final report

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Making More from Sheep on irrigated pastures

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Abstract

Central Murray farm enterprises typically consist of a mixture of dryland grazing through to irrigation-based annual clover/rye pastures and crops (cereals, rice). Few fodder crops are grown specifically for grazing and many producers attempt to finish autumn/winter drop lambs on stubbles (with supplements) or within grain-based feedlot systems with varying degrees of success, questionable profit margins and high risk.

The PDS aimed to develop practical, profitable systems that identified and utilised a range of pasture species to meet lambing ewe and weaner feed requirements; maximise pasture production water efficiencies and improve sheep enterprise profitability's. Several pasture species and varieties were compared across a number of sites to generate economic (establishment costs, pasture dry matter cost, benefit/cost); pasture and lamb growth rate data.

Economic analyses suggest that under current Store lamb and irrigation water prices the profitability of finishing lambs on irrigated pastures within the Murray Irrigation region is relatively risky. Profit margins depend heavily on the starting lamb value relative to finished lamb returns; purchase and delivery costs per Mega litre (ML) of temporary water; pasture quality; irrigation layout; fertiliser history and irrigation efficiencies – particularly the Dry Matter production achieved per ML of water used per hectare.
The analysis showed that profit margins in excess of $10 per lamb were only likely when producers could:

- produce in excess of 2 tonnes of Dry Matter per ML of water (all costs borne by the lamb finishing exercise) OR
- 1.5 tonnes of Dry Matter per ML if half of costs can be attributed to the ewe flock and when
- (for both scenario's) temporary irrigation water costs were less than $175 per ML

Further research is recommended to determine the optimum mix of improved, irrigated pastures/forages; pasture management protocols; supplements and/or grain based finishing systems under current temporary irrigation water charges.

Executive summary

The “Making More from Sheep on Irrigated Pastures” PDS aimed to identify a range of irrigated pasture species and management systems that would provide early autumn/winter feed to meet lambing ewe and weaner feed requirements; maximise pasture production water efficiencies and improve sheep enterprise profitability within farming systems of the Central Murray Irrigation districts of NSW/Victoria.

PDS Trial site(s) and several Satellite sites (funded by the Western Murray Land Improvement Group and cooperating producers) examined a number of pasture and forage species and varieties across a range of soil and irrigation management systems. Where possible trial data was benchmarked against independent trial findings and/or district pasture, water use and lamb production averages.

Pastures species/varieties involved included Cereals (wheat, oats, barley); Brassica’s; Turnips; Forage Rye and Corn; RRR Blend; Fescues; Chicory; Lucerne; Ryegrass and Clover varieties. Ryegrass/Clover based pastures are the dominant pasture base within the region.

PDS findings were

- Lamb daily live weight gains in excess of 260 g/h/day are achievable under all irrigated pasture systems trialled, with some demonstrations achieving rates in excess of 280 and 350g/h/d for Merino and Crossbred lambs respectively (Objective 1)
- Most forage/pastures trialled compared favourably to industry pasture establishment costs, prime lamb production and gross margin outcomes with benefit/cost returns of between 1.6 to 2.4 to 1 possible (Objective 2)
- A number of forage/pasture options were identified as having reasonably low cost(s) per tonne of Dry Matter; reasonable lamb growth rates and stocking rates. Unfortunately, these findings were not always repeatable across all demonstration sites, were not benchmarked or did not include a standard pasture for the region (such as ryegrass/clover) or establishment / management costings for the same.
- The cost of pasture production and benefit/costs of the same in terms of finishing Merino and Prime Lambs is heavily influenced by input costs, particularly irrigation water, infrastructure and pumping costs. While a range of forage/pasture options were identified as being both cost effective (in terms of a lower cost per tonne of feed produced); filling the autumn feed gap/extending the grazing period or providing additional feed able to sustain higher stocking rates than previously recorded (anecdotally) on participating properties, no single variety was identified as the preferred option of all producers, much depending on individual soil, paddock/irrigation system features and infrastructure/irrigation water cost and availability (Objective 3). This information has however provided CMBWBL producers with ‘base’ information and training that will assist them with future selection and costing of pasture species and variety use.
- CMBWBL PDS activities and research findings were promoted widely through a series of pasture walks, field days, meetings, workshops (16 activities; total attendance 384) and electronic media (WMLIG newsletter, email distribution lists,

newspaper articles, etc). Face to face activities helped to facilitate adoption/use of practices that increased on-farm cost efficiency and productivity by BWBL members. Extension methods used were reasonably successful in terms of developing, conveying and engaging producers, with 83% of CMBWBL members attending one or more scheduled events (Objective 4)

- Two (2) benchmarking studies were undertaken during the PDS. Survey 1 sought to develop base farm production and enterprise statistics within Central Murray enterprises. Survey 2 looked to capture CMBWBL members pre and post PDS knowledge, attitude, skills and/or aspirations (KASA) and Adoption rates. Survey results suggest
    - CMBWBL members were more proactive in terms of pasture assessment and meeting stock feed needs than non-BWBL members (Survey 1) and
    - the average 'percentage changes' among respondents in terms of improvements in Knowledge; Attitude; Skills; Aspirations and Practice Adoption ranged from 52 to 56% prior to and following completion of the PDS (Survey 2)
- A major issue faced by producers during the period of this PDS was the increasing cost of general security water within the Murray Irrigation region. Two (2) benefit/cost analyses undertaken by CMBWBL members examined the profitability of finishing Store lambs to Trade lamb weights on irrigated pastures. Profit margins were reasonably tight throughout the period analysed (2011- November 2015), with the 2015 results suggesting that producers were better off financially to sell unfinished lambs rather than look to finish the same on irrigated pastures under current irrigation water costs (Objective 5).

Key producer learnings/ recommendations include:

- Developing and implementing pasture assessment and feed budgeting skills on-farm
- The importance of understanding and meeting livestock feed needs
- Understanding how to use feed quality test information to develop suitable rations
- The importance of good pasture establishment and grazing management to optimise pasture quality and quantity
- Cost per kg of feed of greater importance than cost/ha
- Palatability of some varieties can be an issue
- Benefit/costs in excess of 1.6 to 1 were found for most irrigated pasture systems within the Murray Irrigation catchment area during 2012-2014. The benefit cost findings from this PDS may further improve if analysed over 3-5 years (due to seed/preparation etc costs being spread across a longer period) however increasing irrigation input costs also need to be factored. Producers therefore need to consider a range of cost/production scenarios to assist with pasture production decision making

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1 Background

1.1 Making More from Sheep on irrigated pastures

1.1.1 Producer group background

- The Central Murray Best Wool/Best Lamb (CMBWBL) group, initiated in June 2011, has twenty-three (23) active members managing in excess of 40,000 sheep over an estimated 47,000 hectares. This equates to an average of 2.05 DSE/ha.
- The primary objective of the CMBWBL Group is to improve the adoption of Best Management Practices among members in an effort to increase profitability, efficiencies and sustainability of regional sheep meat and wool based enterprises.
- In excess of 90 regional businesses and producers receive BWBL emails and correspondence
- Most CMBWBL members are also members of the Western Murray Land Improvement Group (WMLIG). WMLIG's primary objective is to contribute to a viable, capable and adaptable community by promoting sustainable farm and land management practices for landholders within the Western Murray Catchment region. WMLIG provided funding for several of the Satellite Sites involved with this PDS.
- Farm enterprises consist of a mixture of dryland grazing through to irrigation-based crop (cereals, rice) and pasture based systems. Livestock enterprises range from self-replacing Merino enterprises through to composite and prime lamb production systems and some (minor) cattle enterprises.
- Group members typically lamb in autumn and look to market lambs prior to a drop in Spring feed quality and increasing issues with grass seed contamination. Many however struggle to meet these targets and are forced to sell non-finished lambs on a falling market and/or attempt to finish lambs on stubbles (with supplements) or within grain-based feedlot systems.

1.1.2 Establishment of the Producer Demonstration Site

- Most farms of the members of CMBWBL group have a mixture of irrigation and dry land fodder production on heavy soils. Annual sub clover/ryegrass pastures dominate with (increasing) interest and use of cereal pastures to fill the autumn feed gap. Trial and Satellite sites are representative of the regions soil and land use systems.
- EOI's were distributed and sites selected for sowing of selected pasture varieties. A range in pasture species and varieties were selected in an effort to generate information related to on-farm cost efficiencies and productivity and enhance the competitiveness and sustainability of their enterprises. These objectives are in line with MLA Strategic Plan (Objectives and Strategies, Section 3:1) and incorporates strategies within Modules 6, 7 & 8 of the MLA Making More from Sheep program manual.
- Pasture species and varieties included Cereals (6); Clovers (4); Ryegrass (2); Fescues (2); Chicory (1); Brassica's (2); Turnips (2); Forage rye corn (1), RRR Blend (1) and Lucerne (1).
- Two (2) PDS Sites and four (4) Satellite sites were proposed. Satellite sites were included as demonstration sites to generate additional data to support PDS Site findings.

- Management and data collection was overseen by CMBWBL Coordinator (Rick Ellis); cooperating producers and independent agronomists Dean Harrington (Harrington Ag Consulting) and Damian Jones (Agresults).

2 Project objectives

2.1 Making More from Sheep on irrigated pastures

2.1.1 To develop systems to maximise water efficiency use in pasture production and develop more profitable sheep enterprises utilising irrigated pastures.

1. Increase lamb growth rates from 180 g/h/d to 350 g/h/d by increasing pasture production and utilisation efficiency.
2. Investigate and compare the cost benefit of establishing and grazing a range of pasture species in the Central Murray area.
3. Identify a pasture production system to assist with filling feed gaps that impact on lamb growth rates.
4. Assist the members in the Central Murray BWBL group to adopt practices that are proven to increase cost efficiency and productivity on-farm.
5. Conduct benchmarking across 70% of Central Murray BWBL group members to more accurately define the cost benefit of adopting new pasture management systems compared to the current more traditional systems
6. As a result of the above, increase the proportion of lambs sold as finished (prime) versus store lambs.

3 Methodology

3.1 Making More from Sheep on irrigated pastures

3.1.1 Planning and coordinating group member activities

- CMBWBL's inaugural Planning Meeting was held on August 22nd, 2011 to discuss objectives and development of a PDS application
- A series of workshops, field days and pasture walks were planned for 2012/14. These are listed in the Section 4 (Results).

3.1.2 Assessing alternative pastures and cost efficiency

- Trial site development, sowing, management and data collection was overseen by CMBWBL Coordinator (Rick Ellis); cooperating producers and independent agronomists Dean Harrington (Harrington Ag Consulting) and Damian Jones (Agresults)
- Trial findings were promoted at workshops, field days, pasture walks and through the CMBWBL and WMLIG newsletters/email distribution lists

- Where possible trial data was benchmarked against independent trial findings and/or existing pasture bases on participating farms
- Pasture establishment/maintenance costs were generated during the PDS. These have enabled pastures to be compared on both a $/ha and $/kg or $/tonne Dry Matter basis.
- Two (2) analyses using average General Security irrigation water prices was undertaken to look at the benefit/cost of finishing Store lambs and selling as Trade lambs on irrigated pastures over the life of the PDS. Findings of these are outlined in Section 5.8 (Economics).

3.1.3 Change Implementation/Barriers to Adoption

- Timing of site preparation; land forming/irrigation issues; competition from weeds; issues with pasture establishment; significant increases in irrigation water prices and health issues faced by the PDS Coordinator impacted on PDS and Satellite site(s) performance / data collection.
- Not including a ryegrass/sub clover 'control' at most sites and the short duration of some grazing at some sites made it difficult to benchmark trialled varieties against a traditional pasture base for the Central Murray region.
- Evaluation survey results suggest that pasture and livestock production gains made during the course of the PDS were, in part, attributable to the implementation by CMBWBL members of best practice management systems that improved cost efficiency and productivity on farm
- PDS and Satellite Site findings have provided CMBWBL producers with 'base' information and training that will assist them with future selection and costing of pasture species and variety use.

