Farming Systems

Profitable crop sequences with a one or two year break
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Key messages
• Continuously cropping cereals has increased grass weeds and root disease to a point that it is no longer the most economical option, due to decreased yield and costs associated with addressing weed and disease issues.
• Two year breaks starting to pay their way in the third year of the rotation.
• One year breaks have lifted wheat performance but have not kept grassy weeds or diseases under control.

Why do the trial?
To determine the comparative performance of alternative crops and pastures as pest and disease breaks in an intensive cereal phase.

In low rainfall regions of south-eastern Australia broad-leaf crops make up only a very small proportion of the total area of sown crops. In light of increasing climate variability farmers have adopted continuous cereal cropping strategies as non-cereal crops are perceived as riskier than cereals due to greater yield and price fluctuations. At the same time, this domination of cereals is increasing the need for non-cereal options to provide profitable rotational crops, disease breaks and weed control opportunities to sustain cereal production. Currently, the most common ‘break crop’ is often a poor performing volunteer annual grass dominant pasture. They are often havens for cereal pests and disease and are seen as having negative impacts on subsequent cereal grain yield and quality.

How was it done?
In year three (2013) of the study all of the treatments were sown to wheat at 55 kg/ha with 65 kg/ha DAP (18:20:0:0) on 14 May. Three treatments that had been sown with cereals (wheat or oats) in both the previous two years were sown with the Clearfield variety Kord CL Plus to address grass weed issues. Five treatments that had not had any legume break phase (2 x continuous wheat, vetch/oats mix followed by wheat, oats then canola and canola then oats) in the previous two years also received 50 kg/ha of urea at sowing to compensate for any nitrogen deficiency.

One month post-sowing the Kord plots were sprayed with Intervix @ 0.7 L/ha. The entire trial was sprayed for broadleaf weeds with MCPA+ diflufenican @ 0.75 L/ha on 4 July and any treatment that had had a medic break phase received an additional herbicide application the following day of clopyralid 0.08 L/ha to target volunteer medic.
Seven treatments (Angel medic/wheat, oats/canola, oats/peas, Jaguar medic/wheat, canola/peas, peas/wheat and peas+canola/wheat) with high levels of grassy weeds were subsequently sprayed with grass selective cloquintocet-mexyl + pyroxsulam @ 0.5 L/ha.

Grassy weeds were measured in three ways to gain a greater understanding of what was occurring within rotations. Prior to sowing soil was collected from the west end of each plot to assess weed seed banks. They were grown out in a shade house where emerged plants were counted and recorded. The counting process was repeated following three times of emergence 22 May, 30 May and 3 July. The second assessment was undertaken in the field plots on 20 August when grass species were counted and recorded for each plot, and thirdly on 25 September panicle counts of grass weeds were completed as a measure of potential seed bank for the 2014 season.

Each sub-plot was machine harvested individually to identify any differences as a result of the management strategies employed in years one and two. Grain samples were retained for quality testing.

**What happened?**

Treatments sown to Kord compared to Mace had fewer plants established with 106 plants/m² compared to 124-152 plants/m², despite being sown at the same rate of 55 kg/ha. Larger seed size and continuous cereal stubble residues causing poor seed-to-soil contact and intermittent blocking of machinery is likely to have contributed to Kord failing to reach similar plant populations to Mace.

On 15 August roots were collected and scored on a 0-5 (0 being no damage, 5 severe damage) scale for Rhizoctonia wheat root damage. The continuous cereal treatments had significantly higher root disease incidence with levels above two, compared to all other treatments. At these levels nutrient uptake can be reduced and could help explain the poor yields recorded in these treatments.

Grain yields averaged 1.7 t/ha with continuous cereals right up to 2.9 t/ha following a 2 year fallow (Figure 1). Wheat following a one year legume break in 2011 still yielded higher than a continuous cereal rotation, highlighting the continued yield benefit two years after a single break.

Screenings greater than 5% were measured with continuous wheat (sown with Kord) which is classified as Australian General Purpose (AGP) despite protein levels of over 13%. This drop in classification from H1 to AGP resulted in a $60/ha reduction in gross margin using Viterra Port Lincoln cash prices 20 November.

