual gross margin per farm ($)
Strategic grazing to reduce annual weeds in pasture phase	47	40	7.5	5.3	3	2	10.7	5	3,526
Pasture cropping	97	40	15	2.7	2	3	8.0	8	16,162
Grazing winter cereals	80	80	7.5	10.7	1	4	42.7	34	4,462
Transition systems – Undersowing	304	40	7.5	5.3	1	4	21.3	65	7,254
Transition systems – Twin sowing	76	40	7.5	5.3	3	2	10.7	8	1,383
Alley farming	50	40	15	2.7	3	2	5.3	3	956
Total	654							123	6,362

Mixed Farming Systems: BUSINESS PLAN

Table 12: South NSW - Wagga

Practice	Engagement target	Max adoption rate (% of engagement target)	No. of years to max adoption	Annual adoption rate (%)	Year of first adoption	No. of years of adoption prior to end of program	Adoption rate by end of program (%)	No. of adopters by end of program	Increase in annual gross margin per farm ($)
Strategic grazing to reduce annual weeds in pasture phase	48	40	7.5	5.3	3	2	10.7	5	763
Pasture cropping	98	40	15	2.7	2	3	8.0	8	5,306
Grazing winter cereals	80	80	7.5	10.7	1	4	42.7	34	8,784
Transition systems – Undersowing	304	40	7.5	5.3	2	3	16.0	49	13,584
Transition systems – Twin sowing	77	40	7.5	5.3	3	2	10.7	8	-2,952
Total	607							104	9,445

Mixed Farming Systems: BUSINESS PLAN

Table 13: Northern

Practice	Engagement target	Max adoption rate (% of engagement target)	No. of years to max adoption	Annual adoption rate (%)	Year of first adoption	No. of years of adoption prior to end of program	Adoption rate by end of program (%)	No. of adopters by end of program	Increase in annual gross margin per farm ($)
Match enterprise mix & new forages	400	80	7.5	10.7	3	2	21.3	85	23,250
Ley pastures	400	80	7.5	10.7	1	4	42.7	171	78,000
Optimise grazing strategies	400	80	7.5	10.7	2	3	32.0	128	46,500
Increase forage mixes	400	80	7.5	10.7	3	2	21.3	85	10,500
Total	1,600							469	47,182