4 Results

4.1 Making More from Sheep on irrigated pastures

4.1.1 PDS trial site(s) and satellite sites

Outcomes for two (2) PDS Sites ("Fairley Downs" and "Reedy Waters"). and four (4) Satellite Sites are outlined below. The latter were financed by the Western Murray Land Improvement Group (WMLIG) and through in-kind funding by cooperating producers.

PDS Site 1:"Fairley Downs"
Co-operators: Dennis Carmichael & Glenice Ficken, 416 Fairley Rd. Kerang 3579

2012

Background
A 44ha block was renovated and subdivided into 3 paddocks (12,16 and 16ha). A pasture mix of Bindoon and Trikala clovers, Wedgetail wheat, Lucerne, Sungrazer and Sprinter rye grasses were sown within each plot in autumn 2012.
Plots were watered in early March (3-9/3/12); late April (28/4/12) and received one watering during Spring. Establishment/Maintenance costs were $449.50/ha. Costs included irrigation

water (200 ML's @ $56/ML = $254/hectare) and pasture establishment (seed, Single Superphosphate, Weed control etc = $195.50).

Outcomes

Mature aged Merino ewes and Merino weaners grazed plots from May 26th to November 7, 2012 (22.5 weeks) for a total of 25,928 and 65,324 'grazing' days respectively.
A 70% increase in available pasture compared to existing, traditionally managed sub clover, ryegrass and barley grass pastures (Dean Harrington, per.comm), effectively increased the traditional grazing window by 4 weeks. Pasture exclusion cage, dry matter assessments and an increase in stocking densities during the trial period support these statements.

In Summary:

Total Merino ewe grazing days	25,928
Total greasy wool produced	628 kg (14.27 kg/ha).
Gross income (wool)	$128 /ha
Monitored Condition Score	0.5 CS gain (group average increased from 2.5 to 3.0)
Total Merino lamb grazing days	65,324
Total kg of meat produced	4,115 kg
value	93 kg per ha @ $3.00 per kg = $280 per ha.
Total greasy wool produced	711 kg
value	16 kg per ha @ $8.06 per kg = $129 per ha
Total Crossbred lamb grazing days	13,230
Total kg of meat produced	3,149 kg (236g/h/d)
value	78.74 kg per ha @ $4.00 per kg = $314.96 per ha

Total gross income from meat and fibre production over 22.5 weeks was $723.96 per ha Gross profit was estimated as $274.46/ha based on Gross Income ($723.96/ha) minus Establishment/Maintenance costs ($449.50/ha). Estimated Benefit/Cost was 1.6 to 1 (Gross Income divided by Establishment/Maintenance Costs).

In terms of available biomass the Wedgetail wheat plots provided early bulk feed followed by clovers; rye grass and Lucerne

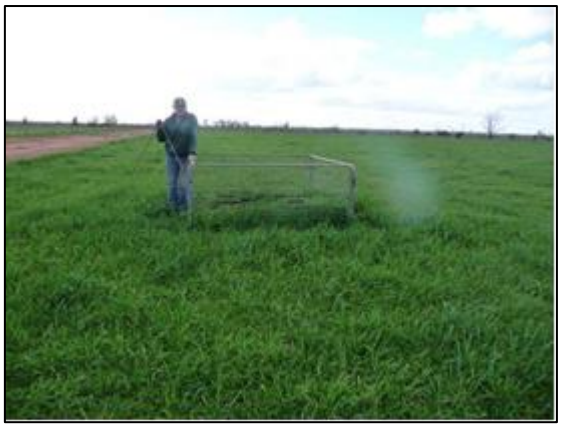

Photo 1. PDS Site 1 ("Fairley Downs") Wedgetail wheat trial plot with pasture exclusion cage (June 2012)

2013

A second 8ha block was sown in March 2013 to a variety of pastures including including:

- Wheat (Wedgetail and Mansfield)
- Barley (Moby); Oats (Cooee); Sub clovers (Trikkala coated and uncoated)
- Sulla (forage legume sown as an alternative to Lucerne)
- Brassica (Titan); Turnip (Australian Purple Top and Barkant)
- Swede (Highlander)
- Chickory (Puna) with Arrowleaf Clover
- Chickory (Puna) with Lucerne (Stamina)

The trial site was topdressed with 60 kg MAP/ha + 2.5 t Gypsum/ha.

Outcomes
Poor site preparation, land forming/irrigation issues and competition from weeds impacted on pasture establishment within some plots. Site was re-sown in April 2013 and again sprayed for grass control, leaving some areas 'unsprayed' to illustrate the impact of poor weed control.

Plots however were unsuitable for the trial to proceed and a decision was made to relocate the PDS site to "Reedy Waters", Murrabit in 2014.

PDS Site 2:"Reedy Waters"
Co-operators: Jamie and Sandy Semmler, 1751 Koondrook Rd, Murrabit 3579

2014

Background
Seven (7) 1.25 hectare border check bays were individually sown on April 27, 2014. Total trial area was 9 ha's. Pasture species included Wheat (Wedgetail, Mansfield); Barley (Moby); Oats (Winnaroo, Cooee, Urambie) and Shaftal Clover.

Outcomes
Late ground preparation, a delay in pre-sow irrigation, followed by 95mm of rain in late March/April, saw plots sown after the recommended sowing date. Poor pasture establishment, concerns re the rising cost of irrigation water and health issues faced by PDS Coordinator prevented the trial site from operating as planned.
No livestock or pasture production data was generated.

Satellite Site 1 ("Murray View")

Co-operators: Simon Ettershank, Murrabit, 3579 (0428) 575232;

2012

Background

Demonstration objective was to investigate the carrying capacity and average daily live weight gain (kg/day) across a number of pasture species and varieties
Soil tests conducted March 2012. Plots (6 ha total) were sown April 5th, 2012.
Pasture varieties and costs/ha (seed, sowing, weed control) included:

- Barley (Moby $158.80; Urambie,$124)
- Wheat (Wedgetail, $132)
- Oats (Coee, $156.50)
- Brassica (Titan, $114.40; Greenland, $113.60)
- Turnip (Appin, $113.20)
- RRR Blend ($206)
- Southern Green Forage Rye corn ($222/ha).

Management:

Plots top dressed with MAP (100kg/ha), site pre-watered prior to April 7th, 2nd irrigation May 9th, 2012. Total irrigation cost $200/ha (4ML/ha @ $50/ML). Plots were grazed from June 4th, 2012

Outcomes

Due to infrastructure constraints weaned Merino lambs grazed plots on a species not varietal basis. Collectively lambs averaged 317gms/day over the grazing period (75 days) for a total average live weight gain of 10.7kg.

Assuming a 45% yield this equates to a 1.0 kg HSCW gain/week. Valued at $4.00/kg and based on an average stocking rate of 57 lamb's/ha plots produced $228/ha in meat/week across all species.

Pasture Quantity, quality and cost/kg summaries are shown in Figures 1 and 2 below:

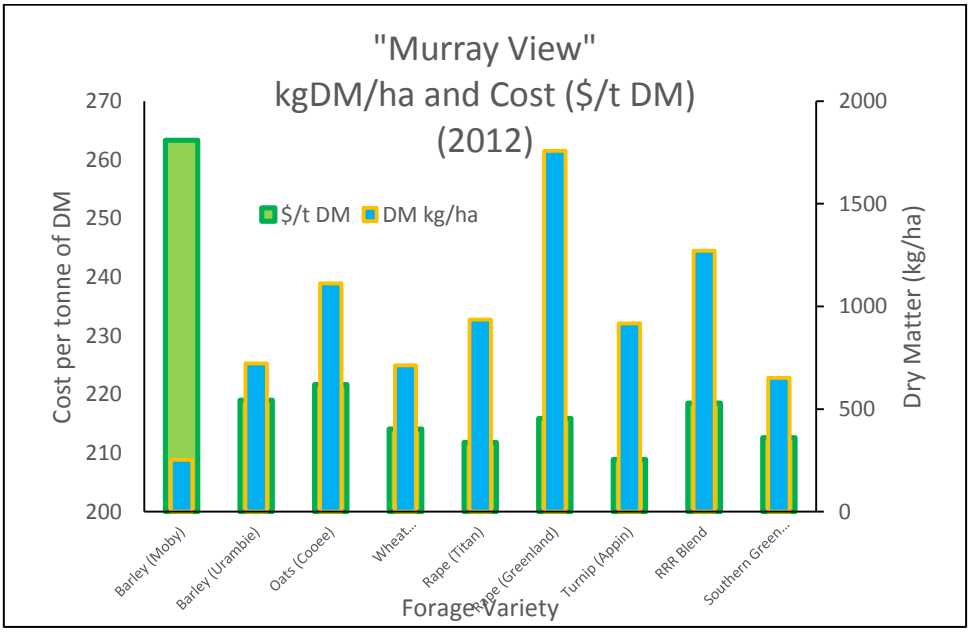

Figure 1 Dry Matter per hectare (Day 57 post sowing when stock introduced) and Cost per tonne of Dry Matter at Satellite Site 1 ("Murray View)

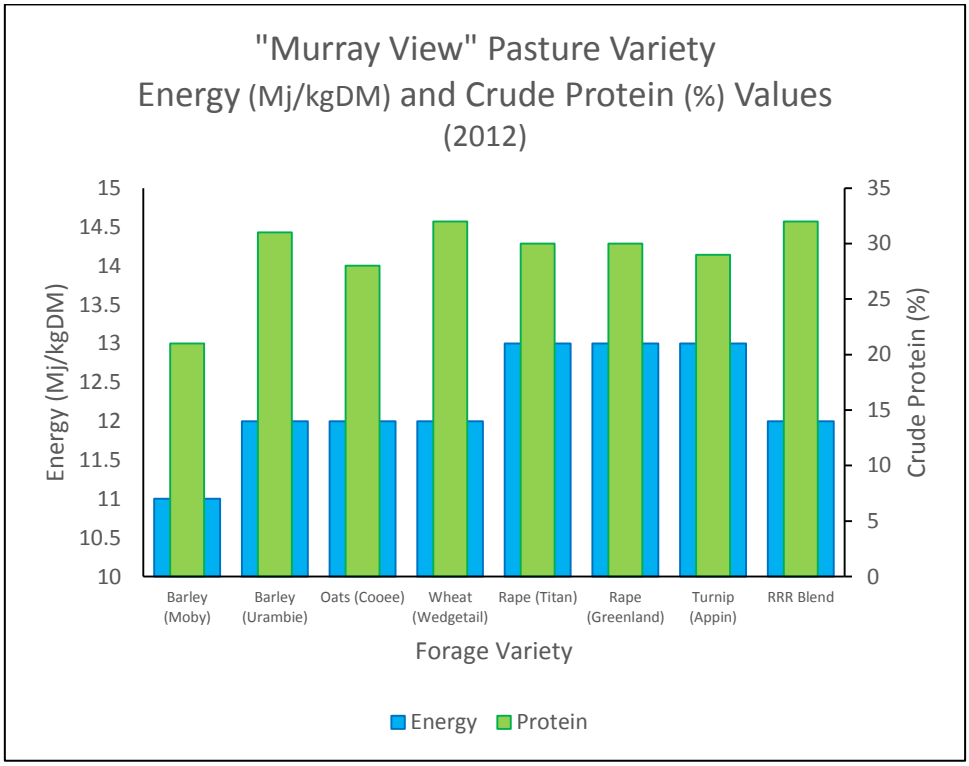

Figure 2 Varietal Energy and Protein Values (Day 57 post sowing when stock introduced) at Satellite Site 1 ("Murray View)

2013

Background
Demonstration objective was to investigate the carrying capacity and average daily live weight gain (kg/day) across a number of grass, clover and Lucerne varieties
The following varieties were sown in March 2013 over a total area of 6ha:

- Fescue (Quantum II) with clover
- Short Rotation Rye (Banquet) with Rye (Maverick GII) and clover
- Fescue (Resolute) & Lucerne (Stamina) with Chicory.