Wheat in 2013 following canola yielded on average 0.28 t/ha less than if the break had been medic, peas or oats, regardless of the phase prior to the 2012 canola. Canola following oats yielded lower than canola following peas or medic due to a higher grass weed burden despite several control operations.

Cutting canola for hay in 2012 instead of harvesting for grain increased grain yields in the following wheat crops by up to 0.7 t/ha.

![2013 Wheat Yield & Grass Weed Burden](image)

**Figure 1** 2013 wheat yields (t/ha) and grass weed counts plants/m² taken 20 August 2013 following treatments imposed in 2011 and 2012
Late germinating barley grass was problematic in this trial. Expensive but effective selective grass herbicides used post emergence in many treatments in 2013 controlled annual rye grass and brome grass. However, barley grass then became dominant in many of these plots.

Simulated grazing by mowing on three occasions (10 July, 17 August and 18 September) in 2012 substantially reduced grassy weeds in 2013.

A two year break with the biennial legume *Hedysarum coronarium* (Sulla) resulted in the lowest amount of water in the profile (111 mm) pre-sowing in 2013, which compares to volunteer pasture/chemical fallow with 137 mm. Subsequent wheat yields reflected this with 2.2 t/ha, the same as treatments with only a one year 2011 cereal break.

An economic analysis over the 3 years found that continuous cereal cropping was the most profitable through 2011 and 2012, however in year three the positive effects of particular break options became apparent with higher wheat yields recorded. Gross margin comparisons in 2013 saw wheat following two years of fallow as the highest grossing with $558/ha compared to $152/ha for continuous wheat. A two year break of canola cut for hay following peas for grain was the second highest grossing with $550/ha.

When comparing the treatments over three years canola – graze & grain/oats - hay, oats - hay/medic – graze and canola – grain/oats – graze were the highest grossing with over $900/ha and up to $1006/ha. The most profitable one year break was a pea and canola mixture that was grazed, this grossed $840/ha.

**What does this mean?**

The value of break phases in the rotation are starting to show through in this trial. Despite very strong wheat yields in the first two years of the trial, disease and grassy weeds are now starting to reduce performance of continuous wheat. However, wheat following two year breaks are now producing gross margins several hundreds of dollars per hectare better than continuous wheat with no major constraints developing yet. One year breaks have improved the following wheat performance, but weeds and diseases are still present.

In 2014 the treatments will be sown again to wheat and this will complete the four year rotation for each of the 20 treatments. Any ongoing benefits of the break treatment options in 2011 and 2012 will continue to be measured.

**Acknowledgements**

We would like to thank Ian Richter and Wade Shepperd for their technical support. This project is funded by the GRDC - Profitable crop sequencing in low rainfall areas of south eastern Australia (DAS00119).

Intervix – registered product of Crop Care Australasia Pty Ltd.
Key messages

- Increasing incidence of barley grass in cropping paddocks in southern Australia is likely to be due, at least in part, to selection of more dormant biotypes.
- In some districts, barley grass management is becoming difficult because of the development of group A resistance. However, there still appear to be several effective herbicide alternatives for barley grass control in broadleaved crops.
- Herbicide resistance in barley grass is generally at a low level across Eyre Peninsula (EP), particularly compared to Upper North. However, two highly resistant paddocks have been identified on EP.
- Integrated weed management strategies are critical to delay resistance and prolong the effectiveness of our cheap and effective herbicides.

Why do the trial?

Feedback from growers and consultants in southern Australia has clearly shown increasing spread of barley grass (*Hordeum murinum ssp glaucum*). In a survey by Fleet and Gill (2008), farmers in low rainfall districts in South Australia and Victoria also reported increasing incidence of barley grass in their crops. Research undertaken at the University of Adelaide has shown that barley grass has developed increased seed dormancy in response to management practices used in cropping systems. Presence of increased seed dormancy in this grass weed species has enabled it to escape pre-sowing control tactics used by growers. This explains why barley grass has become a more problematic weed in cereal crops.

