



GARDINER FOUNDATION



Priority themes for Irrigation RD&E in the Murray Dairy region 2010

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Executive Summary

The dairy industry within the Murray Dairy (MD) region contributes 20% of the nation's dairy production with a farm gate value of over \$600 million. The industry sustains a large number of regional industries and communities, directly employing over 8,000 people. The operating environment for dairy farmers over the last 10-15 years has seen significant variability in climate, the global economy and water availability. In parallel, major changes to water policy and irrigation distribution systems have occurred. That operating environment will continue to change. This creates the need for dairy farmers to have access to new and relevant information which assists them to maintain profitability in a changing environment.

This Report defines the priority themes for irrigation research, development and extension (RD&E) within the MD region at 2010. It is our expectation that the effective delivery of these themes over the next 3-5 years and beyond will provide essential platforms for short term adaptation and for long term sustainable transformational change in the MD dairy industry.

The RD&E themes were developed using an extensive program of consultation with regional dairy farmers, researchers, extensions specialists and service providers (Section 3).

The themes provide clear directions for future RD&E within the MD region and identify specific outcomes to be achieved within each theme. They provide important signposts for future regional RD&E proposals and standards against which such proposals can be assessed.

The priority RD&E themes for the MD region are:

Theme 1 Fodder to milk under seasonal variability

Target outcomes: Dairy farmers understand the risks, performance and management of major forages under different seasonal conditions and irrigation water allocations, and make informed decisions about feeding options for improved animal performance, profitability and environmental outcomes. The specific areas for RD&E activity within this theme are provided in Section 4.1.

High regional priorities include completion of RD&E on the performance and management of lucerne and tall fescue under seasonal variability; the identification and implementation of more effective means of packaging RD&E information on forage performance; and the establishment of a network of Focus Farms which demonstrate how various RD&E outputs are being implemented in a commercial farm environment.

Theme 2 My water future

Target outcomes: Providers of RD&E information understand the end-user dairy farming community and effectively deliver their information needs.

Dairy farmers enhance their farm business management skills and knowledge so that they make better strategic and tactical decisions which improve their business and lifestyle while also improving environmental outcomes, and

Dairy farmers develop and implement strategic, sustainable on-farm water plans which are integrated with their business plans. The farm business plan will be

linked to a farm water management plan that may encompass strategic and tactical use of irrigation and dryland blocks, high and low security water products, water trade, carryover options and irrigation technologies appropriate for different seasonal conditions. Farm water management plans will provide the on-farm planning framework to enable irrigators to adapt to seasonal and longer term changes in water allocation, climate and markets. The specific areas for RD&E activity within this theme are provided in Section 4.2.

High regional priorities include social RD&E to better understand farmer ‘worldviews’ on farming and water as a platform for designing more effective means of engagement with farmers in areas such as FBM skills development. Using the learnings from the social research, the development of a Sustainable Farm Water Program.

Theme 3 Flexible irrigation systems for feed production on dairy farms

Target outcomes: Dairy farmers understand the costs and benefits, advantages and limitations of the range of irrigation technologies available, including “fast flow” and pipe and riser delivery systems for surface irrigation, subsurface drip systems and spray systems.

Dairy farmers are better able to make informed investment and development decisions within the biophysical and business context of their enterprise, and to make ongoing management decisions that capture the benefits of these systems. The specific areas for RD&E within this theme are provided in Section 4.3.

High regional priorities include completion of the RD&E to better understand the costs and benefits high flow irrigation technologies. Farmers understand and use life cycle analysis as a part of their irrigation technology selection process.

It is critical to note that the RD&E packages within all themes require the full complement of RD&E activities, ie not just R independent of D independent of E. The target outcome is the effective utilisation of RD&E information by the end-user dairy farmer community. This requires seamless RD&E development and delivery.

The next steps are that Murray Dairy will take these RD&E theme recommendations forward for further consideration and action in terms of seeking funding support for conduct and delivery of particular packages.

Recommendations defining the high priority RD&E packages for the MD region are summarised in Section 5. Their implementation will assist both short term adaptation and long term sustainable transformational change within the MD region dairy industry.

We commend the RD&E themes and recommendations to the MD Board and other dairy RD&E funders for consideration and action.

1 Introduction

Over the last 10 years the Murray Dairy region has experienced extended drought, record temperatures and significant reductions and year to year variations in irrigation water allocations. Farmers have adapted by changing pasture types, feed mix strategies and buying and selling water. In parallel, the Northern Victorian Irrigation Renewal Project is investing \$2 billion dollars to upgrade the irrigation delivery system. This will result in contraction of the irrigation system, fewer delivery points, reduced channel leakage and provide farmers connected to the backbone with more consistent flow rates and reduced ordering times. This new operating environment creates new opportunities and new challenges for irrigators.

To help facilitate transformational change under these new conditions, the Gardiner Foundation has funded the Department of Primary Industries Victoria (DPI) to develop a business case for irrigation research, development & extension (RD&E) needs in the Murray Dairy region.

2 Context - irrigated dairy in the Murray Dairy region

2.1 The current and projected environment for irrigated dairy

The regional climate and the average rainfall deficit with respect to plant water requirements make the dairy industry in the Murray Dairy region reliant on irrigation.

During the 1980s and 1990s south eastern Australia experienced a relatively wet climatic sequence. This meant that dairy businesses in the Murray Dairy region enjoyed a competitive advantage based on relatively cheap land and access to reliable, abundant and cheap water. Dairy deregulation drove significant expansion of the dairy industry in northern Victoria, leading to greater investment, greater production and greater use of irrigation water.

Limits to water consumption were recognised at the time. Policy responses such as the Murray Darling Basin Cap, which placed a limit on water diversions from river systems in the Basin, were implemented.

Further water policy changes which sought to enable producers to put water to its most valuable use, resulted in the introduction of water markets, the separation of water from land, and the removal of impediments to water trade. Government has also invested significantly in irrigation infrastructure upgrades to improve distribution efficiency. These changes have provided significant benefits to irrigators, allowing industries and enterprises to adapt to changing circumstances and operate more efficiently.

Water scarcity during the 1996-2009 drought drove dramatic changes in regional dairy farming systems. Farmers moved away from traditional perennial ryegrass/white clover pastures to more water conservative systems based on a range of feed sources such as annual pastures and forages, annual fodder crops, lucerne and bought in feed.

Increased community expectations of environmental protection and projections of a drier future climate have driven further water policy changes. The Federal “Restoring the Balance in the Murray-Darling Basin” program is purchasing agricultural water entitlements for reallocation to the environment.

The on-going reduction of agriculture's access to water means that irrigation water can no longer be assumed to be a reliable, cheap or abundant resource in the Murray Dairy region. Continuing uncertainty in both climate and water availability is driving irrigated dairy toward the development of more flexible farming systems which can operate under climate uncertainty and make the best use of both rainfall and irrigation water.

These systems need to be able to adapt to within-year and year to year changes in the operating environment, usually require significant investment to establish, are more expensive to operate and more complex to manage. In the short term, they are likely to reduce the margins for dairy businesses and demand greater investment, business management and technical skills.

The uncertainty, in particular the lack of detail, with respect to future government policies such as the Murray Darling Basin Plan and schemes to reduce greenhouse gas emissions, appear likely to remain.

2.2 Relevant current RD&E

As a precursor to the definition of future irrigation RD&E needs, this section summarises some of the key recent and current RD&E initiatives.

Project	Funders	Duration	Objectives	Contact
Dairy Directions - Analysing Farm Systems for the Future	DPI, Dairy Australia, Murray Dairy, GippsDairy, WestVic Dairy, The University of Melbourne	July 2008 to June 2011	Analyse options for dairy farms to maintain and increase profit, net worth and manage risk under: <ul style="list-style-type: none"> • Fluctuating milk price and real increases in input costs • Climate change projections and related policy changes • Increasing land values, which impact on the expansion of dairy businesses. Disseminate information generated from the project to inform influential farmers, service providers and policy groups of options to optimise profit and manage risk.	Bill Wales, Christie Ho
Flexible Feeding Systems	DPI, Dairy Australia	July 2009 to June 2012	Define the underlying physiological principles connecting milk protein, fat production and feeding regimes. Develop strategies for flexible and efficient feeding systems incorporating high levels of supplements. Optimise farm production, cow performance, health and welfare with constraints of high supplements systems.	Bill Wales, Joe Jacobs, Martin Auldish
Genetic markers for feed efficiency in dairy cows	DPI, Geoffrey Gardiner Dairy Foundation	July 2010 to June 2013	Reduce the amount of feed required to produce a litre of milk for Australian dairy cattle by genetic selection using DNA marker panels (Estimated value = \$80 million NPV) Establish the relationship between feed conversion efficiency in lactating dairy cows and methane emissions, and quantify the extent of emissions in low and high feed conversion efficiency animals. Develop biotechnology tools to manage a reduction in GHG emissions per litre of milk produced.	Ben Hayes Bill Wales
Feeding Systems for Higher Value Milk	DPI, Geoffrey Gardiner Dairy Foundation, Dairy Australia	July 2010 to June 2013	Determine the impact of new feeding systems developed within the Flexible Feeding Systems and Methane Mitigation Strategies programs at DPI Ellinbank on the composition and utility of the milk supply received by the dairy processor. Describe the effects of observed variations in milk composition on the suitability of milk for the manufacture of dairy products, and produce and deliver a range of information and technology packages tailored to the needs of dairy company milk supply officers and processing managers.	Martin Auldish