Management
The trial site was sprayed with Buttress/Le Mat and MCPA/Buttress in mid-April and early May, 2013 respectively and top dressed with 60 kg/ha urea in January 2014. Plots were irrigated 4 times between March 20th and November 16th, 2013 (5 ML/ha, 30 ML in total) for a total irrigation cost of $2160 ($72/ML)

Outcomes
Pastures were stocked between May 17th 2013 and April 23rd 2014 for a total of 157 grazing days.
Varying classes of livestock grazed plots during this period. These ranged from merino ewe weaners, crossbred weaners, maiden merino ewes, aged merino ewes and Angus steers. Dry Sheep Equivalent (DSE) ratings for the above were 1.2, 1.5, 1.5, 1.8 and 8 respectively.

A total of 41,745 DSE's were carried across the 157 grazing days. This equates to 266 DSE per day grazed over the 6-hectare site or 44.3 DSE/ha per grazing day. For the 341-day period between first and last recorded grazing of trial plots the site carried an average of 122 DSE per day or 20.4 DSE/ha.

20.4 DSE/ha is equivalent to a 170 to 290% increase in stocking rate compared to accepted long-term district average which ranges from 7 to 12 DSE/ha (Geoff Duddy, pers. comm) depending on pasture base and irrigation management

Key findings from the demonstration include:

- A variety of grass and legume based pastures can increase stocking rates compared to long term averages from traditional pasture (ryegrass/sub clover) base

Satellite Site 2 ("Weilmoringle")

Co-operator: Rick Ellis, 410 Wearne Rd. Pental Island, 3585

2012

Background
Demonstration objective was to investigate the performance of weaned wether Merino lambs on brassica pastures

Management:
Sit was top dressed with MAP (100kg/ha) prior to sowing. 5ha

Titan Brassica plot sown late April 2012. Estimated establishment cost was $264/ha which included contract sowing ($40/ha); seed ($59/ha) and fertilizer ($165/ha) plus irrigation costs of $250/ha (25ML/ha over 4 watering's). Total establishment and maintenance/irrigation costs = $514/ha.

Outcomes

- 550 Merino wether lambs, averaging 29.28kg live weight, entered plot on 21/7/12. Estimated average carcase weight was 12kg (HSCW) valued at $60/head (NLRS pers.comm)
- Mob size, grazing days and stocking rates were:
    - 550 lambs, 20 days, 110/ha
    - 344 lambs, 26 days, 68/ha
    - 240 lambs, 26 days, 48/ha for a total of 26,184 'days grazed'
- Lamb grazed plot for a total of 72 days. Total lamb weight gain during was 3663kg or 50.9 kg/day. The plot generated 10.18kg/ha/day (50.9 divided by 5 hectares)
- Lamb drafts were taken on three (3) occasions (12/9/13, 23/1/13 and 8/1/13). Slaughter weight averages were 20.0, 23.9 and 27.3kg HSCW respectively.
- The average HSCW and gross returns were 23.92kg and $107.66 per head across all lambs to average 421c/kg HSCW (including skin value)
- Growth rate estimates for these drafts (based on a 5kg birth weight and an 'average' age for the lamb drop) while grazing the Brassica plot were 344g, 208g and 243g/h/day respectively
- The average daily gain for all Merino wether lambs in the demonstration was 274g/h/day
- Increase in total gross meat income was estimated to be $50.10 per lamb (average slaughter HSCW minus starting HSCW multiplied by 421c/kg) or $1002/ha
- Gross profit was estimated as $488/ha based on Gross Income ($1002/ha) minus Establishment/Maintenance costs ($514/ha) and the estimated Benefit/Cost was 1.95 to 1 (Gross Income divided by Establishment/Maintenance Costs).

Photo 2 Weaned merino lambs grazing Titan brassica trial at Satellite Site 2 ("Weilmoringle")

Photo 3 Twin bearing merino ewes grazing brassica surplus at Satellite Site 2 ("Weilmoringle")

The demonstration site did not compare results for lambs grazing a traditional ryegrass/clover pasture base against the brassica pasture base. Brassica establishment costs, prime lamb production and gross margins however compared favourably to annual pasture and fodder crops (based on independent agronomic advice).

Key findings from the demonstration include:

- Brassica's can sustain high growth rates in merino wether lambs
- The benefit cost of Brassica's depends heavily on establishment costs, particularly irrigation use and cost, but can be in the order of 2 to 1

Satellite Site 3 ("Wyndamah")

Co-operator: Andrew Oxley, Fishpoint Rd. Pental Island, 3545

Demonstration objective was to investigate the performance of crossbred lambs on brassica

2012

Background
7.5ha of Titan and Goliath Brassica plot sown late March 2012.

Management
Top dressed with MAP (100kg/ha).

Outcomes
Poor weed management impacted on Brassica establishment and the cooperating producer was unable to complete the trial.
The performance of weaned crossbred lambs on Lucerne was however able to be monitored and costed. The properties Lucerne stands are primarily used for commercial hay production, are grazed between April-August and have an expected stand life of between 4 to 5 years.

Amended demonstration outcomes are summarised below:

- Lucerne establishment and maintenance costs (49 hectares):
  - Seed 14 Kg L56 @ $10/kg = $140.00
  - Single super 200 kg per ha = $75.00
  - Water x 2 50 ML + pumping cost = $25.50
  - Establishment costs = $ 240.50 per ha.
- 934 weaned crossbred lambs were moved to the 49 ha Lucerne block on July 18th, 2012, averaging 37.0kg live weight.
- Lambs grazed the stand for a total of 42 days during which time live weights and slaughter information were recorded.
- Average daily gain was 333g/h/d over the grazing period
- Lambs were sold in five (5) drafts between September 6th and October 12th, 2012, averaging $4.40/kg over all consignments (plus an average skin value of $11.60)
- Total Crossbred lamb grazing days (934 x 42 days) = 39,228
- Total kg of meat: = 13,986 kg (333g/h/d x 42 days)
  = 6,433.5 kg carcase (yield 46%)
  = 131.3 kg/ha @ $4.40/kg carcase weight
  = $577.70 per ha
- Total skin value = $10834.40 (934 lambs x $11.60)
- Total Gross Return = $39,141.80 or $577.70/hectare
- Gross profit was estimated as $337.20 based on Gross Income ($577.70/ha) minus Establishment/Maintenance costs ($240.50/ha).
- Estimated Benefit/Cost was 2.4 to 1 (Gross Income divided by Establishment/Maintenance Costs). This value would be greater if spread over a 4 to 5 year stand life of the Lucerne plot depending on maintenance and irrigation cost increases

The demonstration site did not compare results for lambs grazing a traditional ryegrass/clover pasture base against the Lucerne pasture base. Establishment costs, prime lamb production and gross margins however compared favourably to annual pasture and fodder crops (based on independent agronomic advice).

Key findings from the demonstration include:

- Lucerne can sustain high growth rates in crossbred lambs
- The benefit cost of Lucerne depends heavily on establishment costs, particularly irrigation use and cost, but can be in the order of 2.4 to 1
- The benefit cost would be expected to improve due to seed, sowing etc costs being reduced when spread over the 3-5 year life span of the Lucerne stand. Irrigation costs however must be factored in to any future analysis

Satellite Site 4 ("Mooloomoon")

Co-operator: Nick McKindlay, Moulamein NSW 2783)

2012

Background
Demonstration objective was to investigate the performance of merino lambs on brassica and turnip

Management:
Site top dressed with 250 kg of single super/ha ($94/ha) and a 4ha site sown to Raphro Brassica (1 ha, 8kg/ha); Barkant Turnip (1 ha, 1kg/ha) and Titan Rape (2 ha, 4kg/ha) in April 2012.

Outcomes
Trial unable to proceed due to poor establishment/competitiveness of Barkant and Titan varieties against sub clover and ryegrass growth post sowing. Decision was made to re-initiate this trial in 2013

2013

Background
Demonstration objective was to investigate the performance of crossbred lambs on brassica, turnips and ryegrass/clover pastures

Management
Site top dressed with 250 kg of single super/ha ($94/ha) pre sowing.
The 4 ha site sown in late April/May 2013 to Forage Brassicas (Titan, Greenland 1 ha); Turnips (Appin and Appin Bulb Only 1 ha) and Ryegrass/sub clover (2 ha). A fourth trial plot (10 ha) consisting of established ryegrass/sub clover pasture was included in the demonstration. Supplementary feed (oats) was provided via self-feeders in this plot.
Seed, sowing, fertiliser and weed control estimated costs for Brassica's, Turnips and Ryegrass/Sub Clover were $208, $207 and $176 respectively Irrigation Costs estimated at $275/ha ($3850 over 14-hectare site; 63 ML at 4.5ML/ha). Total establishment and maintenance/irrigation costs were $483; $482 and $451/ha respectively.

Outcomes
- Plots were grazed with weaned, crossbred lambs for a 26-day period during June/July 2013.
- Stocking rates were 40/40/20 and 4 lambs/ha on the Forage Brassica's, Turnips, Ryegrass/Sub Clover and Ryegrass/Sub Clover plots respectively
- Live weights and gains are shown in Table 1 below:

Table 1. Comparative Growth Rate of Crossbred Lambs at Satellite Site 4 ("Mooloomoon")

	Brassicas (Titan, Greenland)	**Turnips (Appin, Appin bulb)**	**Rye/Sub Clover**	**Rye/Sub Clover and Supplements***
Lambs/plot	40	40	40	40
Start Weight (kg)	34.2	34.1	34.5	35.2
Final Weight (kg)	41.5	42.1	41.3	40.6
Av Gain (kg)	7.3	8	6.8	5.4
Days on feed	26	26	26	26
Av Growth Rate (g/hd/d)	281	308	262	208

(*) Given an appreciably lower stocking rate and a failure to record total supplementary feed intakes within plot 4 only findings for Plots 1 to 3 are discussed below.

Key findings from the demonstration include:

- Total Dry Matter production varied between species and varieties. Pastures, in descending order of kilograms of Dry Matter produced per hectare were Titan (Brassica) > Diamond T (Rye) > Appin (Turnip) > Greenland (Brassica) > Tetila (Rye) and Appin Bulb Only (Turnip) as illustrated in Figure 3 below.
- Reasonable growth rates were attained on all pastures trialled
- In terms of average daily lamb live weight gain the pastures, in order of greatest gain were, Turnips > Brassica's > Rye/Sub Clover.
- All pasture Metaboliable Energy (ME/kgDM) values were adequate in terms of requirements for producing reasonable growth rates in crossbred lambs (refer Figure 4)
- Protein levels in Turnips, despite being lower than Brassica and Ryegrass, were adequate for the weight/age and growth rate requirements of lambs involved (refer Figure 4)

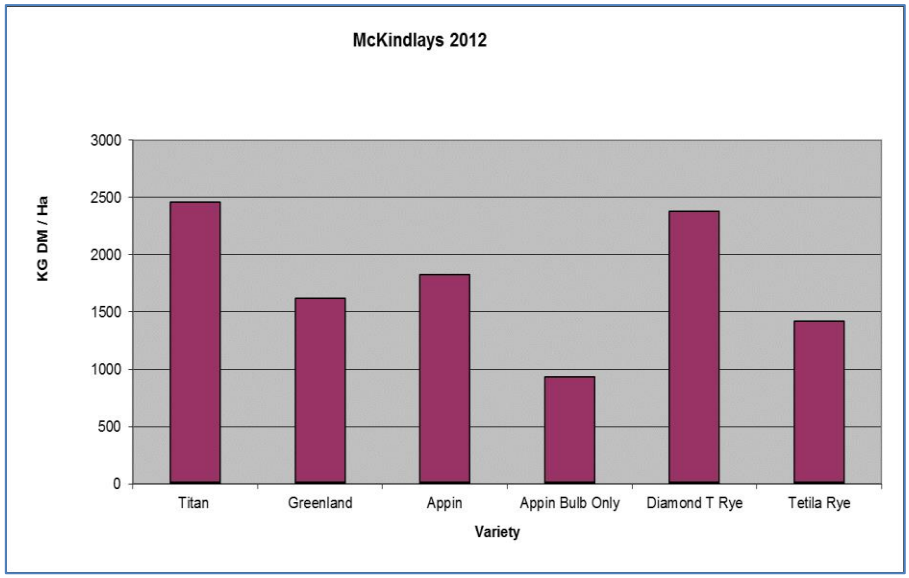

Figure 3 Pasture Dry Matter production (kg/ha) June 2013 (6 weeks post sowing) at Satellite Site 4 ("Mooloomoon")