In some locations like Port Germein and Baroota districts, it is now almost impossible to control barley grass in pulse crops. This is mainly due to the presence of group A (fop and dim) herbicide resistance. Currently in these locations barley grass control is reliant on growing Clearfield cereals and the use of imidazolinone (lmI) (group B) herbicides. This management strategy is at high risk of collapsing from the additional development of group B herbicide resistance. Resistance to group B herbicides can develop quickly when large weed populations are sprayed regularly with group B herbicides. The extent and nature of this resistance needs to be better understood and effective management strategies to manage resistant barley grass in pulse crops developed.

How was it done?

Barley grass seed was collected prior to harvest in 2011 from a paddock at Baroota that was suspected to be resistant to group A herbicides. Resistance was confirmed in 2012 in a pot study which justified undertaking a paddock survey to determine the frequency of resistant populations.

Two random surveys were conducted prior to harvest in 2012 to evaluate the extent of herbicide resistant barley grass. The first focused on cropping paddocks between Port Pirie and Port Augusta, where most reports of resistance have been. The second survey focussed on problem barley grass regions on Eyre Peninsula and included transects from Kimba to Wirrulla, Kimba to Buckleboo, Cowell to Smoky Bay via Elliston, and Darke Peak to Kopi via Port Neill and Tooligie (Figure 1). Samples from these surveys were screened at the University of Adelaide for herbicide resistance during 2013.

Collected seed was cleaned and planted in pots at the start of the 2013 growing season, herbicides were applied and barley grass survival was assessed. Populations that exhibited any sign of resistance were planted out for a confirmation screening assessment.
Figure 1 Map of barley grass herbicide resistance survey, EP transects ▲ and UN ●

Figure 2 Effect of quizalofop (e.g. Targa) on the survival of barley grass from Baroota (Pt Germein) and from a susceptible population at Yaninee. Herbicide rates are 0, 1/8, ¼, ½, 1, 2, & 4 x field rate (300 ml/ha of herbicide)

What happened?
Barley grass was collected from a trial site at Baroota that had a high level of resistance, probably as a result of repeated exposure to group A herbicides (Figure 2). This population has resistance to quizalofop (Targa), haloxyfop (Verdict) and clethodim (Select).

Survey results for fop (group A) herbicide resistant barley grass are shown in Table 1. Barley grass fop resistance is at a low frequency across EP, particularly in comparison to the Upper North (UN) where almost 50% of barley grass has some level of resistance. While at quite a low frequency, some paddocks on EP have been identified with very strong resistance. Resistance is obviously developing and extra care needs to be taken to delay further resistance development. Always follow up fop applications with another control measure such as a pasture/crop top or a hay-cut and remember that multiple applications of the same herbicide group in one season will increase selection for resistance more than a single application.
Survey results for Imi and sulfonylurea (SU) (group B) herbicide resistant barely grass are shown in Table 2. While no barley grass was found to be resistant (>20% of population surviving), low levels were identified. The level of developing Imi resistance is of concern, but not surprising given the reliance on these herbicides in controlling barley and brome grass. Levels of Imi resistance were lower in the UN, but likely to increase rapidly with the increased selection pressure on Imi herbicides due to loss of group A herbicides in many paddocks.

What does this mean?
Group A herbicide resistance is at a low frequency across EP, which means these herbicides will still work well in most situations. However individual paddocks have already been identified where group A herbicides no longer work due to resistance and the frequency of such paddocks is likely to increase. Early signs of group B resistance developing in barley grass are also a concern for the future. Care is needed to preserve these herbicides. Always aim to reduce weed seed bank and where possible do not rely on a single herbicide group to control barley grass. Carefully selected weed management tactics should be integrated to delay onset of herbicide resistance in weeds.

Acknowledgements
Research on herbicide resistance in barley grass reported here was undertaken in a current GRDC funded project (UA00134). The authors would also like to thank Barry Mudge (Upper North Farming Systems), Peter Boutsalis & Malinee Thongmee (University of Adelaide) for their involvement in this work.