Reducing Emissions from Livestock	DPI, Dairy Australia, DAFF, MLA	March 2009 to December 2011	Evaluate forages and dietary supplements for methane mitigation and production impacts.	Peter Moate
Flexible forage systems for variable water supplies	DPI, Dairy Australia and Murray Dairy	July 2008 to June 2014	Determine the production, water use and persistence of lucerne under variable irrigation strategies. Develop practical, physiologically-based grazing criteria for tall fescue to optimise its production, utilisation by the grazing animal, and water productivity. Determine the seasonal and annual probability distribution of water requirements of irrigated forages in the Murray Dairy region under a range of climatic scenarios. Contribute to increased adoption of better adapted forages within irrigated dairy systems.	Kevin Kelly
Project 3030 Phase 2: Resilient dryland forage systems	DPI, Dairy Australia, GippsDairy, WestVic Dairy, Murray Dairy, DairySA	July 2005 to June 2011	Phase 1 of Project 3030 began in early 2005, with the aim of: 'Increasing profit by 30% through a 30% improvement in the consumption of home-grown forage'. This remains the over-arching objective for phase 2 of 3030. The specific objectives for Phase 2 of the project are to: <ul style="list-style-type: none"> • Complete the development of integrated forage systems for dryland dairy businesses that result in higher rates of consumption of home-grown forage and higher profitability • In partnership with leading farmers, test the extent to which 3030 know-how and tools can support accelerated, planned change in forage production and profit in commercial farm businesses • In partnership with the DEC and other practice change extension providers, co-develop extension programs to increase the capacity of farmers to manage forage systems to reach productivity goals. 	Brendan Cullen, University of Melbourne Joe Jacobs
Benchmarking Regional Farm Irrigation Performance in the GMID	DSE	July 2009 to June 2013	The project aims to deliver a water-use appraisal system that will support the reporting of WUE indicators as part of the evaluation process for modernisation. It will report baseline water use indicators and supporting information for the 2008/09 and 2012/13 irrigation seasons for the GMID and provide an ongoing information source to support the planning and implementation of the modernisation program in GMID by Northern Victorian Irrigation Renewal Program (NVIRP).	Andy McAllister

Satellite based information systems for improved irrigation water management in Victoria	DSE	July 2010 to June 2014	Remote sensing data has shown that paddock scale vegetative cover of existing perennial pastures is very variable. Crop water requirement (CWR), the amount of water needed to maximise crop yield, also varies strongly because of the dependence of CWR on vegetative cover. Better matching of CWR based water needs with water applied provides for high yields and ensures that water is not wasted. This project aims to deliver affordable block-scale CWR information for on-farm use by irrigators.	Des Whitfield
Irrigation in dry conditions	DPI, DSE, Murray Dairy, GGF	July 2010 to June 2014	Develop and validate irrigation system analysis tools and models appropriate for dry climatic conditions, the current range of irrigated crops and a modernised irrigation delivery system in northern Victoria. Update or develop guidelines for irrigation system selection, design and management on major GMID soil types under dry conditions, different crops and a modernised supply system. Facilitate decision-making by irrigated farm businesses in the Food Bowl in regard to the future options available for their enterprises	Mike Morris
Helping dairy farmers secure their water future	DSE, DEC		Help farmers and service providers better understand and take advantage of new water policy directions and better manage their water resources and associated risks, through delivery of activities such as irrigation policy briefings for irrigators, DPI and DSE staff and service providers from the financial, legal and farm sector	Rob O'Connor
Climate Change	DEC, DPI		Staff capacity - deliver training programs for DEC to increase their skills in understanding and managing climate change. Planning for Climate Change - deliver climate change awareness activities across the state to both farmers and service providers Adaptive forage planning - inform farmers and service providers about climate and market signals to inform growing and purchasing decisions. Provide timely information about growing and managing crops for both dairy and cropping farmers "Milking the Weather" - this seasonal newsletter will deliver the latest seasonal climate risk information to dairy farmers, service providers and other interested subscribers.	Lyndal Metcalf
Profitable feeding systems	DEC		Deliver Feeding Pastures For Profit (FPFP) programs to dairy farmers Deliver consolidation material to past participants Deliver FPFP capability training to DEC staff to help farmers understand their system and to more profitably manage their pasture and feed resources, in a "water-challenged" context.	Phil Shannon

<p>Changing Irrigation Practices (Sustainable Irrigated Landscapes Program)</p>	<p>DPI, DSE.</p>		<p>Irrigation Assessments - Farm irrigation Assessments were to be the primary focus of a two year project. Once it became clear this work would be privatised well ahead of expectation, the project was able to incorporate other initiatives, including those listed below:</p> <p>Demonstrating Soil Moisture Monitoring Technology - 12 demonstration sites have been established and associated field days and other communication events have been delivered. Irrigators and private companies are intensely interested in how the different systems perform.</p> <p>NVIRP Work Site Assessments</p> <p>Farm Services Victoria has supported NVIRP meet their State and Commonwealth environmental obligations. This involves site assessments to ensure proposed works (replacing outlets, regulators, channel lining and other modernisation activities) comply with existing Land and Water Management Plan objectives and other environmental overlays.</p> <p>Practice Change Research - Two relevant Practice Change Research projects have been commissioned to assist DPI in more effectively targeting their irrigation efficiency practice change activities.</p> <p>The first one considered the level of understanding irrigators have about the potential to invest in farm system changes to improve their water use efficiency. This work confirms there is considerable interest in taking advantage of water savings opportunities but there is some scepticism where government co-investment is involved.</p> <p>The other is an investigation into the factors that increase farmer's interest in adopting new irrigation technology. This work is incomplete but will provide an understanding of the market segments and the evidence to better target DPI's services.</p>	<p>Neil McBeath.</p>
<p>Farms, Rivers and Markets – how to do more with less water</p>	<p>National Water Commission, Victorian Water trust, the Dookie Farms 2000 Trust (Tallis Trust) and the University of Melbourne</p>	<p>November 2008- November 2011</p>	<p>Identify:</p> <ul style="list-style-type: none"> • More flexible, environmentally sustainable yet profitable agricultural production systems. • More robust approaches to meeting environmental objectives for groundwater and surface water. • More efficient and environmentally sound options for water supply system operation and planning. • Market pricing and governance mechanisms to provide information for decision makers. 	<p>John Langford University of Melbourne</p>

3 Dairy Irrigation Advance workshop

3.1 Background

The first stage of defining the irrigation RD&E priorities for the Murray Dairy region involved the planning and implementation of a one-day Dairy Irrigation Advance workshop. This brought together experienced dairy farmers who manage a range of production systems, researchers, extension specialists and service providers from the Murray Dairy region to identify regional irrigation RD&E priorities.

3.2 Dairy Irrigation Advance workshop

The aims of the Dairy Irrigation Advance workshop were to:

- Reflect dairy farmer perspectives on the regionally relevant irrigation RD&E needs which would facilitate better adaptation to current new conditions in the short-medium term,
- Identify and prioritise the strategic irrigation RD&E needs which would facilitate transformational change in the Murray Dairy region,
- Use the best available formal and local knowledge in the above identification and prioritisation process,
- Ensure that the regional RD&E priorities identified were consistent with the national agenda as defined in Dairy Moving Forward (DMF), and
- Achieve a reasonable gender balance amongst participants.

3.3 Workshop Steering Committee, attendees, processes

To achieve these aims, a Steering Committee of key regional dairy farmers selected from across the irrigation region plus researchers, extension specialists and service providers was established (see Section 3.5). Approximately 40% of Steering Committee members were dairy farmers.

The Workshop was attended by 55 people including 23 dairy farmers (ie over 40% of participants), researchers from the University of Southern Queensland (USQ), Melbourne University (UM) and DPI at Warrnambool, Ellinbank and Tatura, extension specialists from DPI at Echuca and Tatura and service providers such as Farmanco, G-MW, RMCG and Fonterra.

To ensure that regional RD&E needs were consistent with national priorities, participants considered the target outcomes defined in the 5 program areas of DMF¹. Participants then identified the irrigation RD&E needs specific to the Murray Dairy region and prioritised projects according to their perception of regional importance.

¹ The DMF program areas are Feedbase and Animal Nutrition; People; Natural Resource Management and Climate Change (NRMCC) including water, sustainability and greenhouse gas (GHG) reduction; Animal Performance and Farm Business Management (FBM).

3.4 Workshop outputs and RD&E Themes

The highest regional priority areas identified by the Workshop were:

- A greater uptake of (and capability in) FBM by the ‘middle’ 30% of dairy farmers. This would fast-track recovery by assisting farmers to recover profit, improve efficiency, develop reliable milk supply and strengthen communities.
- Understanding the performance, management and integration of forages under conditions of variable water supply. This is an urgent issue which can be resolved in the next 3-5 years and will help the majority of dairy farmers increase their production and profitability.
- Increased understanding of high flow irrigation systems – where it works, under what conditions, what are the opportunities, how flexible can it be? This is important because surface irrigation will remain the primary irrigation technology and fast flow may provide a significant improvement in efficiency. However, the potential and opportunities it may provide on the range of forages, crops and soil types in the region is unknown.
- A program which enables individual farm businesses to develop their own sustainable water strategies. This would include a business focus and improved decision-making skills.
- A program which enables irrigators to understand the whole-of-life energy and economic costs and benefits of different irrigation systems (gravity and pumped). New systems are often swapping water savings for carbon and a whole of system investment analysis is required.
- Demonstrate how to integrate new water use systems, partial mixed rations and cropping into pasture-based systems using either demonstration sites or Focus or monitor farms.

Nine workshop participants from research (DPI, UM, USQ) and extension (DPI) met after the Workshop to consider the priority areas. The 15 priority projects were clustered into 7 RD&E themes for further development in the business case. The 7 Themes for irrigation RD&E in the Murray Dairy region are illustrated in Figure 1. They link the ability to manage forages under seasonal variability with benchmarking of on-farm performance and nutrient management; the development of strategic on-farm water use plans which are linked to farm business plans. This includes the collection of water-use efficiency indicators which demonstrate industry improvements to the wider community; and the improved understanding of and ability to select irrigation technologies for improved delivery systems and reduced water availability.