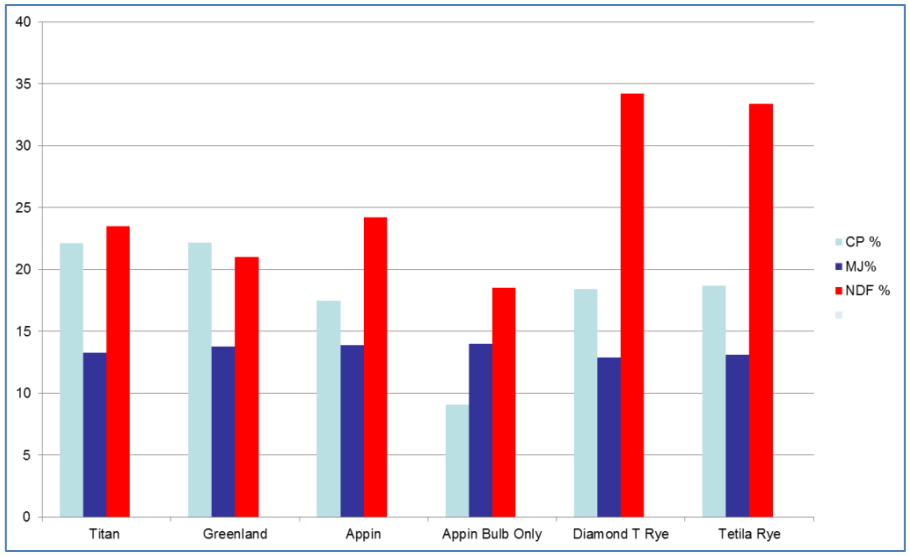

Figure 4 Pasture Energy, Crude Protein and Neutral Detergent Fibre Test Results (June 2013)

Collectively, the Brassicas:

- Recorded higher crude protein values than Ryegrass and Turnips
- Were similar to Ryegrass and Turnips in terms of metabolisable energy values
- Were similar to Turnips but lower than Ryegrass varieties in terms of Neutral Detergent Fibre values (NDF is the portion of fibre composed of hemicellulose, cellulose, lignin, silica etc. and is used to predict forage intake and quality. Feeds lower in NDF are usually of high quality and have high levels of intake. The higher NDF values of ryegrass

varieties may explain the lower lamb growth rates despite reasonable energy and protein values.)

- Were higher in terms of establishment cost ($483/ha) than ryegrass/sub clover ($451/ha)
- Were similar per cost of kg of dry matter produced despite higher dry matter production per hectare than Turnips and Rye/Clover. Cost per kilogram produced (based on varietal dry matter averages) were:

	DM/ha	Cost/ha	Cost ($/t DM)
Brassica's		($483)	
Titan	2450		= 197
Greenland	1600		= 302
Averaged	2025		= **239**
Turnips		($482)	
Appin	1800		= 268
Appin Bulb	950		= 507
Averaged	1375		= **351**
Rye/Clover		($451)	
Diamond T	2400		= 188
Tetila	1400		= 322
Averaged	1900		= **237**

Key findings from the demonstration include:

- most pasture varieties can provide adequate energy, protein and dry matter to support prime lamb growth rates in excess of 260 g/h/day
- high dry matter production does not necessarily translate into improved animal performance (or reduced costs of production) as shown in Figure 3 and Table 1 for Diamond T Ryegrass.
- Costs per kilogram/tonne of dry matter produced varied considerably between pasture variety and species
- Palatability issues between pasture species and varieties can have a significant effect on pasture acceptance and utilisation. This was illustrated during the demonstration between Brassica varieties Titan and Greenland as shown in Photo 3 below

Photo 4.
Grazing effect due to palatability differences between Titan (LHS) and Greenland (RHS) Brassicas at Satellite Site 4 ("Mooloomoon")

4.1.2 CMBWBL Activities/Training

A total of 16 events were conducted over the three-year life of the PDS project, with a total attendance of 384:

Year	2012	2013	2014	2015
Total Attendance	112	144	23	105

A number of these events were held in conjunction with other partners including the Department of Environment and Primary Industries Vic, EverGraze, Making More from Sheep program (MLA), NSW Catchment Management Authority, Landcare and the Western Murray Land Improvement Group.

Extension methods used (workshops, field days, newsletters, etc.) were reasonably successful in terms of developing, conveying and engaging both BWBL members and non-BWBL producers.

Most activities were reasonably well attended by CMBWBL members with between 7 (30%) and 19 (83%) of registered CMBWBL members attending scheduled events.

2012:

- CMBWBL/Vic DEPI Pasture Walk "*Forage Production and Livestock*" ("Murray View", June 18th, 2012; attendance 35)
- CMBWBL/Vic DEPI/MLA workshop "*Managing the Feed Base to Meet Market Specifications*" (Murrabit' July 23rd, 2012; attendance 28).
- CMBWBL workshop "*Post-flooding Soil, Pasture and Livestock*" (Benjeroop, August 22nd, 2012, attendance 32)
- CMBWBL Pasture Walk and Field Day "*Measure and Manage Pastures to meet the Requirements of Productive Sheep*" (September 25th, 2012, attendance 17)

2013:

- CMBWBL PDS Presentation Evergraze Forums (Echuca February 5th, 2013, attendance 33)
- CMBWBL "*Benchmarking, Soil and Fertiliser Analysis* workshop" (Murrabit, February 14th, 2013; attendance 22)
- CMBWBL workshop "*Feeding Lambs for Profit; Livestock Health and Sale Preparation*" (Murrabit, April 22nd, 2013; attendance 26)
- CMBWBL Pasture Walk and Talk "*Estimating Pasture Quality, Quantity and Carrying Capacities*" ('Fairley Downs" and "Murray View", May 27th, 2013, attendance 18)
- CMBWBL Pasture Walk *"Getting it right using BMP"* (Boort, June 17th, 2013, attendance 12)
- CMBWBL workshop "*The 3 P's – Pasture, Post-Mortems and Planning*" ("Reedy Waters" Murrabit, August 12th, 2013; attendance 18)
- CMBWBL Planning Meeting (Murrabit, August 12th, 2013; attendance 15)

2014:

- CMBWBL "*Soils and Forages*" Pasture Walk ("Murray View", February 3rd, 2014; 15)
- CSIRO/CMBWBL Field Day "*Enrich Saltbush*" ("Craiglea", May 15th 2014; attendance 8)

2015:

- CMBWBL/MMfS workshop "*Turning Pasture into Profit*" (Murrabit, March 23rd, 2015; 34)
- CMBWBL/MMfS workshop "*Healthy & Contented Sheep*" (Wakool, March 24th, 2015; 21)
- CMBWBL/MMfS workshop "*Healthy & Contented Sheep*" (Moulamein, March 23rd, 2015; 50)

5 Discussion

5.1 PDS Objective 1: Increase lamb growth rates from 180 g/h/d to 350 g/h/d by increasing pasture production and utilisation efficiency

Outcomes

Average daily growth rates in excess of 180g/h/d were recorded for both Merino and Crossbred lambs on all demonstration sites with

- Improved growth rates among weaned merino lambs recorded at
    - Satellite Site 1 (Murray View, 317g/h/d)
    - Satellite Site 2 (Weilmoringle, 274g/h/d)
- Improved growth rates among weaned crossbred lambs recorded at
    - Satellite Site 3 (Wyndamah, 333g/h/d)
    - PDS Site 1 (Fairley Downs, 236g/h/d)
    - Satellite Site 4 (Mooloomoon, 281 g/h/d (brassicas); 308 g/h/d (turnips); 262 g/h/d (rye/sub clover) and 208 g/h/d (rye/sub clover and supplements)

5.2 PDS Objective 2 Investigate and compare the cost benefit of establishing and grazing a range of pasture species in the Central Murray area.

Outcomes

With growing pressure in terms of ever increasing irrigation water price, CMBWBL members are selectively looking at pasture varieties in terms of production per hectare and per ML. Of species and varieties trialled there was a range of production (DM/ha) responses (Figures 1 and 3) and varietal feed test values (Figures 2 and 4)

Variations in terms of cost per hectare and/or per tonne of DM across a range of species/varieties were also found. Findings are outlined in Tables 2a-c (above) and 3 (below).

Table 2a: A summary of establishment costs, gross profit and pasture benefit/cost benefit data generated from PDS Site 1 and Satellite Sites 2 and 3

Site	**"Fairley Downs", Kerang VIC**	**"Weilmoringle", Pental Island VIC**	**"Wyndamah", Pental Island VIC**
Year	2012	2012	2012
Species/Varieties	Bindoon and Trikala clovers, Wedgetail wheat, Lucerne, Sungrazer and Sprinter rye grasses	Brassicas	Lucerne
Establishment and Maintenance Costs ($/ha)	$449.50	$514	$240.50
Gross Profit (First Year) ($/ha)	$274.46	$488	$337.20
Benefit/Cost Ratio (First Year)	1.6 to 1	1.95 to 1	2.4 to 1
Comments	These benefit/cost values would be expected to improve as seed and establishment costs per hectare would be reduced over a 3-5-year lifespan of pastures. Variations in irrigation costs and wool/meat returns however makes it difficult to predict 3 to 5-year benefit/cost outcomes		

Table 2b: A summary of establishment costs generated from Satellite Site 1

Site	**"Murray View", Murrabit VIC**						
Year	2012						
Species/Varieties	Barley	Wheat	Oats	Brassica	Turnip	RRR Blend	Sthn Green Forage Ryecorn
Establishment and Maintenance Costs ($/ha)	$219 (Urambie) $263.30 (Moby)	$214.10	$221.70	$211.18 (Titan) 215.90 (Greenland)	$208.90	$218.50	$212.60
Comments	Weaned Merino lambs grazed plots on a species basis. Collectively lambs averaged 317gms/day over the grazing period. Assuming a 45% yield this equates to a 1.0 kg HSCW gain/week. Valued at $4.00/kg and based on an average stocking rate of 57 lambs/ha this equates to $228/ha per week						

Table 2c: A summary of establishment costs generated from Satellite Site 4

Site	**"Mooloomoon", Moulamein, NSW**				
Year	2013				
Species/Varieties	Brassica (Titan)	Brassica (Greenland)	Turnips (Appin)	Turnips (Appin bulb)	Rye/Sub Clover
Establishment and Maintenance Costs ($/ha)	$483	$483	$482	$482	$451
Comments	Plots were grazed with weaned, crossbred lambs for a 26-day period. Growth rates exceeded 260g/h/d on all pastures.				

The Satellite Sites involved vary considerably in terms of soil characteristics and irrigation efficiency/costs, making it difficult for 'broad-sweeping' pasture selection recommendation(s) to be made. Outcomes may be used as a guide by participating CMBWBL producers but

property specific issues that may impact on pasture responses need to be interpreted on an individual basis.

A number of forage/pasture options were identified as having lower cost(s) per tonne of Dry Matter; improved lamb growth rates and high stocking rates. Unfortunately, these findings were not always repeatable across all demonstration sites or were not benchmarked against a standard pasture for the region (such as ryegrass/clover) or establishment/management costings for the same.

An example of varying costs of pasture production (tonnes of DM/ha) is shown in Table 3 below. Note the range in pasture cost between Satellite Sites 1 and 4 for the Brassica's and Turnip pastures

Table 3. Range in pasture cost ($/tDM) at Satellite Sites 1 ("Murray View") and 4 ("Mooloomoon")

Pasture	Variety	"Mooloomoon"	"Murray View"
Brassica	Titan Forage Rape	200	110
	Greenland Forage Rape	300	150
Turnip	Appin	270	90
	Appin bulb	510	
Cereals	Wheat (Wedgetail)		140
	Barley (Moby)		640
	Barley (Urambie)		190
	Oats (Cooee)		210
Ryegrass/Sub Clover	Diamond T	190	
	Tetila	320	

Demonstrations were however able to provide some benefit/cost estimates for a number of pasture species/varieties. This information has provided CMBWBL producers with 'base' information and training that will assist them with future selection and costing of pasture species and variety us

Overall winter cereals, Lucerne and Brassica's all produced reasonable quantities of high value feed as well as reasonable prime and merino lamb (and merino ewe) growth rates. The future cost of pasture production and benefit/costs of the same in terms of finishing Merino and Prime Lambs is heavily influenced by input costs, particularly irrigation water, infrastructure and pumping costs.

5.3 PDS Objective 3 Identify a pasture production system to assist with filling feed gaps that impact on lamb growth rates.

Outcomes

Difficulties faced at PDS Sites 1 ("Fairley Downs") and 2 ("Reedy Waters") and a failure to include a traditional Central Murray pasture base (such as ryegrass/sub clover) in all but one of the Satellite Sites impacted on obtaining data necessary to meet this objective.

Pasture growth/exclusion cage data at PDS Site 1 ("Fairley Downs") did suggest an increase in available pasture compared to existing, traditionally managed sub clover, ryegrass and barley grass pastures (Dean Harrington, pers. comm) however this is not endorsed by inclusive trial grazing data. While an increase in stocking density was necessary within the trial plots is suggestive of an increase in the traditional grazing window may have occurred this statement is largely anecdotal in nature.

Satellite Site 4 ("Mooloomoon") was the only site where comparative grazing trial data was available. Unfortunately, a limited grazing period (26 days) and lack of information in terms of cost per tonne of Dry Matter makes it difficult to make assumptions re identifying which of the pasture species/varieties trialled may help with cost-effectively filling feed gaps as outlined in Objective 3.

5.4 PDS Objective 4: Assist the members in the Central Murray BWBL group to adopt practices that are proven to increase cost efficiency and productivity on-farm.

Outcomes

Most CMBWBL members were actively involved throughout the duration of the PDS, both as trial co-operators and attendees at the various CMBWBL workshops, field days, pasture walks and meetings. The Western Murray Land Improvement Group (WMLIG) newsletter and email distribution list was used extensively to promote upcoming CMBWBL activities and research findings and facilitate adoption of practices increasing on-farm cost efficiency and productivity. The WMLIG newsletter is received by over 90 businesses and producers within the region.

Members were surveyed (see Appendix 8.1) and asked a series of questions in terms of adopting practices pre and post PDS. Responses varied from 3.94/10 (use of benchmarking pre PDS) to 8.47/10 (marketing lambs as primes instead of stores post PDS) with a range in 'Change' in use/adoption of between 21.0 to 83.6%. Percentage Change in Pre and Post PDS adoption of practices proven to increase cost efficiency and productivity on-farm averaged 51.6% across these questions within the survey.

Benchmark survey outcomes are discussed in depth in 5.5 (PDS Objective 5) below

Questions related to the rate of adoption (Figure 4e) and responses were:

	Pre PDS	Post PDS	% Change
Objective 1: Increase lamb growth rates from 180 g/day to 350 g/day by increasing pasture production and utilisation efficiency.	**5.12**	**8.12**	**58.6%**
Objective 2: Investigate and compare the cost benefit of establishing and grazing a range of pasture species in the Central Murray area.	**4.88**	**7.82**	**60.2%**
Objective 3: Identify a pasture system to assist with filling feed gaps and increase lamb growth rates	**5.18**	**8.24**	**59.1%**

	Pre PDS	Post PDS	% Change
Objective 4: Adopt practices that are proven to increase cost efficiency and productivity on farm	**5.65**	**8.18**	**44.8%**
Objective 5: Conduct benchmarking across 70% of Central Murray BWBL group members to define the cost benefit of adopting new pasture systems compared to traditional systems.	**3.94**	**7.24**	**83.6%**
Objective 6: Increased proportion of lambs sold as finished (prime) versus store lambs	**7.00**	**8.47**	**21.0%**

5.5 PDS Objective 5: Conduct benchmarking across 70% of Central Murray BWBL group members to more accurately define the cost benefit of adopting new pasture management systems compared to the current more traditional systems.

Outcomes

Two (2) benchmarking studies were conducted to identify CMBWBL member base production and enterprise levels and pre (and post) PDS knowledge, attitude, skills and/or aspirations (KASA).

Survey 1 was conducted during a CMBWBL "Capitalising on Opportunities in the Sheep Industry" Information Night at Wakool on September 7th, 2015. Although not designed to measure pre and post PDS actions/learnings, the survey was conducted to provide a base knowledge of non-CMBWBL and participating CMBWBL farm enterprise practices and production data.A summary of group findings is shown in Table 4.

Table 4: Central Murray BWBL Member vs Non Member Survey findings based on enterprise size and management practices (September 2015)

	Non BWBL	BWBL
Total Area (ha)	38954	28824
Average area (ha)	3246	2882
Total Sheep	43300	18820
Average Sheep	3926	2353
Stocking Rate	1.21	0.82
DSE/ha	1.50	1.90
Av 5 years Lambing %	101%	109%
Assess Pastures	46%	90%
Preferentially Feed Twinners	15.3%	80.0%

Responses suggest that BWBL members surveyed (n=10, 43% of total BWBL members) have

- lower stocking rates
- higher DSE/ha and
- higher average lamb marking results than Non BWBL members surveyed (n=15).

Higher lamb marking averages can be directly linked to BWBL members being proactive in terms of pasture assessment and meeting stock feed needs, key objectives of the CMBWBL PDS

Survey 2 was collated in November 2015. Pre and post average percentage change in awareness, knowledge and practice implementation for the five (5) PDS Objectives. A sixth question looking at BWBL members change in their sale of Store vs finished lambs was included to provide additional information on how the PDS has improved lamb finishing skills.

71% of CMBWBL members completed the survey.

A summary of questions and findings from the survey are outlined in 5.6 Group Learnings (below) and Appendix 8.1

5.6 Group Learnings:

Group members were surveyed at the conclusion of the project to evaluate the extent to which the PDS was able to facilitate practice change (adoption) associated with each objective, as well as the four sequential steps to practice change as established in Bennett's Hierarchy – i.e. changes in knowledge, attitudes, skills and aspirations (KASA).

For each of the six PDS objectives, the producers were asked to rate their own knowledge, attitude, skills, aspirations (KASA) and adoption pre-PDS and post-PDS. Ratings were based on a 1 to 10 scale. The improvement in these self-assessed scores was calculated as the difference between the average pre and post scores, expressed as a percentage of the initial average pre-PDS assessment.

For example, for an average pre-PDS score of 4.8, and an average post-PDS score of 7.0, the measure of improvement is 7.0 ÷ 4.8 = 146%, a change of +46%.

Survey Questions 1 to 4 recorded in the range of 4.9 to 5.7 for pre-PDS KASA and Adoption ratings. Post-PDS "improvements" for these ranged from 41% to 70%.
Question 5 ("Conduct Benchmarking") pre-PDS responses rated significantly lower than all other objectives but also recorded the greatest Post-PDS score and improvement.

Figures 4a to 4e below present the average pre and post-PDS scores and average percentage changes in KASA (knowledge, attitude, skills, aspirations) and Adoption levels associated with the six objectives of the PDS.

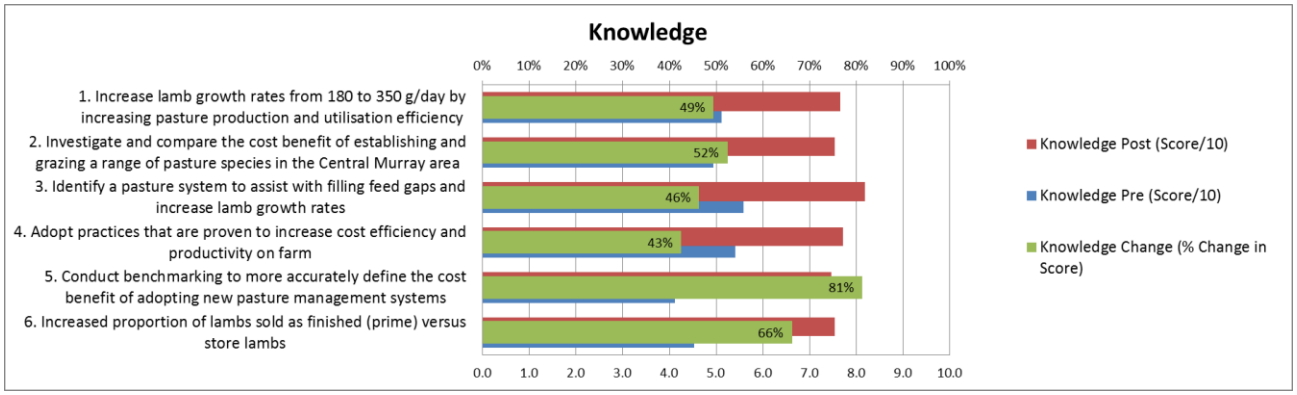

Figure 4a: Pre and post PDS and Percentage Change findings (CMBWBL Members - Knowledge)

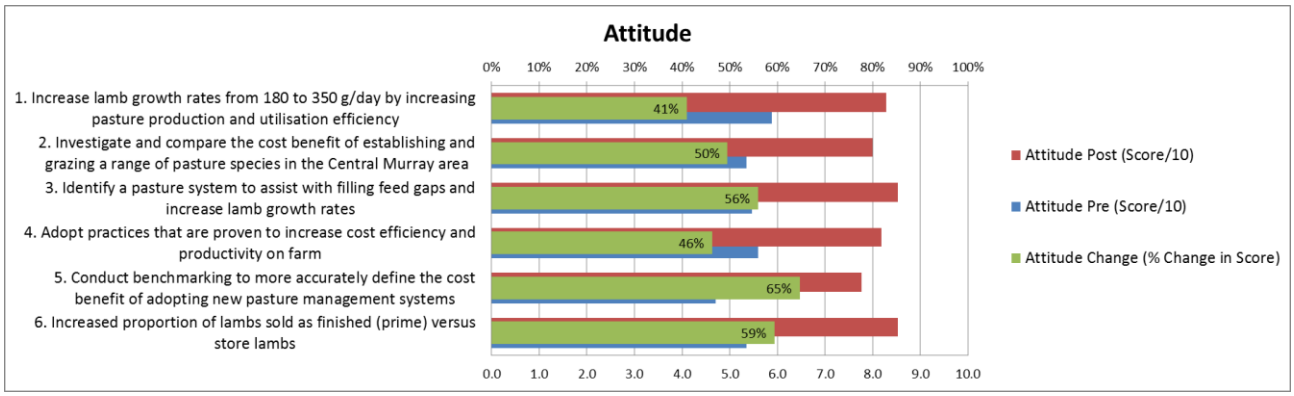

Figure 4b: Pre and post PDS and Percentage Change findings (CMBWBL Members - Attitude)