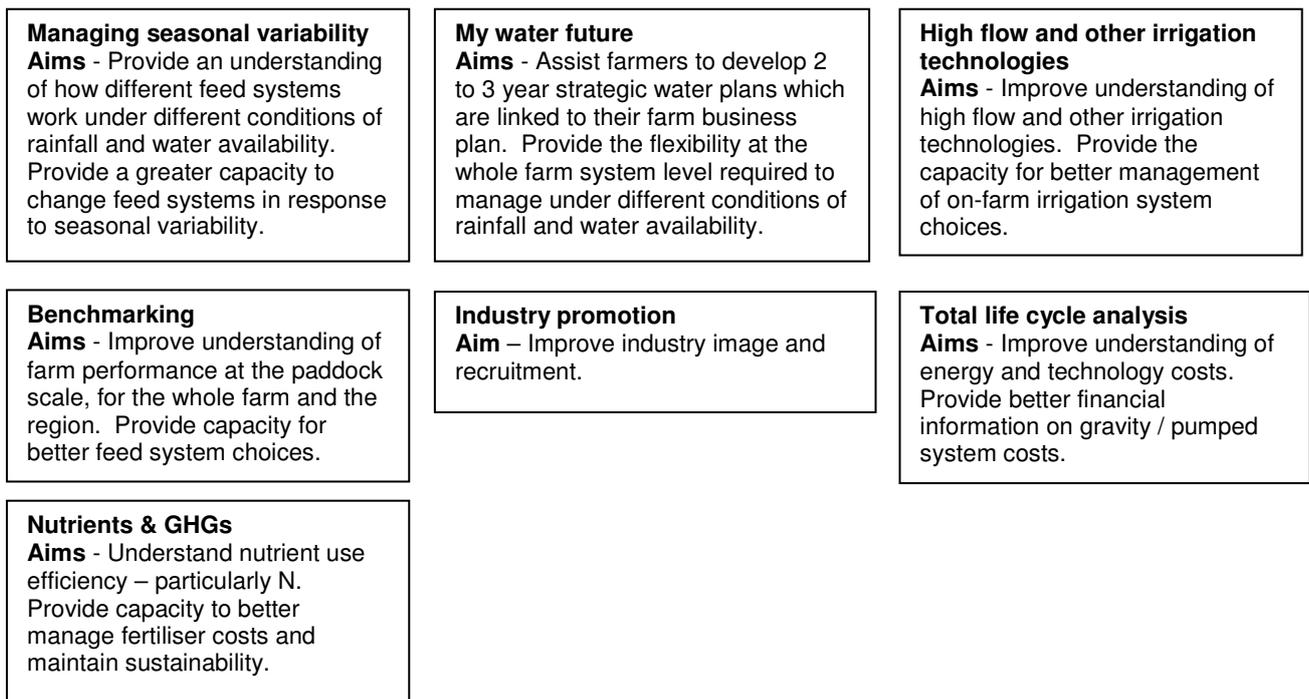


Figure 1 Irrigation RD&E Themes

Details of how the 15 priority project areas identified at the Dairy Irrigation Advance Workshop were embedded within Theme are given in the following pages. The group noted the following potential gaps in theme coverage:

- The potential for totally new irrigation technologies;
- Dairy farming leadership at a high level in relation to water;
- Consideration of short and long term ‘policy sensitivity’ in all theme areas;
- Farmer business management and other skills development required to adapt to a strongly varying environment;
- The shift from public infrastructure to (syndicated) private infrastructure;
- Social implications of less irrigation water;
- Drainage and salinity issues; and
- The methane, carbon and phosphorus implications of changing feedbase systems.

Theme 1: Improving Capacity to Manage Seasonal Variability

AIM Improve the capacity of farmers to use different feed systems under different conditions of rainfall & water availability (provides within season tactical capability)

- This has a strong emphasis on feed systems, captures what people are doing, demonstrate their working – feeds into capacity to manage
- It is consistent with irrigation RD&E focus – provides an understanding of the role of irrigation in whole farm feed production systems
 - Water for dry matter for milk, system flexibility between seasons, risk management, carry over water - so that people can plan and not react
- Aims to smooth out / make production more consistent, capture limits of each feed system, deal with transition times, increase profitability, trade off between optimising production and flexibility

DMF PROGRAM AREA	PROJECT AREA	WHY WE HAVE ALLOCATED THIS PRIORITY	WORKSHOP VOTES
Feedbase and Nutrition – Research & Development	Understanding the performance, management and integration of forages under conditions of variable water supply.	<ul style="list-style-type: none"> • Urgent issue that can be resolved in the next 3-5 years and held the majority of dairy farmers increase their production and profitability • Will optimise the milk production from each ML of water which is becoming more scarce and availability • Without projects such as this it is likely that the impact of reduced water allocations will be greater on the dairy industry 	21
Farm Business Systems - Development	Demonstrate, through focus or demonstration farms, profitable and optimal water use efficiency systems based on the integration of partial mixed rations and cropping into pasture-based systems.	<ul style="list-style-type: none"> • Knowledge gaps exist in broader industry • A higher proportion of farmers are attempting alternative feeding systems with variable results • Opportunity to improve productivity and wealth of the business • Provide more flexibility in a variable environment 	15
Animal Performance – Research & Extension	To determine the impact on animal performance of feed base variability	<ul style="list-style-type: none"> • Feedbase can vary within the season as well as between seasons due to irrigation allocations • Different seasonal herds on one farm will also experience feedbase impacts • Declining herd fertility – is there a relationship between feedbase and fertility? What management practice should be used under different feeding systems to optimise fertility? • Mastitis has become a significant problem under TMR and PMR systems. Is this due to metabolic issues, environmental issues or a combination? What is best management practice? • Improving FCE through genetic markers and feedbase selection will drive profitability • Need to overlay cow performance (production and profitability) over other projects relating to water. No point in having forages that are successful – re: WUE if cows will not eat the feed or it does not convert to milk, or has adverse impacts on animal health 	8

Theme 2: My Water Future

AIM Assist farmers to develop 2 to 3 year strategic plans for their farm to provide whole farm system flexibility

- Water strategy at a personal scale, has an farm business management (FBM) component
- Provides understanding at a policy level, Answering questions from policy, Impact on farms, How does the industry report to community

DMF PROGRAM AREA	PROJECT AREA	WHY WE HAVE ALLOCATED THIS PRIORITY	WORKSHOP VOTES
Farm Business Systems - Research & Extension	Greater uptake of and capability in Farm Business Management (FBM) by dairy farmers	<ul style="list-style-type: none"> • To fast track recovery by engaging dairy farmers in FBM to recover profit to farmers leading to better efficiencies and reliable supply of milk and stronger communities • Embraces all existing and new information / tools / programs • Target audience “middle” 30% (300 farmers) have the greatest opportunity • Use social research to design engagement of this group • Believe this group is missing opportunity in meeting goals of profit and wealth, well being and agility to better for see change and respond 	29
People - Development	A program for individual farm businesses to develop sustainable water strategies (sustainable for people profit, environment). This needs to include: a business focus (vision, profit, direction strategy), improved decision making and capacity, NOVEL engagement, use different expertise. Leads to next best decisions	<ul style="list-style-type: none"> • Information about new technology / new feeding etc alone is not enough for supporting change / more from less water. This program will draw on / translate information customised to farm business • People place different values / attitudes towards water / water trading etc. This program will start where people are at (eg. water source audit, risk price thresholds, business, water future) • Community / Government often not aware of progress being made – this program will track progress and report • Many farmers don’t participate on programs / activities available – this program will research and design new ways to engage more people in doing things for a better future • Water is linked to all farm and environment systems – this program will utilise disciplines effectively 	17
Farm Business Systems - Extension & Development	To improve dairy farmers strategic and tactical response capacity to water reform and initiatives, e.g. farm water, modernisation, trade, carry over, new technology, regulation	<ul style="list-style-type: none"> • Federal and State governments are seeking support and solutions for water resources management within MDBA • Investing in delivering infrastructure, but little in environmental solutions or on farm and helping farmers take advantage of the opportunities • Good piece of water policy in Victoria that isn’t yet being optimised because its not well or fully understood by irrigators 	7
Farm Business Systems - Development	Equip farmers with the tools and knowledge to make decisions about the optimal water product mix for their business	<ul style="list-style-type: none"> • No clarity around optimal relationships between permanent and temporary water and the relationships between water and water substitutes such as grain, purchase forage, etc • Increase productivity • Reduce risk 	5

Theme 3: High Flow & Other Irrigation Technologies

AIM Provide farmers with an understanding of high flow systems and all irrigation system alternatives

- Currently have a lack of information on water saving, profitability, soil moisture in the root zone, labour saving, FBM, carbon/economics of different systems
- Links to seasonal variability and farm layout, labour management, economic implications
- Allows farmers to better match application system to plants systems
- Involves skills, training needs

DMF PROGRAM AREA	PROJECT AREA	WHY WE HAVE ALLOCATED THIS PRIORITY	WORKSHOP VOTES
NRM & CC - Research	Increased understanding of High Flow – where it works / under what conditions? What are the opportunities? How flexible can it be?	<ul style="list-style-type: none"> • Surface irrigation will remain the primary irrigation technology – fast flow may provide a significant improvement in WUE, but the potential and opportunities it may provide on the range of forages and crops / soil types in the region is unknown 	19
People Extension & Development	To develop skills and opportunities to make the best use of modernised irrigation systems	<ul style="list-style-type: none"> • To allow farmers to capitalise on changes • Improve lifestyle • Clarify direction for advisors • Enhances practice change 	3

Theme 4: Benchmarking

AIM Enable farmers to collect data on their own farm in order to make informed feed/forage system choices. Data at 3 levels:

- Individual forage components within farm – nutritional question. Feeds into overall farming system approach. Needed for grazed forage. Provides information for supplementary feeding
- Farm level - All water / forage, provides understanding of what current performance is, links to FBM – tactical / strategic
- Farm to regional scale – benchmarking collective impact within season

DMF PROGRAM AREA	PROJECT AREA	WHY WE HAVE ALLOCATED THIS PRIORITY	WORKSHOP VOTES
Feedbase & Nutrition - Extension & Development	To improve the profitability of dairy farms by enabling farmers to benchmark the utilised DM per ha and per ML for each forage type grown on their farm	<ul style="list-style-type: none"> • Farmers need to measure their performance so as to know how to improve if there is scope to improve. This is critical for the future possibility and sustainability to position the industry for success 	3
NRM & CC - Research & Development	Better measures of water productivity at farm to regional scales (GIS/Remote sensing of ET and Land mapping)	<ul style="list-style-type: none"> • The dairy industry is under scrutiny over water use requiring objective measures to improvement in water productivity • At farm scale can provide basis for benchmarking and monitoring system improvement 	2

Theme 5: Total Life Cycle Analysis

AIM Provide farmers with cost information on their water and energy system, particularly when pumped systems are being used

- Links to 'system' farming, and to strategy, tactical

DMF PROGRAM AREA	PROJECT AREA	WHY WE HAVE ALLOCATED THIS PRIORITY	WORKSHOP VOTES
NRM & CC - Extension & Development	For irrigators to understand the whole of life energy and economic costs and benefits of the various irrigation systems (ie. gravity and pumped)	<ul style="list-style-type: none"> • Gap in knowledge / solves an urgent issue • Urgent need given investment decisions driven by modernisation • Swapping water savings for carbon ie. water saving is justifying the investment without knowing the project life carbon and economic costs and benefits (trying to avoid swapping water for carbon and future costs) • Positions the industry as reliable and profitable • Engages the industry in business best practices for the time • Prepares people for change • Be of direct benefit to the majority 	17

Theme 6: Greenhouse Gases and Nutrients

DMF PROGRAM AREA	PROJECT AREA	WHY WE HAVE ALLOCATED THIS PRIORITY	WORKSHOP VOTES
NRM & CC - Research & Development	Nutrient use efficiency (N particular) – biological? Concentrated sowers and dispersed sowers Dairy shed, Laneways (?), Feedpad / stand off Redeposition in paddock Feed inputs Nitrogen fertiliser inputs C&N linkage Intervention - likely strategies	<ul style="list-style-type: none"> • Cost of production – ie. inputs versus outputs • Nutrient loss pathways - efficiency of production systems <ul style="list-style-type: none"> - greenhouse liability - nutrient loss (catchment targets) • Water key linkage in N cycle (+carbon) 	4

Theme 7: Industry Promotion

AIM Change the negative perceptions of the industry for recruitment and workforce, and to justify our water use

DMF PROGRAM AREA	PROJECT AREA	WHY WE HAVE ALLOCATED THIS PRIORITY	WORKSHOP VOTES
People	Irrigated dairying is valued in the community. Demonstration of sustainable practices. Good news stories. The true value of the industry to the local and national economy. Good jobs – researchers, tech, animal, business and practical. Education – secondary / uni.	<ul style="list-style-type: none"> • People think irrigated dairy farming is like whaling – we need to turn this around 	3

3.5 RD&E Steering Committee

Steering Committee members

<i>Dairy farmers</i>	Malcolm Holm	(MID – Blighty/Finley)
	Monique Bryant	(Murray Valley – Numurkah)
	Jeff Odgers	(Central Goulburn - Ardmona) Chair
	Ann Gardiner	(Rochester - Bamawm)
	Craig Lister	(Loddon Valley - Calivil)
	Steve Henty	(Torrumbarry – Cohuna)
<i>Dairy industry</i>	Dr Amy Richards	(Geoffrey Gardiner Foundation)
	Cathy Phelps	(Dairy Australia)
<i>Research / Extension</i>	Dr Joe Jacobs	(DPI) – FFSR Program Leader Dairy
	Penny Shaw	(DPI) – FSV Program Manager Dairy
	Neil McBeath	(DPI) – FSV Program Manager Sustainable Irrigated Landscapes
	Dr Ruth Nettle	(UniMelb) – Leader - Rural Innovation Research Group
<i>Water / land managers</i>	Louissa Rogers	(DSE) Water Resources Planning Policy
<i>Service providers</i>	Cameron Smith	(Farmanco)
	Daryl Poole	(RMCG)

4 Irrigation RD&E themes for the Murray Dairy region

This section presents the RD&E business plans for the three major Theme areas identified in Section 3, ie managing seasonal variability, my water future and high flow systems. Within each business plan, we have focused on articulating the target outcomes to be achieved, and identifying some of the complexity and substance which needs to be considered in achieving those outcomes. We have reflected the priority of RD&E needs identified by workshop participants as high, medium and low, based on the number of workshop participants' votes each Theme element received. In some cases, we have identified issues which were not raised by participants but which provide co-requisite information for a workshop goal to be achieved. We have also attempted to delineate between specific RD&E needs for the MD region and national RD&E needs with important regional implications. We have distinguished between those elements which can be delivered with short term investment and those elements which are long term in nature and require ongoing RD&E investment. Finally, we make the point that the Theme areas are complex and highly interdependent systems, which highlights the need to ensure effective communication within and between RD&E Themes.

This is a business case. However, the reality that we faced was that research leaders were very reluctant to put hard numbers on the time and resources required to achieve particular outcomes without first thoroughly scoping the issue. Their experience is that such scoping is an integral part of the preliminary work within a given RD&E package and is best done by the group delivering that package. Given these difficulties, after discussions with researchers, we have attempted to provide an indicative estimate of time and resources required where we can.

In terms of the benefits likely to be accrued by delivery and effective implementation of the RD&E packages, we have likewise only been able to provide qualitative rather than quantitative benefits.

4.1 Theme 1- Fodder to milk under seasonal variability

Context

Farmers are required to manage their farming systems under within-season and inter-seasonal weather variability and under early season uncertainty with respect to irrigation water allocations. This invariably leads to reactive management of the forage/feed mix components of the farming system, with suboptimal outcomes. The provision of carry-over water in the Goulburn Murray Irrigation District provides farmers with greater certainty in relation to subsequent irrigation seasons, enabling them to engage in strategic business planning of their future feedbase with respect to water availability.

Target outcomes

Farmers (a) understand the risks, performance and management of different forages under a range of seasonal conditions and irrigation water allocations, and (b) make better decisions about feeding options which improve animal performance, profitability and environmental outcomes.

Information needs and current status

To effectively manage their forage and feed mix under varied seasonal conditions, farmers need information on:

- How major forages perform with respect to expected dry matter production (annual and seasonal) and nutritional value, under different seasonal conditions and water regimes on different soil types. This was identified as a high priority for this region.

From a research perspective, these issues are reasonably well understood for the mainstream regional forages (e.g. perennial ryegrass and annual clovers). DPI is currently focusing research on lucerne and tall fescue, with plans for a further 3 years of research in this area currently under review. The completion of this work is strategically important to the region.

Farmers identified the need for more effective D&E on regional forages so that the research information is readily usable by farmers and service providers.

A low priority regional D&E need was that farmers need to measure what they grow. While this was allocated a low priority relative to other needs, the lack of information on farm performance at the paddock scale undercuts the ability to manage supplements effectively. Farmers may also require assistance on how to integrate production information into their farming systems management.

An area discussed but not prioritised for future RD&E is: Given that climate variability, change and altered water availability may reduce the suitability of current staple regional forages, there is potential for further RD&E to be done on a new range of forage species which may be more suited to future conditions in the region.

- The farm business trade-offs which have to be made between pasture, conserved fodder and bought-in feeds with respect to future water availability and the strategic use of water, grain and fodder markets and/or supply contracts. This was identified as a high priority regional need.

Introductory information on these issues is provided in the Farm Services Victoria (FSV) Irrigation and Risk Management course. This program needs to be continued and strengthened and is considered further under Theme 2.

The market segmentation work done by DA and others is noted. Further social research to clarify farmer attitudes to risk (personal levels of acceptable risk tolerance, business risk, production risk etc) and the appropriate design of information packages tailored to different risk profiles. This work could be integrated with work under the next stage of DPI's Dairy Directions project, which addresses uncertainty in farm development decisions. It is also considered further under Theme 2.

- Farmers require information on how to measure the pre- and post-grazing mass and nutritional intake of cows in close to real time. While not identified at the workshop as a regional priority, the information would improve partial Total Mixed Ration (pTMR) feed mix design and management.

It is understood that CSIRO has done some work on satellite based remote sensing of pasture utilisation. The current status of that work in terms of how effectively it is being used by farmers in their feed-mix design decisions is unknown. The effectiveness of vehicle mounted remote sensing systems as a means of estimating quantity of intake is being evaluated in commercial settings. However, the degree to which those commercial tests will address the range of forages being used by farmers in this region is unknown. In addition, there is likely to be an RD&E need for independent verification of manufacturer's results at the regional level.

D&E which demonstrates the value of the technology in terms of farming decisions on allocating pastures consistently to the herd and the real costs and benefits of the data in

relation to feed mix costs and milk production would assist the industry regionally and nationally. However, the willingness of farmers to collect and use the data to fine tune their feed mix is unknown, so the work also has an important social research and extension component. The Feed2Milk project has done some work in this area. This is one of those borderline RD&E issues which is national in nature but which has important regional implications. There is the possibility of mounting a national RD&E program to address this issue, which could use pilot sites in the MD region.

Quality of the pasture feed ingested by cows is currently estimated using a nutritional database which has been assembled for each of the 3 dairy regions in Victoria. The database contains information on a limited number of grasses. There is a regional RD&E need to extend that database to include all major regional forages.

- Information on (a) how feed mix changes impact on animal health, milk production and fertility, (b) how to integrate different forages into the feed mix for optimal milk production (protein and fat) and fertility and (c) how to manage the inter-seasonal transition times when the next forage is not completely available. This was identified as a moderate priority regional need.

Over the past 15 years, the focus of research has been on fully elucidating the complex interactions between pasture (type, allocation, nutritive characteristics) and traditional grain feeding (type and amount). The focus has now shifted to understanding how the more complex feeding systems now in place function – changing forage base and more complex mixed rations. This is a strategic area of research at the national rather than the regional level. It requires a funding commitment for a number of years to come. Whilst the focus of this work will be undertaken at Ellinbank, there is also a need to collect data on regional farms where these systems are being successfully used on a commercial basis.

At the national level, issues of feed mix and animal health (mastitis) are currently being explored under a PhD program between Melbourne University and DPI. When complete, this will provide important information for the region and should be factored into future regional D&E programs.

Fertility research has historically been industry-led under the DA funded In Calf Program. It has considered a range of management issues affecting fertility, one of which is nutrition, others being animal health, body condition management, energy balance etc. The research is entering a new phase of development using 10-12 years of data from moderate – high production herds. Professor Jock Macmillan from the University of Melbourne has been the pre-eminent researcher.

In terms of integrating forages into the feed mix DPI has developed tools which assist farmers to design their feed mix once they have these data (Diet Check and Pasture Consumption Calculator). There is an RD&E need to refine these tools for major regional forages.

- How to increase nutrient use efficiency, particularly nitrogen (N), under different conditions of water availability.

Historically there has been significant investment in nutrient management research in dairy, much of it based in Gippsland where potential for impacts on the Gippsland Lakes provides a focus. Experience there has shown that adoption of improved nutrient management practices by dairy farmers significantly lags behind what is already known from research, so new research work in this area should focus on how to better drive desired nutrient management practice change on dairy farms. This is a social research

issue at national scale for the dairy industry, not a specific focus for the Murray Dairy region. The market segmentation work done by DA and others is noted. Research on biophysical aspects of specific interest to the Murray Dairy region, such as the management of dairy nutrients with surface irrigation, may be more efficiently done with established nutrient research groups using sites in the Macalister Irrigation District and/or northern Victoria.