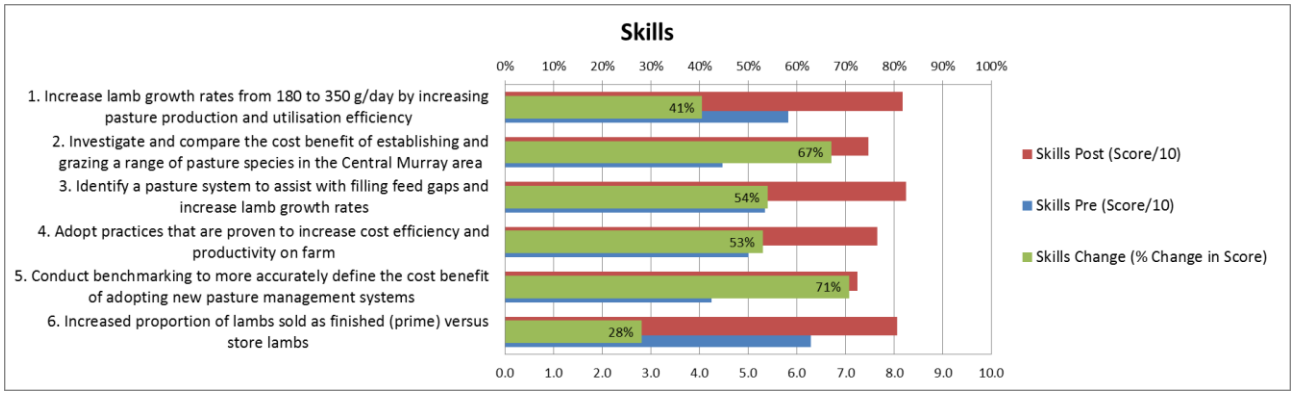

Figure 4c: Pre and post PDS and Percentage Change findings (CMBWBL Members - Skills)

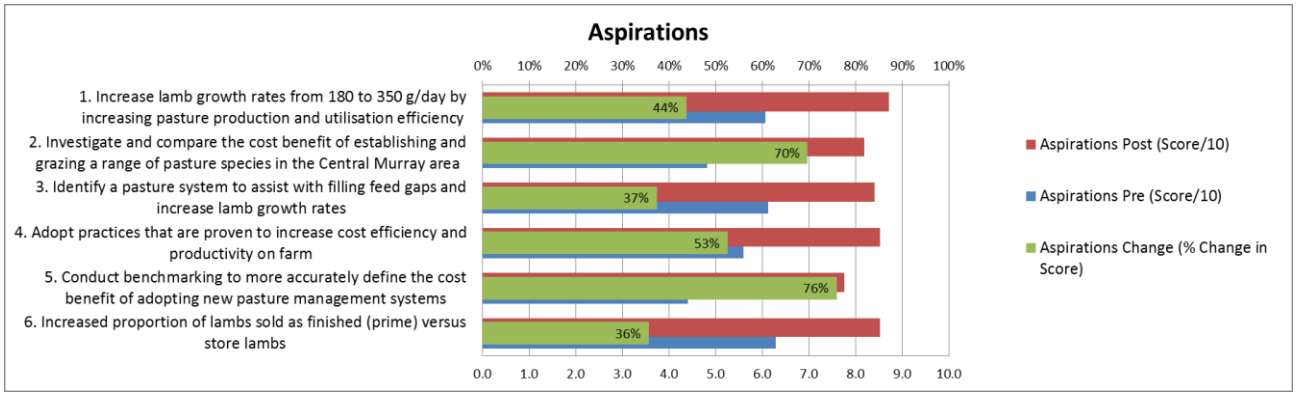

Figure 4d: Pre and post PDS and Percentage Change findings (CMBWBL Members - Aspirations)

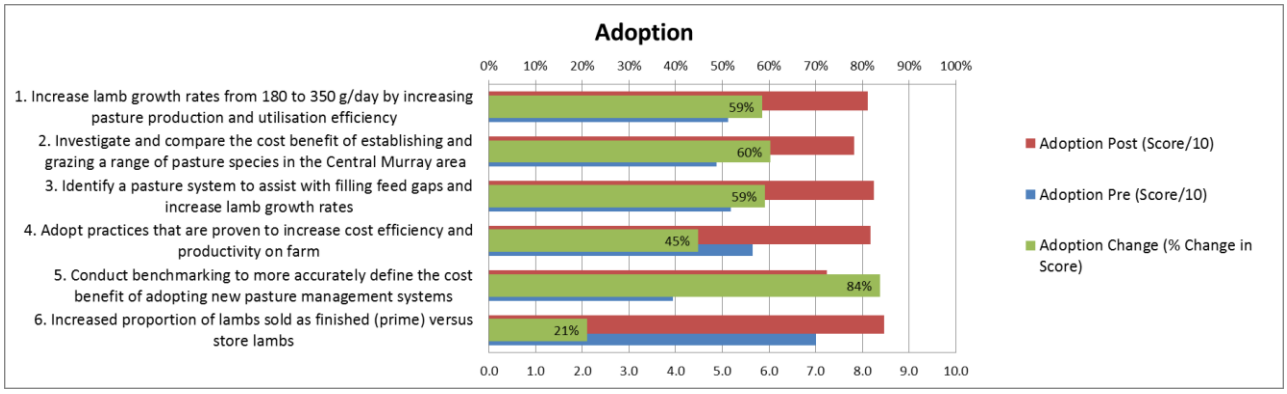

Figure 4e: Pre and post PDS and Percentage Change findings (CMBWBL Members - Adoption)

Adoption scores (Figure 4e) across all objectives increased and ranged from a low of 21% (Qn 6: “selling lambs as suckers”) to a high of 84% (Qn 5: use benchmarking to define cost benefit of new pasture systems”). Question 6 rated highest (7.0) among pre-PDS adoption scores - suggesting that producers were generally targeting this objective but, based on the post PDS score of 8.5 expected to improve as a result of undertaking the PDS.

Producer comments also provide an insight into the learnings from the PDS and the influence of external factors (eg: change in price of irrigation water) on the ultimate achievement of its objectives. Comments received, relative to each Objective, are listed in Table 5 below.

Table 5: CMBWBL Producer Survey Comments (November 2015)

Objective	Comments
1. Increase lamb growth rates from 180 to 350 g/day by increasing pasture production and utilisation efficiency	• Some advanced breeding techniques may produce more than dreamed of a decade ago through conversion rates • The biggest drawback to this practice at the moment is the price of irrigation water • After the 10-year drought, the introduction of the MDBP and losing water sales, trying to juggle stock and feed has put extreme pressure on farming in general making pasture improvement essential or give up! • Improving pasture production and management was one of my principle objectives on commencing BWBL
2. Investigate and compare the cost benefit of establishing and grazing a range of pasture species in the Central Murray area	• Had not tried new or fodder crops. Learnt that it's important not to get too excited (i.e: seed companies sell new sub-clovers for example but they were a waste of time sowing into old sub clover ground) • Came to conclusion that new ryes sown into sub clover paddocks better option than new clover or brassicas. While good to produce over $2300/ha the high cost of water and labour work against it
3. Identify a pasture system to assist with filling feed gaps and increase lamb growth rates	• With limited water we are improving one paddock each year. Barley grass is a big issue with us. We breed merinos and like to run the May drop lambs through to November (so wool >60mm). This is when we run into trouble with heavy infestation and discomfort in body, ears and eyes as well as wool
4. Adopt practices that are proven to increase cost efficiency and productivity on farm	• During the course of this project the cost of temporary and permanent transfer water has risen from $70 and $1500 per meg respectively to $300 and $2,500. This has all but killed it. The outcomes form these demonstrations at least provide me with the tools and knowledge to make decisions based on economics and implementing improved management practices • For irrigated prime lamb producers the relative cost of water has escalated to the extent that the viability of the enterprise is threatened • The main change I have made is the use of grain to fill gaps in feed availability. I have started new pasture systems but run into constraints due to water availability
5. Conduct benchmarking to more accurately define the cost benefit of adopting new pasture management systems	• A day to day farm diary has always been kept re activities and stock movements but given high water costs and lack of economic data, a cost per hectare was not attempted till 2012 • I would like to see some more benchmark figures in the future • While a guide there are a few differences between demonstration sites that saw differences between some pasture costs particularly cost per tonne of Dry Matter. I will look to use the results as a guide when doing cost benefit analysis on my own property
6. Increased proportion of lambs sold as finished	• Sell young stores when markets strong. In 2014 50% of our maiden ewes scanned in lamb, increasing our lambing %

Objective	Comments
(prime) versus store lambs	from 100% in 2011 to 122% in 2015. In 2014/15 all wether lambs were sold between Oct and January for $79, no supplementation costs. In 2015 all wether lambs sold for $82 by September 2015 • In 2015 we have shorn 60 lambs out of 1950, the balance have gone as suckers - not achieved before • Tighter season and low water availability coupled with higher lambing percentages may mean that in spite of establishing new pasture projects this year my percentage of stores to primes will be influenced by supplementary feeding. I may turn off more lambs but the ratio may remain at 50/50 stores to primes

5.7 Key PDS Learnings

Key producer learnings/ recommendations include:

- Developing and implementing pasture assessment and feed budgeting skills on-farm
- The importance of understanding and meeting livestock feed needs
- Understanding how to use feed quality test information to develop suitable rations
- The importance of good pasture establishment and grazing management to prolong pasture lifespan and quality
- Cost per kg/tonne of Dry Matter of greater importance than cost/ha
- Palatability of some varieties can be an issue
- Benefit/costs can be in excess of 1.6 to 1 for most irrigated pasture systems within the Murray Irrigation catchment area. The benefit cost findings from this PDS may further improve if analysed over 3-5 years (due to seed/preparation etc costs being spread across a longer period) however increasing irrigation input costs also need to be factored. Producers therefore need to consider a range of cost/production scenarios to assist with pasture production decision making

5.8 Economics

A major factor affecting irrigated pasture use within prime and merino lamb enterprises during the period of this PDS has been the increasing cost (and availability) of general security water within the region serviced by Murray Irrigation.

Several analyses were conducted using data generated from PDS findings to determine the benefit/cost of irrigating improved pastures, with the assistance of CMBWBL members Jamie Semmler, Andrew Oxley and Simon Ettershank.

The Sheep CRC Feedlot Calculator was used to predict profit margins for finishing Store (17kg HSCW) lambs to Trade (23kg HSCW) lamb weights between 2011 to November 2015. An example of the program is shown in Appendix 8.2

The following assumptions were used in the analysis:

- 500 crossbred lamb operation
- 1% deaths
- 15 hectares of improved pasture (3tDM/ha; 10MjDM, 14% Crude Protein)
- 39 kg store lambs (17kg HSCW)

- 48kg finished (trade) lambs at sale (23kg HSCW)
- Lamb and average water values were obtained from NLRS and Murray Irrigation (Anon 2015a) respective web sites.
- Pasture costs were based on the assumption that 1 ML of irrigation water produces 1 additional tonne of DM (as proposed by Jolly and Dickson (2010)).

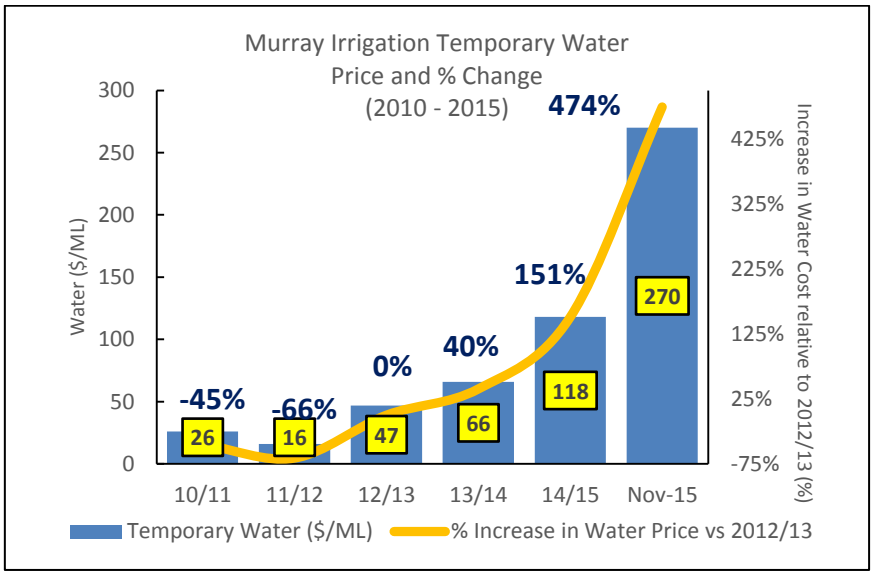

Figure 5: Murray Irrigation Temporary Water Price and % Change (2010- November 2015)

Figure 5 illustrates the relative increase in the cost of temporary water since 2012/13. From a base price of $47/ML in 2012/13, the cost has risen by $223, or 474 percent as of November 2015.