There is also the view that we have a poor understanding of whole farm cycling of nitrogen. Increased adoption of BMPs for fertiliser application is an extension issue for P but there is a poor quantification of N loss pathways across the farming system - we don't know by what pathways 50% of the N is lost. Issues such as how to manage animal returns (urine and faeces) and how to best balance crude protein/energy intake are key knowledge gaps - many of our feeds are too high in protein resulting in excess being excreted.

- The expected off-site impacts of changing feed mixes in terms of nutrient and greenhouse gas emissions, and how to measure and manage them.

Off-site nutrient impacts on rivers and wetlands has been a “sleeper” issue during the drought while surface drains have been dry, but will become a focus of attention again after the recent wet conditions. Nutrient loss from dairy pastures is arguably a lower priority in northern Victoria where most dairy pastures are serviced by irrigation re-use systems that recycle nutrient loads. However re-use systems are not designed to manage rainfall runoff, and community attention now focussed on the Murray and its icon floodplain environment will ensure that nutrient losses from dairy production systems will be an ongoing management issue for Murray Dairy region dairy farmers. As with nutrient use efficiency, the priority is to find how to better drive desired nutrient management practice change on dairy farms.

Nitrogen loss pathways such as volatilisation and nutrient leaching and loss in runoff have liability under greenhouse accounting systems.

The DPI Reducing Emissions from Livestock Program will answer questions about the impacts of fat supplements and to some degree tannins. Additional work on alternate forages and their impact on methane and nitrous oxide emissions is required.

Additional RD&E needs

This section aggregates the additional RD&E identified above into a small number of packages for future regional RD&E investment. The priorities identified by workshop participants are clearly identified. The packages focus on:

- Improved understanding and management of major regional forages under different seasonal conditions (Theme 1),
- Benchmarking, which focuses on the collection of on-farm (paddock scale) performance measurement, definition and collection of performance indicators at the sectoral and regional scale, and rapid measurement of the quantity and quality of grown and utilised grazed forage (Theme 4),
- The integration of this information to manage the feed mix - animal performance components of the farm system under seasonal variability (Theme 1), and
- The understanding and management of on-farm aspects of nutrient management and greenhouse gases (GHG's) (Theme 6).

These RD&E packages exist as complex and highly interdependent pieces of work. An overview of the packages (shown in boxes), their regional priorities and some of their complex interdependencies (shown by arrows) is given in Figure 2. A description of the substance within each package follows.

In terms of benefits, the systematic development and dissemination of this information will assist irrigated dairy farmers in the MD region to better manage forage/feed-mix and animal performance under different seasonal conditions. This will strengthen their capacity to increase and optimise profitability under their current risk profile and provides one of the foundations for longer term transformational change.

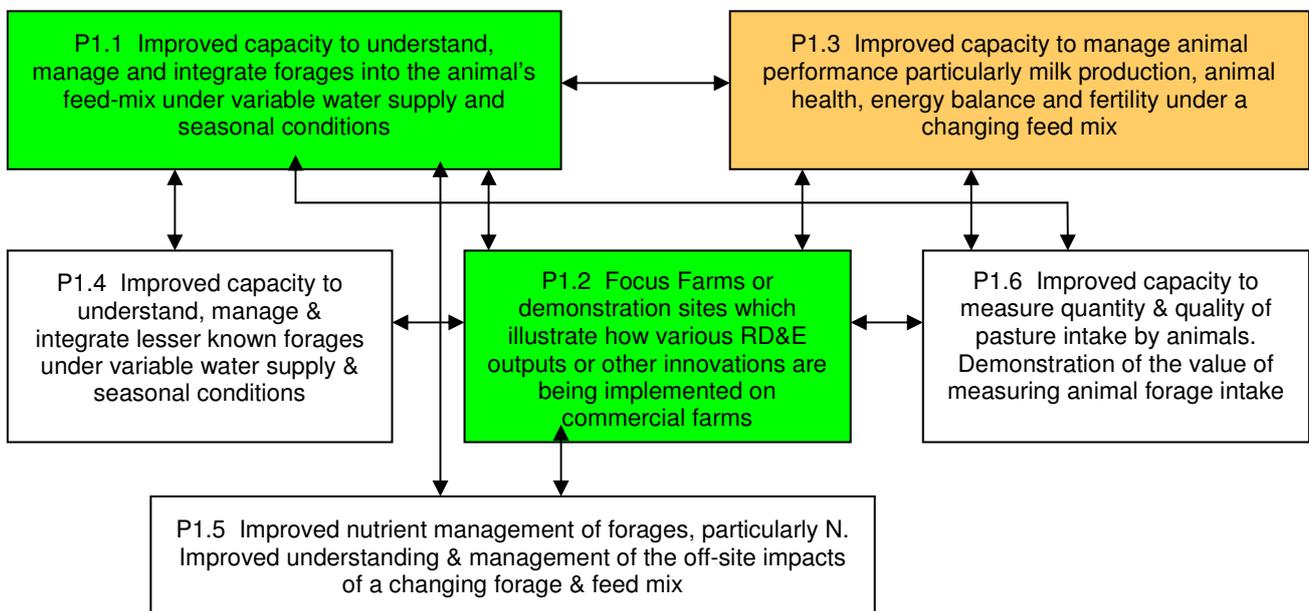


Figure 2 RD&E - Managing Seasonal Variability

Legend – Regional priorities allocated by workshop participants



High regional priority

P1.1 Improved capacity to understand, manage and integrate key forages under variable water supply and seasonal conditions

- Continue to invest in and complete regional RD&E on the performance and management of lucerne and tall fescue under variable seasonal conditions (currently being reviewed by DPI and DA).

Indicative time requirements for this work are: 3 – 5 years

Indicative cost requirements for this work are: \$800k-\$1 million / year

- Identify and implement more effective means of packaging and disseminating information on the strengths and weaknesses of major forages under variable seasonal conditions and water availability.

Indicative time requirements for this work are: 12 – 18 months

Indicative cost requirements for this work are: \$200k - \$250k

- Define the data which farmers should be collecting, such as forage performance at the paddock scale. Provide clear guidelines on how to collect and use that data in decision-making. Note – this has been shifted to a high regional priority because it is readily achievable and will provide important complementary information to the forage RD&E.

Indicative time requirements for this work are: 12 – 18 months

Indicative cost requirements for this work are: \$200k - \$250k

P1.2 Expand the program of Focus Farms and establish demonstration sites to provide on-farm examples of how different forages perform and how they are integrated with supplements into the feedbase

- Expand the *Focus Farm* program run by Murray Dairy to include Focus Farms addressing business goals relating to irrigation modernisation, water productivity, forage performance and, as research results become available, the integration of cropping and partial mixed ration systems into the feedbase. Consider the use of Focus Farms as a means of collecting additional data on how certain forages, irrigation technologies etc are performing under commercial conditions.

Focus Farms are here defined as demonstration sites which illustrate how various RD&E outputs or other innovations are being implemented on commercial farms.

The Murray Dairy region does not have a farmer cooperative owned demonstration farm, unlike regions such as Gippsland (Macalister Demonstration Farm), southwest Victoria (DemoDairy) and Tasmania (Tasmanian Dairy Demonstration Farm). While this means that the MD region lacks an established, independent site for farm system demonstrations, it provides an opportunity to invest in a distributed demonstration site model, which establishes demonstration sites at strategic locations in the region for specific purposes and defined periods. They may demonstrate and promote innovations, technologies and/or good management practices on operating commercial dairies. They may also be integrated into a data collection network which provides information for controlled R&D as an adjunct to research taking place at Ellinbank and elsewhere.

This approach requires a commitment by farmers to host Focus Farms and demonstration sites. To be successful, farmers hosting Focus Farm and demonstration sites will need to be

adequately compensated for their involvement. This will be particularly important during the current industry recovery period following the drought and recent floods.

Medium regional priority

P1.3 Improved capacity to manage animal performance particularly milk production, animal health, energy balance and fertility under a changing feed mix

- The industry should continue to fund current fundamental research on how changes to the feed mix impact on milk production and animal health and the factors affecting fertility; how to integrate different forages into the feed mix for optimal milk production (and fertility in terms of energy balance); and how to manage the inter-seasonal transition times when the next forage is not completely available. This is a strategic, long term RD&E need at the national level, and while not specific to the Murray Dairy region it has important implications for the region and therefore should be encouraged.
- These programs provide an essential complement to the work under P1.1. Information delivered from these programs would be packaged and delivered with information under P1.1.
- Initiate RD&E which refines the ability of tools such a Diet Check and Pasture Consumption Calculator to incorporate major regional forages.

Low regional priority

P1.4 Improved capacity to understand, manage and integrate lesser known forages under variable water supply and seasonal conditions

- Initiate research on the performance and management of the lesser known forages to assess the degree to which climate variability enhances their suitability as important forage crops. This would require a series of experiments that were able to cover the interactions between forage type, soil type and water regime, and also include a range of defoliation (grazing and conservation) practices. Again, the information delivered from this program would be packaged and delivered with information under P1.1.

P1.5 Improved capacity to manage nutrients & off-site impacts

- Extend the next stage of the DPI *Reducing Emissions from Livestock* and similar R&D projects to consider alternate forages and their impacts on methane and nitrous oxide emissions. RD&E programs targeting whole farm management of nitrogen use efficiency and loss pathways contributing to N₂O are proposed. This work is relevant at a national scale, and is not specific to the Murray Dairy region.
- Adoption of improved nutrient management practices by dairy farmers has been limited to date and lags behind known information from biophysical research. Further social research perhaps along the lines of the DA market segmentation work is required to identify better ways to effect required change. There are opportunities for the dairy industry to partner with CMAs, DSE and Commonwealth agencies in this, and in coordinated delivery of practice change programs in this area, potentially increasing the effectiveness of extension programs and providing opportunities for positive dairy industry promotion.

P1.6 Improved capacity to measure animal forage intake

- Consider the value of RD&E which independently verifies the performance of current technologies for measuring quantity of animal grazing intake.