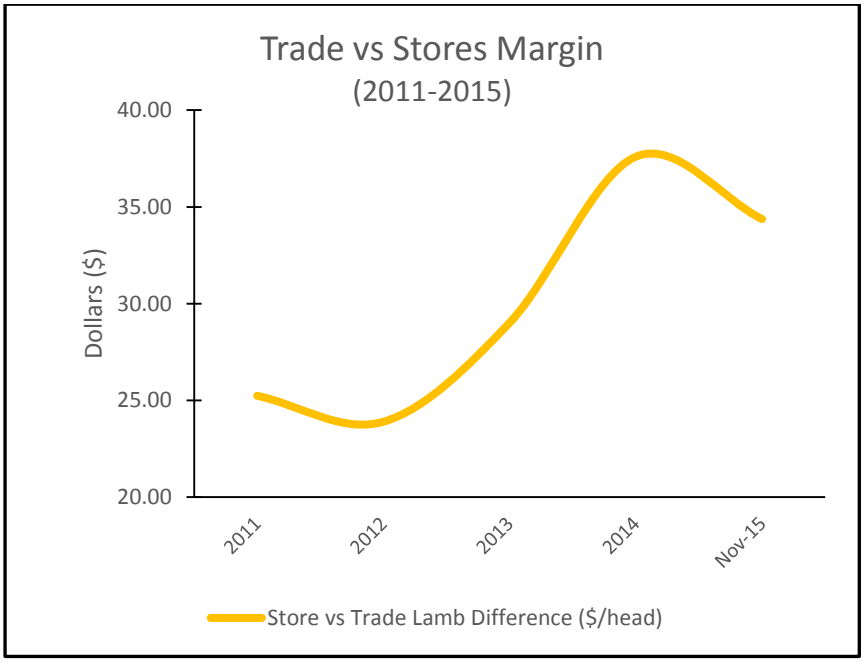

Figure 6: Relative Margin between Eastern States Store and Trade Lambs (2011-2015)

Figure 6 illustrates how the margin, in dollar terms, between the average value of Eastern States Store and Trade (finished) lambs has increased since 2011. This would suggest a

greater opportunity to profitably finish lambs on-farm during this period. Unfortunately, once the rising cost of irrigation water is taken into account, this is not the case.

Analysis results agree with the findings of Davey (2013) that irrigated pasture systems are not viable unless the Store/Trade lamb margin is >$50 per head and/or water costs are <$50/ML.

The data values used to generate Costs and Profitability of finishing Store Lambs on Irrigated pastures within the CMBWBL region as outlined in Table 6 and Figure 7 below.

Table 6: Summary of inputs and outcomes when analysing the costs and profitability of finishing Store lambs on irrigated pastures within the Central Murray BWBL region (2011-November 2015)

	Water Cost ($/ML)	**Pasture Cost** ($/t DM)	**Pasture cost** ($/hd)	**Profit** ($/hd)
2011	$16	$15.6	$1.33	$4.31
2012	$47	$45.7	$3.92	$3.34
2013	$66	$64.2	$5.50	$6.98
2014	$118	$114.8	$9.84	$9.44
Nov-15	$270	$262.6	$22.51	**- $6.94**

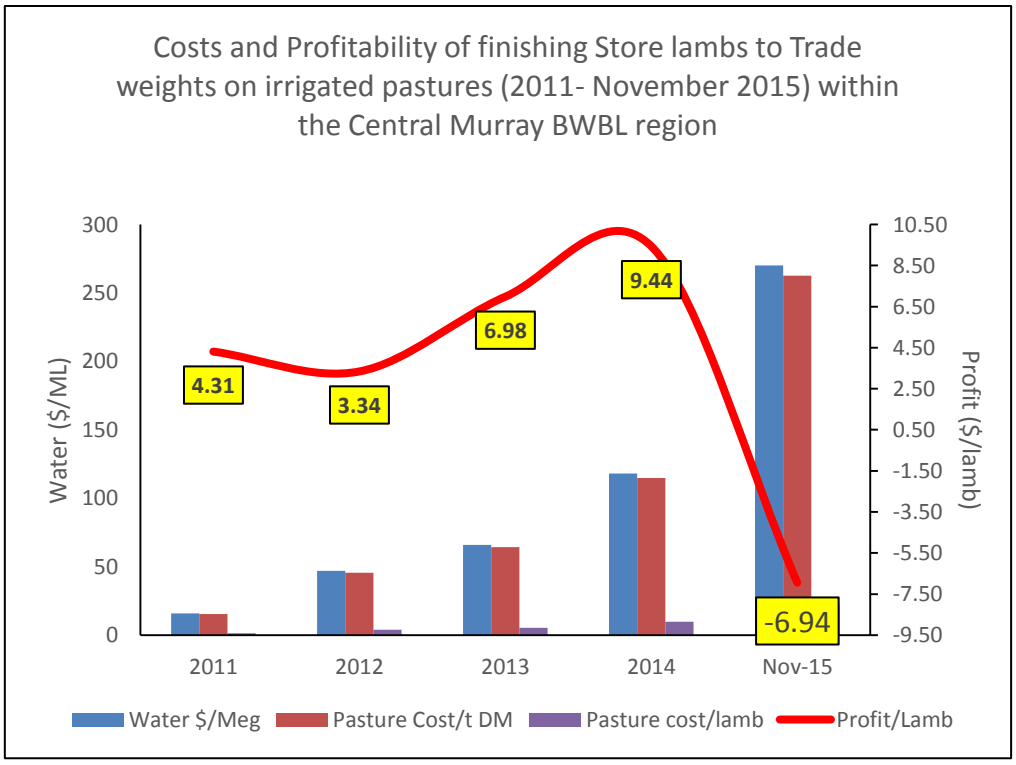

Figure 7: Costs and Profitability of finishing Store lambs to Trade weights on irrigated pastures (2011- November 2015) within the Central Murray BWBL region

Figure 7 shows that profit margins for finishing Store lambs to Trade weights has been reasonably tight (but profitable) between 2011 and 2014. Reduced margins between Store

and Trade lambs (Figure 6) and significant increases in irrigation water costs (Figure 5) have however impacted heavily on profit margins in 2015 under assumptions made within this analysis and producers would have been better positioned financially to sell unfinished lambs rather than look to finish the same on irrigated pastures.

A sensitivity analysis was also undertaken to investigate the profitability of finishing Store lambs using 2015 base water prices ($270/Ml) under

- varying pasture responses where 1 ML produced 1, 1.5 or 2 tonnes of DM and where
- costs were borne
  - solely by the lamb finishing exercise versus
  - half costs assigned to lamb finishing/half to ewe base (assuming residual feed use from pasture)

Findings are shown in Figure 8 below.

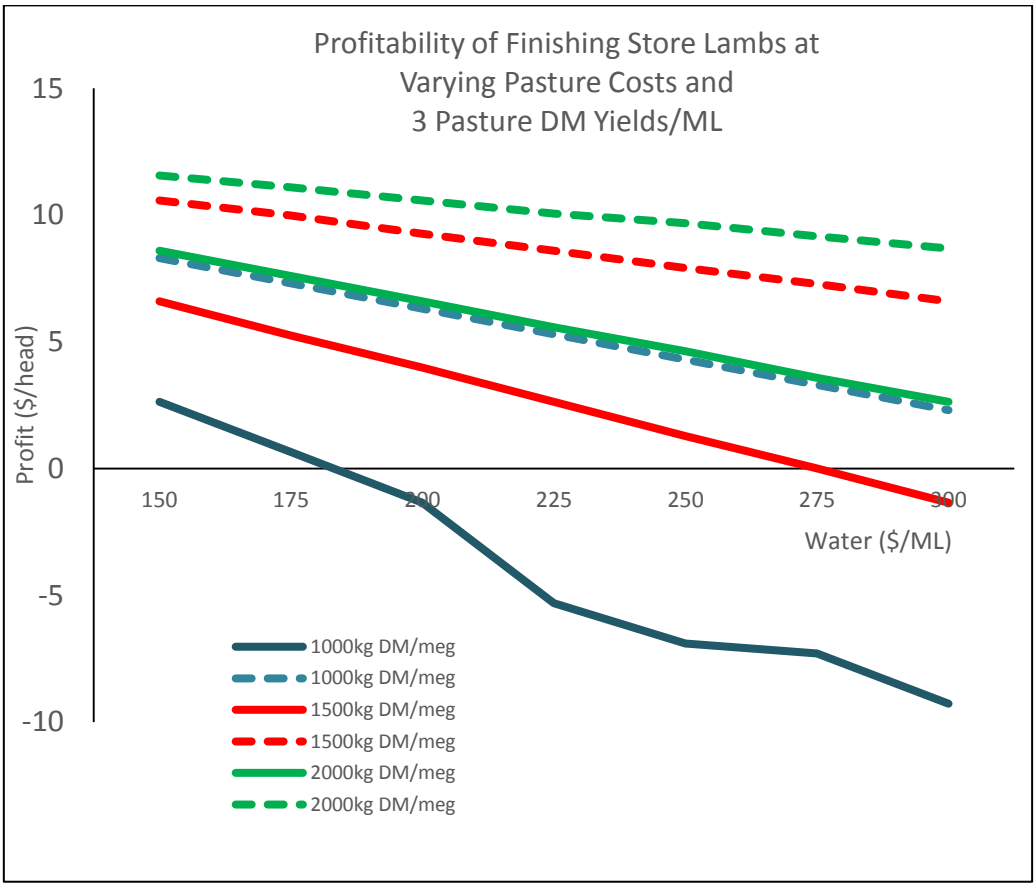

Figure 8: Profitability of finishing Store lambs in 2015 on irrigated pastures within the CMBWBL region under varying pasture DM production per ML assumptions and costs (100% allocated to lamb finishing or shared equally between lamb finishing and ewe flock)

This analysis underlines the need for strategic use of irrigation water to finish Store lambs within the Central Murray irrigation districts. Findings suggest that reasonable profit margins

are possible under current 'high' water costs provided high (1.5+ tonnes DM/meg) dry matter production per ML and use of residual pasture by breeding ewes are possible.

5.9 Future Communications:

Central Murray BWBL members continue to investigate the pros and cons associated with a variety of irrigated pasture systems. The benefit/cost ratio of finishing crossbred or merino lambs on pasture compared to sale as Stores, and the alternative of using supplements and/or grain-based finishing systems remains an area of interest.

On-farm trial work will continue through CMBWBL members who are actively involved with Western Murray Land Improvement Group activities.

6 Conclusions/recommendations

The Making More from Sheep on Irrigated Pastures PDS aimed to develop systems to maximise water use and efficiency in pasture production demonstrations and make more from sheep on irrigated pastures.

Despite the negative impact of issues related to site preparation, pasture establishment, irrigation costs and health concerns faced by the PDS Coordinator on the outcomes of PDS sites, the increase in adoption of practices related to the PDS objectives by BWBL members has been pleasing.

Economic analyses suggest that, under current Store/Trade lamb and irrigation water prices, there is a high level of risk associated with the profitability of finishing lambs on irrigated pastures within the Murray Irrigation region.

Further research is recommended to establish the best mix of improved, irrigated pastures/forages; supplements and/or grain based finishing systems under current irrigation water values.

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Appendix 8.1

Practice change evaluation survey

At the conclusion of the PDS, Central Murray BWBL group members were surveyed to ascertain the changes occurring to their adoption of the practices associated with each of the six project objectives, and the precursors to practice change (i.e. knowledge, attitudes, skills and aspirations).