- Demonstrate the effectiveness of currently available remote and proximal sensing technologies to measure the pre- and post-grazing mass and nutrient intake of forage being consumed by cows in close to real-time. Identify the indicative costs and benefits of using such data in relation to optimising milk production.
- Conduct social research in partnership with extension providers, to explore the willingness of farmers to collect and use the data to fine tune their feed management systems and to develop an effective program for disseminating the information to farmers.
- The above elements of the RD&E package are considered to be strategic, long term needs at the national level which provide a key piece of information for the effective management of the forage / feed mix system. As such, the RD&E effort required is not specific to the Murray Dairy region, however, if a national study was initiated the MD region could be used as a pilot. When available, the information delivered from this program would be packaged and delivered with information under P1.1.
- Initiate RD&E which extends the database on the quality of pasture and forage ingested by cows to include all major regional forages.

Alignment

The package of RD&E programs proposed here aligns with the *Feedbase & Animal Nutrition, Animal Performance, People* and *Natural Resource Management and Climate Change (NRMCC)* Theme areas within DMF.

4.2 Theme 2 – My water future

Context

The dairy farm business environment is increasingly volatile and complex. In response to such volatility, dairy farmers are seeking farming systems which are flexible and able to be adjusted or switched in response to external changes. Increasing flexibility usually increases operational complexity and comes at significant business cost. This reduces profit margins and requires astute investment decisions and better management. Improving farm business management (FBM) skills has been a perennial priority for the dairy industry. However, the ‘inconvenient truth’ is that, in general, farmers do not engage with ‘formal’ programs in this area, and yet the need in northern Victoria has probably never been greater. Therefore, in facilitating the process of sectoral and regional transformational change, the challenge to providers of RD&E information is: How do we provide RD&E information to the end-user community in a more effective manner?

A current example is that farmers are adapting to the Modernisation and Sustainable Irrigation incentives provided under DSE’s Sustainable Irrigation Program, the Commonwealth’s Farm Water Project and NVIRP by installing new systems for on-farm water distribution. These new systems reduce transmission losses, increase operating flexibility and irrigation WUE. In general, they are being adopted with limited formal analysis of the long-term economic viability of the investment. This does not mean that no analysis is being carried out. Many farmers have an internal model of their farming system comprising a vision, goals and plans which they use to intuitively assess change options. Furthermore, many of the perceived benefits of these new systems, such as ease of management, more flexibility, reduced uncertainty or improved lifestyle, are difficult to quantify and include in formal analyses. The concern is that a culture of making investment decisions intuitively may limit the ability of the industry and the region to respond profitably and sustainably to change. The issue for providers of RD&E information is to seek to engage farmers ‘where they are at’ rather than simply developing more of the same fact sheets, websites and decision tools that we have always provided. In terms of urgency, the window of opportunity for major supported on-farm change may be open for the next 3-5 years only. This means that RD&E initiatives in this area need to be able to ramp up quickly if they are to assist farmers to effectively use the opportunities available for transformational change.

We note that the recent floods in the central and north western parts of the GMID add further contextual relevance and immediacy to the types of decisions dairy irrigators are facing.

Target outcomes

Providers of RD&E information better understand, engage with and deliver more effectively the information needs of the end-user dairy farming community.

The farm business management (FBM) skills and knowledge of dairy farmers are enhanced, enabling them to make better strategic and tactical decisions which improve their business profitability, lifestyle and environmental outcomes.

Farmers develop and implement strategic sustainable on-farm water plans which are integrated with their business plans. This will link their water management plans, ie use of irrigation and dryland blocks, high and low security water product mix, water trade, carryover options and irrigation technologies to their business plan under different seasonal conditions. It will provide the on-farm planning framework necessary for flexible adaptation to seasonal and longer-term changes in water allocation, climate and markets.

The concept of “target audience” for this work was discussed at the Workshop, with the view expressed that future FBM programs should target the ‘middle 30% of farmers’, considered to be the group that could be most readily assisted to improve their FBM skills, thereby capturing what was perceived to be ‘low hanging fruit’. Subsequent discussions have revealed alternate views, for example that the target audience should simply be those farmers who are focused on running a profitable business. There is clearly scope for further social research in this area, aimed at identifying farmer motivations, learning styles and how to best engage with and enhance the skills of a diverse dairy farmer population.

An overview of RD&E programs in understanding farmer worldviews and decision making, and how they link to the development of FBM skills and on-farm water planning

- The University of Melbourne has been involved in research on understanding farmer ‘worldviews’ (the lens through which farmers see and make decisions about the world), their decision-making processes and client centred RD&E. This understanding underpins how farmers will engage with the information embodied in the RD&E outputs from all Themes. Regional social RD&E is required to provide the baseline understanding of how farmers see farming and water within the region.
- Current DPI research in the *Dairy Directions* project provides information on dairy farm development in the light of fluctuating milk prices, climate change and increasing land prices. Future research could be expanded to consider issues such as the personal, business and operational risks associated with various combinations of water product mix, incremental development of on-farm water technologies, and the adoption of systems which increase the flexibility and resilience of farming systems.
- FSV provides a 4 day *Irrigation and Risk Management* course which assists farmers to better manage their water resources and reduce irrigation related risk. The course assists irrigators to make informed decisions about their water product mix, water trading, irrigation upgrades, farm forage/feed mixes and assists them to take advantage of a modernised delivery system and other water reform opportunities. Further work is being conducted to deliver more usable products targeted at different sectors of the industry. The aim is to help irrigators make informed financial decisions about changing their water product mix and/or converting to pressurised irrigation systems.
- The DSE funded, FSV delivered *Sustainable Irrigation Program* is an integrated program that includes Whole Farm Planning grants and targeted information aimed primarily at improving water use efficiency and reducing the environmental footprint associated with irrigation.
- In farm business management, FSV has historically run programs such as Farm\$mart. Anecdotal evidence is that this had an uptake rate amongst farmers of generally less than 1%. At the current level of resourcing, Dairy Business Network programs are also reported to have a fairly low uptake rate. This highlights that there are some real engagement challenges which DPI and other providers of RD&E information have to overcome if any new proposal in this area is to significantly lift dairy farmer FBM skills. Initiatives in the Flexible Dairy Business Program being developed by GGF, DA and DPIV are noted.
- A number of tools which assist farmers to manage parts of their water, farming system and business plan are available (eg the Water Trading Tool, Murray Dairy Business Tool). The tools are largely uncoordinated in the sense that they may overlap and are not

accessible at a 'one stop shop'. Data on the numbers of farmers using these tools and the value derived from them is not available.

- Given the current floods in northern Victoria and the fact that farmers may be going through a rebuilding phase, a process which assists them to consider whether they still want to farm, and if so, changes to farm layout or systems so that they can better manage extremes may be useful. While this was not identified as a need at the workshop, it is considered relevant at this stage.

Additional RD&E needs

This section aggregates the additional RD&E identified above into a small number of packages for future regional RD&E investment. The priorities identified by workshop participants are clearly identified. The packages focus on:

- Social RD&E directed toward understanding dairy people, their attitudes to water, their commitment to place and their preferred learning styles. It is these dimensions that impact on people's capacity to transform.
- Extending social RD&E toward understanding the reasons behind the lack of farmer engagement in FBM programs, to design improved programs for engagement, and to pilot new ways of engagement to significantly increase farmer participation. The need to improve dairy farmer FBM skills is recognised as a national priority in DMF and is not peculiar to the MD region.
- The development and effective delivery of a Sustainable Farm Water (SFW) program which integrates farm water and business plans so that farmers have a better understanding of and ability to manage:
 - Water product choices, trade and carryover in an environment of changing water availability,
 - Irrigation technology investment choices, incorporating economic, lifestyle and environmental aspects of different irrigation technologies under different seasonal conditions, water allocations and milk prices.
- An integrated farming systems economics RD&E program directed toward understanding and communicating the risks and benefits associated with new on-farm water distribution and application systems under variable water availability will support this SFW Program.

These RD&E packages exist as complex and highly interdependent pieces of work. An overview of the packages (shown in boxes), their regional priorities and some of their complex interdependencies (shown by arrows) is given in Figure 3. A description of the substance within each package follows.

In terms of benefits, the effective development and delivery of the social RD&E and SFW Programs will engage a greater percentage of regional dairy farmers in planning for longer term transformational change and enhance the rate of recovery of the dairy industry in the MD region.

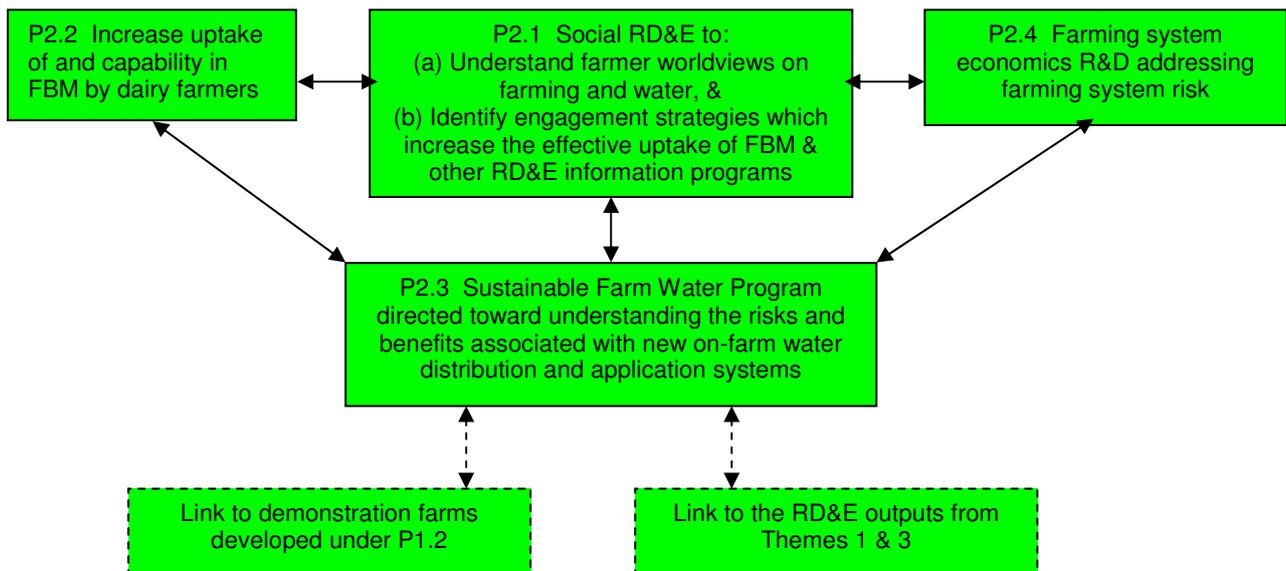


Figure 3 RD&E - My Water Future

Legend – Regional Priorities allocated by workshop participants

High priority

P2.1 Social RD&E to:

- Understand farmer ‘worldviews’ on farming and water.

This is expected to involve activities such as the building of a baseline profile of where people are at in relation to water in their life, in their business now and in the future, how people make sense of the world. It provides the platform for the design and implementation of subsequent FBM and other extension programs.

Indicative time requirements for this work are: 12 – 18 months

Indicative cost requirements for this work are: \$400k-\$500k

- Identify engagement strategies which increase the effective uptake of FBM and other RD&E information programs.

This is dependent on the learning outputs from the previous stage.

P2.2 Increase uptake of and capability in Farm Business Management by dairy farmers

- Using the learnings from the social RD&E program, engage with dairy farmers to develop and deliver programs which assist the dairy farming community in the MD region to enhance their understanding and skills in FBM.
- Invest in service provider FBM skills through development of ongoing, accredited formal training and mentoring programs.
- Expand the current Focus Farm program run by Murray Dairy to include Focus Farms addressing FBM goals relating to irrigation modernisation, water productivity and the adoption of new forages.

P2.3 Sustainable Farm Water Program

- Using the learnings from the social RD&E program, engage with dairy farmers to develop and deliver programs which assist the dairy farming community in the MD region to develop sustainable, strategic multi-year on-farm water plans linked to their business plans which provide the flexibility to deal with in-season and inter-seasonal variability.
- Using the learnings from the social RD&E program, build on the current *Irrigation and Risk Management* program to include issues such as the risks and measurable/non-measurable benefits (lifestyle, environmental etc) associated with various water product mixes, water application technologies and farming systems under a range of future scenarios.
- Link to the farm demonstration sites developed under RD&E Theme 1.
- Develop reportable indicators at the sectoral and regional level which inform policy and the wider community of the strategies that farmers are using to improve the efficiency of their irrigation water use.

P2.4 Farming System Economics R&D

- Extend the next stage of the Dairy Directions project in northern Victoria to include:
 - The risks and benefits of developing greater flexibility to expand or contract the area under irrigation in response to water availability and price versus the cost of investing in under-utilised assets,
 - The costs and benefits of staged development of on-farm water delivery and application infrastructure,
 - An understanding of resilience in the context of dairy farming systems and the development of indicators of farming system resilience or robustness.
- Establish processes to feed this information into the delivery of the Sustainable Farm Water Program

Alignment

The package of RD&E programs proposed here aligns with the *People, Natural Resource Management and Climate Change (NRMCC)* and *Farm Business Management (FBM)* Theme areas within DMF.

4.3 Theme 3 – Flexible irrigation systems for feed production on dairy farms

Context

In response to low and uncertain irrigation water allocations, dairy farmers have been adopting new irrigation technologies. They have also changed from a production system based on perennial ryegrass / white clover pasture to a range of systems based on a mix of annual and perennial pastures and fodder crops. At the same time, water saving initiatives, the Northern Victoria Irrigation Renewal Project, implementation of the Murray Darling Basin Plan and the water market are all driving further system and management innovation on irrigated dairy farms.

Surface irrigation is unlikely to be replaced soon as the dominant irrigation technology used in the Murray Dairy region, but innovations such as “fast flow” irrigation and pipe and riser systems are changing the way surface irrigation is practiced. Pressurised systems, including pipe and riser, subsurface drip and spray systems are being increasingly used, and adoption of these technologies could increase rapidly with a change in the implementation of current government policy.

Target outcome

Dairy farmers understand the costs and benefits, advantages and limitations of the range of irrigation technologies available, including “fast flow” and pipe and riser delivery systems for surface irrigation, subsurface drip systems and spray systems. Dairy farmers are better able to make informed investment and development decisions within the biophysical and business context of their enterprise, and to make ongoing management decisions that capture the benefits of these systems.

An overview of recent and current irrigation RD&E programs

Research on infiltration in the early nineties at Tatura was focused on groundwater recharge and salinity², leading to early GMID work on border check irrigation efficiency. Austin and Prendergast (1997)³ found a simple linear function adequately described infiltration in a Lemnos loam soil and successfully applied it in an analytical model of checkbank irrigation.

In the period 1998 – 2003 the *Improved Irrigation Practices for Forage Production* (IIP) project was a large and coordinated program of work comprising the following modules:

- Border-Check Irrigation Research Review
- Alternative Irrigation Technology Desktop Analysis
- Border-Check (Flood) Irrigation Scheduling Experiment
- Development of Irrigation Audit Hardware
- Recharge Quantification Experiment
- Subsurface Drip and Surge Irrigation Experiment
- Decision Support Timer Development

² Prendergast, J.B., 1995. Soil Water Bypass and Solute Transport under Irrigated Pasture. Soil Science Society of America Journal, 59(6), pp.1531-1539.

³ Austin, N. & Prendergast, J.B., 1997. Use of kinematic wave theory to model irrigation on cracking soil. Irrigation Science, 18(1), pp.1-10.

- Farm Irrigation Audits
- Best Management Practices for Water Use on Irrigated Dairy Farms
- Development of Implementation Pathways

The IIP project focused on irrigation of perennial pasture on Lemnos loam subject to shallow groundwater. Lemnos loam is a dominant soil type in the Shepparton Irrigation Region, and is classed as a heavy soil with a relatively impermeable subsoil. Key findings from the work were:

- Well-managed border-check irrigation is the most appropriate method of irrigation for heavy soils with a shallow watertable.
- Deep drainage under border-check irrigation, appears to be small on heavy soils with a shallow groundwater table during the irrigation season. Most leakage occurs in winter when rainfall exceeds pasture water use.
- Under most weather conditions, advanced scheduling techniques appear to have similar water use efficiencies to well designed time-based scheduling of border-check irrigated pasture.
- For soils that are not heavy, there may be scope to improve water application uniformity over the length of irrigation bays by optimising flow rates.
- Border-check irrigation is generally unsuitable for light soils, and sprinkler systems are more suitable. Performance of irrigation systems and management practices are yet to be appraised for intermediate soil types.
- Spatial information on soil hydraulic properties, such as infiltration and soil water retention characteristics, is critical
- Improving the efficiency of water use is consistent with many other natural resource management issues in that there is no simple, direct association between achieving natural resource outcomes and profitability.

The *Efficient Irrigation Technologies to Match Soils and Dairy Farming Systems* project sought to maximise the environmental and economic benefits returned from private investment in dairy farm irrigation system infrastructure and to maximise the impact of policy initiatives aiming to improve the efficiency of water use on dairy farms through changes to farm irrigation system infrastructure. The project undertook lysimeter experiments that measured deep drainage for a range of soil types, depths to watertable and durations of irrigation ponding, finding that surface irrigation can achieve high efficiency on most Shepparton Irrigation Region (SIR) soils. Farm trials quantified border check and sprinkler irrigation water balance and pasture production on a range of soils, verifying the lysimeter results and showing that surface irrigation can achieve >90% irrigation efficiency on heavy soil and that centre pivot irrigation can achieve >90% irrigation efficiency on a range of soils. The project highlighted the limited scope for significant water savings on heavier soils of the region by changing irrigation technology. A process to aid irrigation system selection, focusing on border check and centre pivot systems, was developed and implemented as a website.

The project *Irrigation in a variable landscape: matching irrigation systems and enterprises to soil hydraulic characteristics* carried out measurements of the soil hydraulic properties of 34

soil types at 79 sites, representing 75% of the total area of the SIR. The project compiled a valuable database of soil hydraulic properties, but found that within soil type and with paddock variability is high. Pedotransfer functions were successfully developed for the soil water retention characteristic, but not for saturated hydraulic conductivity.

Feasibility and sustainability of subsurface drip irrigation in pasture production investigated subsurface drip irrigation (SDI) under grazed perennial pasture. The project found grazing of pasture irrigated with SDI was feasible, but on a light soil was associated with increased deep drainage and reduced production as tape spacing increased from 0.6 m to 1.4 m. An economic analysis undertaken by the Dairy Directions project found that significant water savings and increased production of pasture would be required, with both water and pasture highly valued, for the system to be profitable for grazed pastures. Complementary SDI work undertaken by the University of Melbourne at Dookie investigated water quality and emitter clogging potential, drip tape damage under grazing and the relative performance of three types of SDI drip tape. Potential of SDI for forage production was investigated in a modelling study, with model outputs compared with three case study farms in the GMID.

In 2008/09 and 2009/10 the CRC for Irrigation Futures piloted use of the IrriMATE™ irrigation performance evaluation methodology at 11 checkbank irrigation sites in the GMID. The IrriMATE™ technique, which was developed for furrow irrigation, is now well accepted in the cotton industry. Application efficiencies ranged from 46% to 90%⁴, with modelling indicating potential water savings in excess of 20% by using flow rates approximately double conventional practice.

The *Irrigation in dry conditions* project and the Murray Dairy project *Evaluation of high flow surface irrigation within the Murray Dairy region* commenced in 2010. These projects are undertaking further investigation of fast flow irrigation to evaluate the biophysical effects and economic benefits of checkbank irrigation at higher flow rates.

The RD&E work on irrigated lucerne and fescue performance under different seasonal conditions and water regimes on different soil types referred to in Section 4.1 will complement this work.

⁴ Gillies, M, Smith, R, Williamson, B & Shanahan, M, 2010. Improving performance of bay irrigation through higher flow rates. Australian Irrigation Conference 2010.

Additional RD&E needs

This section aggregates the additional RD&E identified above into a small number of packages for future regional RD&E investment. The priorities identified by workshop participants are clearly identified. The packages focus on:

- Understanding high flow and other irrigation technologies. This aims to improve understanding of the benefits of high flow and other irrigation technologies, and
- Total life cycle analysis (Theme 5). This aims to quantify whole-of-life energy and financial benefits and costs of irrigation systems.

These RD&E packages exist as complex and highly interdependent pieces of work. An overview of the packages (shown in boxes), their regional priorities and some of their interdependencies (shown by arrows) is given in Figure 4. A description of the substance within each package follows.