For each question, producers were asked to rate themselves (on a score range of 1 – 10) in these aspects, both before (pre) and after (post) the conduct of the PDS project.

Seventeen (71%) of CMBWBL members returned surveys. Additionally, a number of comments were received relating to various objectives.

Survey Questions

Question 1: Increase lamb growth rates from 180 g/day to 350 g/day by increasing pasture production and utilisation efficiency.

a) How much did you know about pasture production and utilisation before and after the PDS project?
b) Please indicate your attitude to this practice before and after the PDS project (e.g. Did you think this was an achievable change to make? Is it something worth striving for?)
c) What pasture production and utilisation skills did you have before and after the PDS project?
d) How motivated were/are you to make gains in pasture production and utilisation before and after the PDS project?
e) To what extent were/are you putting this into practice, before and after undertaking the PDS?

Question 2: Investigate and compare the cost benefit of establishing and grazing a range of pasture species in the Central Murray area.

a) How much did you know about the benefits and costs of establishing and grazing specialised fodder species for lamb production before and after the PDS project?
b) Please indicate your attitude to analysing this practice before and after the PDS project (e.g. Did you think this was an achievable change to make? Is it something worth striving for?)
c) What skills did you have in analysing benefits and costs of this practice before and after the PDS project?
d) How motivated were/are you to undertake such an analysis before and after the PDS project?
e) To what extent were/are you using this practice (i.e. evaluating the benefits and costs of fodder establishment), before and after undertaking the PDS?

Question 3: Identify a pasture system to assist with filling feed gaps and increase lamb growth rates

1. How much did you know about optimising pasture systems for increasing lamb growth rates before and after the PDS project?

2. Please indicate your attitude to planning pasture systems for increasing lamb growth rates before and after the PDS project (e.g. Did you think this was an achievable change to make? Is it something worth striving for?)
3. What skills did you have in optimising pasture systems for increasing lamb growth rates before and after the PDS project?
4. How motivated were/are you to design such a pasture system before and after the PDS project?
5. To what extent were/are you using this practice before and after undertaking the PDS?

Question 4: Adopt practices that are proven to increase cost efficiency and productivity on farm

1. How much did you know about the costs and returns (productivity) of your farming system before and after the PDS project?
2. Please indicate your attitude to understanding your costs and returns (productivity) before and after the PDS project (e.g. Did you think this was an achievable change to make? Is it something worth striving for?)
3. What skills did you have in analysing your own costs and returns (productivity) before and after the PDS project?
4. How motivated were/are you to improve your understanding of cost efficiency and productivity before and after the PDS project?
5. To what extent were/are you choosing or changing your production systems based on their cost efficiency and productivity before and after undertaking the PDS?

Question 5: Conduct benchmarking across 70% of Central Murray BWBL group members to more accurately define the cost benefit of adopting new pasture management systems compared to the current more traditional systems.

1. How much did you know about the costs and returns (productivity) of your farming system compared to industry benchmarking averages before and after the PDS project? e.g. lamb production (kg/ha), cost of production ($/kg), gross margin ($/ha), return on investment (%)
2. Please indicate your attitude to benchmarking your enterprise against a larger group before and after the PDS project (e.g. Is it something worth doing?)
3. What skills did you have in benchmarking your enterprise before and after the PDS project?
4. How motivated were/are you to participate in benchmarking before and after the PDS project?
5. To what extent were/are you using benchmarking to compare the benefit/cost ratio of establishing and managing improved pasture systems for lamb production before and after undertaking the PDS?

Question 6: Increased proportion of lambs sold as finished (prime) versus store lambs

1. How much did you know about what was required to get lambs to finished weight and condition before and after the PDS project? e.g. lamb production (kg/ha), cost of production ($/kg), gross margin ($/ha), return on investment (%)

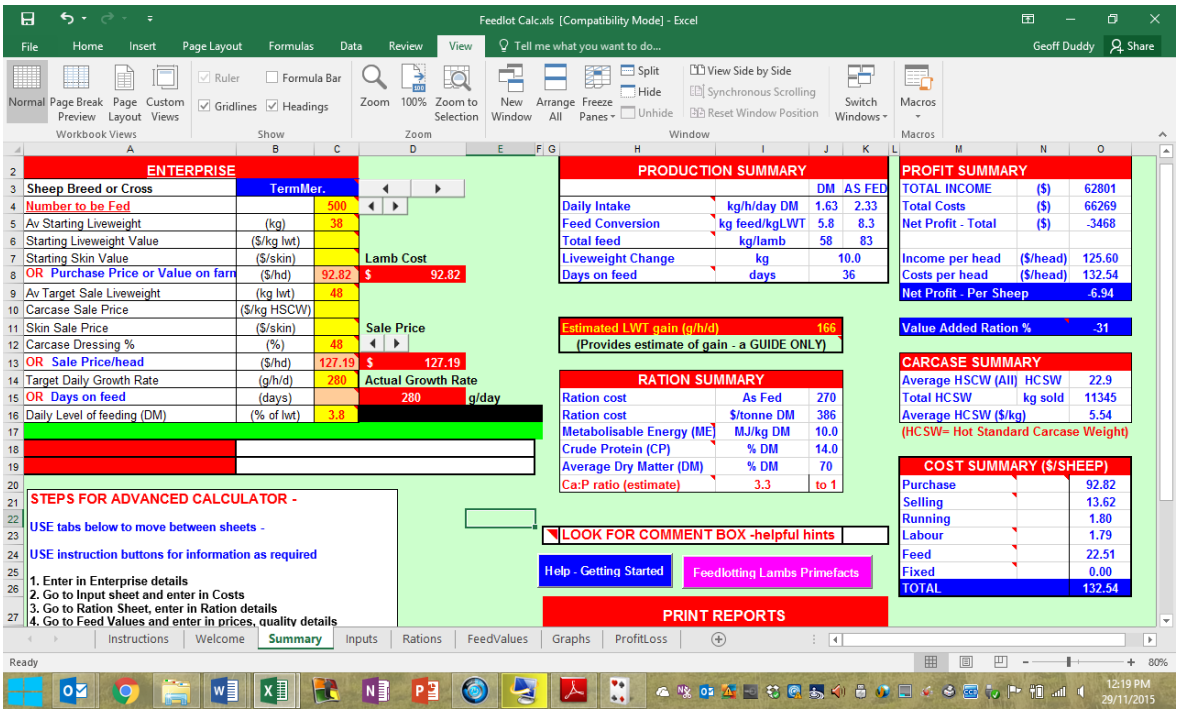
2. Please indicate your attitude to achieving this outcome before and after the PDS project (i.e. Is it something worth striving for?)
3. What skills did you have in finishing prime lambs before and after the PDS project?

4. How motivated were/are you to achieve this outcome before and after the PDS project?
5. To what extent were/are you marketing your lambs as prime lambs (versus stores) before and after undertaking the PDS?

Summary of evaluation survey responses

Objective	Producer Group Member Self-Asessment Scores and Change														
	Knowledge			Attitude			Skills			Aspirations			Adoption		
	Pre (Score/10)	Post (Score/10)	**Change** (% Change in Score)	Pre (Score/10)	Post (Score/10)	**Change** (% Change in Score)	Pre (Score/10)	Post (Score/10)	**Change** (% Change in Score)	Pre (Score/10)	Post (Score/10)	**Change** (% Change in Score)	Pre (Score/10)	Post (Score/10)	**Change** (% Change in Score)
1. Increase lamb growth rates from 180 to 350 g/day by increasing pasture production and utilisation efficiency	5.1	7.7	**49%**	5.9	8.3	**41%**	5.8	8.2	**41%**	6.1	8.7	**44%**	5.1	8.1	**59%**
2. Investigate and compare the cost benefit of establishing and grazing a range of pasture species in the Central Murray area	4.9	7.5	**52%**	5.4	8.0	**50%**	4.5	7.5	**67%**	4.8	8.2	**70%**	4.9	7.8	**60%**
3. Identify a pasture system to assist with filling feed gaps and increase lamb growth rates	5.6	8.2	**46%**	5.5	8.5	**56%**	5.4	8.2	**54%**	6.1	8.4	**37%**	5.2	8.2	**59%**
4. Adopt practices that are proven to increase cost efficiency and productivity on farm	5.4	7.7	**43%**	5.6	8.2	**46%**	5.0	7.7	**53%**	5.6	8.5	**53%**	5.7	8.2	**45%**
5. Conduct benchmarking to more accurately define the cost benefit of adopting new pasture management systems	4.1	7.5	**81%**	4.7	7.8	**65%**	4.2	7.2	**71%**	4.4	7.8	**76%**	3.9	7.2	**84%**
6. Increased proportion of lambs sold as finished (prime) versus store lambs	4.5	7.5	**66%**	5.4	8.5	**59%**	6.3	8.1	**28%**	6.3	8.5	**36%**	7.0	8.5	**21%**
Lowest Value	4.1	7.5	43%	4.7	7.8	41%	4.2	7.2	28%	4.4	7.8	36%	3.9	7.2	21%
Highest Value	5.6	8.2	81%	5.9	8.5	65%	6.3	8.2	71%	6.3	8.7	76%	7.0	8.5	84%
Range	1.5	0.7	39%	1.2	0.8	24%	2.1	1.0	43%	1.9	1.0	40%	3.1	1.2	63%
AVERAGE	5.0	7.7	**56%**	5.4	8.2	**53%**	5.2	7.8	**52%**	5.5	8.4	**53%**	5.3	8.0	**55%**

Appendix 8.2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ENTERPRISE
Sheep Breed or Cross
TermMer.
Number to be Fed
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Av Starting Liveweight
38
Starting Liveweight Value
Starting Skin Value
OR Purchase Price or Value on farm
92.82
Lamb Cost
$ 92.82
Av Target Sale Liveweight
48
Carcase Sale Price
Skin Sale Price
Sale Price
Carcase Dressing %
48
OR Sale Price/head
127.19
$ 127.19
Target Daily Growth Rate
280
Actual Growth Rate
OR Days on feed
280
g/day
Daily Level of feeding (DM)
3.8
PRODUCTION SUMMARY
DM AS FED
Daily Intake kg/h/day DM 1.63 2.33
Feed Conversion kg feed/kgLWT 5.8 8.3
Total feed kg/lamb 58 83
Liveweight Change kg 10.0
Days on feed days 36
Estimated LWT gain (g/h/d) 166
(Provides estimate of gain - a GUIDE ONLY)
RATION SUMMARY
Ration cost As Fed 270
Ration cost $/tonne DM 386
Metabolisable Energy (ME) MJ/kg DM 10.0
Crude Protein (CP) % DM 14.0
Average Dry Matter (DM) % DM 70
Ca:P ratio (estimate) 3.3 to 1
PROFIT SUMMARY
TOTAL INCOME ($) 62801
Total Costs ($) 66269
Net Profit - Total ($) -3468
Income per head ($/head) 125.60
Costs per head ($/head) 132.54
Net Profit - Per Sheep -6.94
Value Added Ration % -31
CARCASE SUMMARY
Average HSCW (All) HCSW 22.9
Total HCSW kg sold 11345
Average HCSW ($/kg) 5.54
(HCSW= Hot Standard Carcase Weight)
COST SUMMARY ($/SHEEP)
Purchase 92.82
Selling 13.62
Running 1.80
Labour 1.79
Feed 22.51
Fixed 0.00
TOTAL 132.54
STEPS FOR ADVANCED CALCULATOR -
USE tabs below to move between sheets -
USE instruction buttons for information as required
1. Enter in Enterprise details
2. Go to Input sheet and enter in Costs
3. Go to Ration Sheet, enter in Ration details
4. Go to Feed Values and enter in prices, quality details
LOOK FOR COMMENT BOX -helpful hints
Help - Getting Started
Feedlotting Lambs Primefacts
PRINT REPORTS
Instructions
Welcome
Summary
Inputs
Rations
FeedValues
Graphs
ProfitLoss
Ready