In terms of benefits, the effective development and delivery of this package of RD&E will enable regional dairy farmers to more confidently select the irrigation technologies most appropriate to their enterprise, understand the business implications of their decisions and thereby improve their profitability. The introduction of new irrigation technologies is a key component of transformational change and recovery of the dairy industry in the MD region, and it is important that it be done with sound business and technical information.

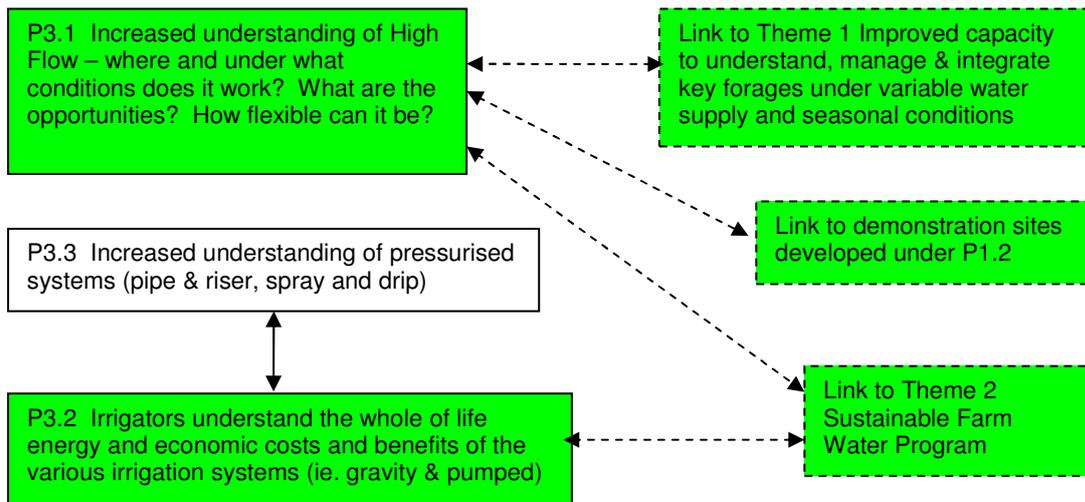


Figure 4 RD&E Flexible Irrigation Systems

Legend – Regional priorities allocated by workshop participants



High regional priority

P3.1 Increased understanding of High Flow – where and under what conditions does it work? What are the opportunities? How flexible can it be?

- Current investment in RD&E on High Flow should continue in order to:
 - Develop a better understanding of surface irrigation infiltration processes on major regional soil types under a range of soil moisture conditions.
 - Improve on-farm surface irrigation analysis tools and models appropriate for a range of soil moisture conditions, a range of irrigated crops and a modernised irrigation delivery system.
 - Improve guidelines for irrigation system design, irrigation system selection and irrigation management on major soil types under a range of moisture conditions, different crops and a modernised supply system.
 - Develop knowledge of surface irrigation flexibility – advantages and limitations of irrigation system design and management with respect to irrigation application depth and uniformity.
 - Develop information packages for integration into P2.2 - Sustainable Farm Water Program.

Indicative time requirements for this work are: 3 – 5 years

Indicative cost requirements for this work are: \$800k-\$1 million / year

P3.2 Irrigators understand the whole of life energy and economic costs and benefits of the various irrigation systems (ie. gravity and pumped)

- Undertake comprehensive life cycle assessments (LCAs) of milk production using the range of feasible alternative irrigation technologies, quantifying the economic and environmental consequences of irrigation systems and management practices, and model uncertainties within a whole farm context.
- Embed results of these assessments into irrigation system selection guidelines and into farm business economic case studies.
- Develop information packages for integration into the Theme 2 Sustainable Farm Water Program.

Indicative time requirements for this work are: 2 – 3 years

Indicative cost requirements for this work are: \$300k-\$400k / year

Low regional priority

P3.3 Increased understanding of pressurised irrigation systems (pipe & riser, spray and drip)

- Investigate the irrigation efficiency and relative productivity of pressurised irrigation delivery and application systems on the range of soil types of the Murray Dairy region.
- Develop information packages for integration into P2.2 - Sustainable Farm Water Program
- This work is required for contexting the relative merits of surface irrigation systems on crops other than pasture, and for life cycle assessments. The low priority ranking given to this activity at the regional stakeholder workshop may reflect the current

Federal water buyback program, which in the GMID does not include pressurised systems. This may change in the future.

Alignment

The package of RD&E programs proposed here aligns with the *Feedbase & Animal Nutrition, People, Natural Resource Management and Climate Change (NRMCC)* and *Farm Business Management (FBM)* Theme areas within DMF.

5 Recommendations

The following packages for RD&E within the MD region were identified as high priority by participants at the Dairy Irrigation Advance Workshop. They are recommended to the MD Board and other dairy RD&E funders for consideration and action. Their implementation will assist both short term adaptation and long term sustainable transformational change within the MD region dairy industry.

Theme 1 Fodder to milk under seasonal variability

P1.1 Improved capacity to understand, manage and integrate key forages under variable water supply and seasonal conditions

- Continue to invest in and complete regional RD&E on the performance and management of lucerne and tall fescue under variable seasonal conditions (currently being reviewed by DPI and DA).

Indicative time requirements for this work are: 3 – 5 years

Indicative cost requirements for this work are: \$800k-\$1 million per year

- Identify and implement more effective means of packaging and disseminating information on the strengths and weaknesses of major forages under variable seasonal conditions and water availability.

Indicative time requirements for this work are: 12 – 18 months

Indicative cost requirements for this work are: \$200k - \$250k

- Define the data which farmers should be collecting, such as forage performance at the paddock scale. Provide clear guidelines on how to collect and use that data in decision-making. Note – this has been shifted to a high regional priority because it is readily achievable and will provide important complementary information to the forage RD&E.

Indicative time requirements for this work are: 12 – 18 months

Indicative cost requirements for this work are: \$200k - \$250k

P1.2 Expand the program of Focus Farms and establish demonstration sites to provide on-farm examples of how different forages perform and how they are integrated with supplements into the feedbase

- Expand the *Focus Farm* program run by Murray Dairy to include Focus Farms addressing business goals relating to irrigation modernisation, water productivity, forage performance and, as research results become available, the integration of cropping and partial mixed ration systems into the feedbase. Consider the use of Focus Farms as a means of collecting additional data on how certain forages, irrigation technologies etc are performing under commercial conditions.

Theme 2 My Water Future

P2.1 Social RD&E to:

- Understand farmer ‘worldviews’ on farming and water.

This is expected to involve activities such as the building of a baseline profile of where people are at in relation to water in their life, in their business now and in the future, how people make sense of the world. It provides the platform for the design and implementation of subsequent FBM and other extension programs.

Indicative time requirements for this work are: 12 – 18 months

Indicative cost requirements for this work are: \$400k-\$500k

- Identify engagement strategies which increase the effective uptake of FBM and other RD&E information programs.

This is dependent on the learning outputs from the previous stage.

P2.2 Increase uptake of and capability in Farm Business Management by dairy farmers

- Using the learnings from the social RD&E program, engage with dairy farmers to develop and deliver programs which assist the dairy farming community in the MD region to enhance their understanding and skills in FBM.
- Invest in service provider FBM skills through development of ongoing, accredited formal training and mentoring programs.
- Expand the current Focus Farm program run by Murray Dairy to include Focus Farms addressing FBM goals relating to irrigation modernisation, water productivity and the adoption of new forages.

P2.3 Sustainable Farm Water Program

- Using the learnings from the social RD&E program, engage with dairy farmers to develop and deliver programs which assist the dairy farming community in the MD region to develop sustainable, strategic multi-year on-farm water plans linked to their business plans which provide the flexibility to deal with in-season and inter-seasonal variability.
- Using the learnings from the social RD&E program, build on the current *Irrigation and Risk Management* program to include issues such as the risks and measurable/non-measurable benefits (lifestyle, environmental etc) associated with various water product mixes, water application technologies and farming systems under a range of future scenarios.
- Link to the farm demonstration sites developed under RD&E Theme 1.
- Develop reportable indicators at the sectoral and regional level which inform policy and the wider community of the strategies that farmers are using to improve the efficiency of their irrigation water use.

P2.4 Farming System Economics R&D

- Extend the next stage of the Dairy Directions project in northern Victoria to include:
 - The risks and benefits of developing greater flexibility to expand or contract the area under irrigation in response to water availability and price versus the cost of investing in under-utilised assets,
 - The costs and benefits of staged development of on-farm water delivery and application infrastructure,
 - An understanding of resilience in the context of dairy farming systems and the development of indicators of farming system resilience or robustness.
- Establish processes to feed this information into the Sustainable Farm Water Program

Theme 3 Flexible Irrigation Systems for feed production on dairy farms

P3.1 Increased understanding of High Flow – where and under what conditions does it work? What are the opportunities? How flexible can it be?

- Current investment in RD&E on High Flow should continue in order to:
 - Develop a better understanding of surface irrigation infiltration processes on major regional soil types under a range of soil moisture conditions.
 - Improve on-farm surface irrigation analysis tools and models appropriate for a range of soil moisture conditions, a range of irrigated crops and a modernised irrigation delivery system.
 - Improve guidelines for irrigation system design, irrigation system selection and irrigation management on major soil types under a range of moisture conditions, different crops and a modernised supply system.
 - Develop knowledge of surface irrigation flexibility – advantages and limitations of irrigation system design and management with respect to irrigation application depth and uniformity.
 - Develop information packages for integration into P2.2 - Sustainable Farm Water Program.

Indicative time requirements for this work are: 3 – 5 years

Indicative cost requirements for this work are: \$800k-\$1 million / year

P3.2 Irrigators understand the whole of life energy and economic costs and benefits of the various irrigation systems (ie. gravity and pumped)

- Undertake comprehensive life cycle assessments (LCAs) of milk production using the range of feasible alternative irrigation technologies, quantifying the economic and environmental consequences of irrigation systems and management practices, and model uncertainties within a whole farm context.
- Embed results of these assessments into irrigation system selection guidelines and into farm business economic case studies.
- Develop information packages for integration into Theme 2 Sustainable Farm Water Program.

Indicative time requirements for this work are: 2 – 3 years

Indicative cost requirements for this work are: \$300k-\$400k / year