Select – registered trademark of Arysta Life Sciences and Sumitomo Chemical Co. Japan. Targa - registered trademark of Nissan Chemical Industries, Co Japan. Verdict - registered trademark of the Dow Chemical Company (“DOW”) or an affiliated company of DOW. Intervix - registered trademark of BASF. Monza - registered trademarks of Monsanto Technology LLC used under license by Nufarm Australia Limited. Raptor - registered trademark of BASF.
The impact of livestock on paddock health
Roy Latta and Jessica Crettenden
SARDI, Minnipa Agricultural Centre

Key messages
• There has been no measured grain production or soil health decline associated with grazing sheep on pastures and crop stubbles over a 4 year pasture-wheat rotation.
• Grain yields were higher as a result of increased wheat seed and fertiliser rates in 2013.
• Higher applied crop seed and fertiliser rates with an improved medic pasture increased estimated gross margins by $16/ha/annum over a 6 year wheat-wheat-pasture-wheat-pasture-wheat rotation.

Why do the trial?
A trial was established on Minnipa Agricultural Centre in 2008 to test whether soil fertility and health could be improved under a higher input system (e.g. higher fertiliser and seeding rates, establishment of improved pasture) compared to a lower input and more traditional system (district practice seed and fertiliser inputs, volunteer pasture). The six year (2008-2013) rotation of: wheat, wheat, pasture (volunteer and sown annual medic), wheat, pasture (annual medic – self regenerating) and wheat, was also split into grazed and un-grazed treatments in both the high and low input systems to establish the relative impact of grazing.

How was it done?
In 2013 the trial was sown to Mace wheat on 5 May at 50 kg/ha with 7 kg N/ha and 8 kg P/ha (45 kg/ha DAP) and 70 kg/ha with 13 kg N/ha and 15 kg P/ha (75 kg/ha DAP) for the traditional and high input treatments respectively. See EP Farming Systems Summary 2012 p 92 for 2012, pasture performance and 2011, p 113 for 2008 - 2011 crop and pasture inputs. Weed control was imposed on all treatments as required in both summer and during the growing season.

Sampling for pre-seeding soil water content and chemical analysis was completed on 16 April. Plant establishment counts were taken on 25 June followed by a biomass sampling, both from 3 x 1 m rows (1 m²), taken prior to grain harvest on 4 November. Post harvest soil water contents were collected on 5 November.

What happened?
Soil fertility was estimated prior to seeding in each year of the study. Table 1 presents the 2011, 2012 and 2013 phosphorous, total organic nitrogen and soil organic carbon results. Residual Colwell P levels were similar or trended lower following annual medic, wheat, pasture (annual medic – self regenerating) and wheat, was also split into grazed and un-grazed treatments in both the high and low input systems to establish the relative impact of grazing.

How was it done?
In 2008, a 14 ha red sandy loam (pH 8.0) portion of a paddock on MAC was divided into four 3.5 ha sections. Each section represented a system treatment: Traditional - grazed, Traditional – un-grazed, High input – grazed and High input – un-grazed. The pasture and grazing treatments were not imposed until 2010. Four sampling points were selected and marked as permanent sampling points in each section. Data presented for each treatment are a mean of the four selected permanent points in each section.
An accurate assessment of the soil chemical and organic carbon response to the treatments imposed requires a statistical analysis with time (years) as a third factor, with treatment and replicate, at the completion of study. To measure grain production in 2013 an experimental plot harvester reaet four 1.8 x 9 m plots at the four permanent points in each section. Table 2 presents the 2013 grain data and the estimated water use efficiency figures.

The two high input treatments produced similar biomass, similar or more plants, more wheat heads and higher grain yields than the un-grazed traditional treatment. The high input grazed treatment produced higher protein content than both the low input traditional treatments, screening percentages were similar.

Table 1 Colwell P (mg/kg 0-10 cm), total mineral nitrogen (kg N/ha 0-60 cm) and soil organic carbon (% 0-10 cm) in April 2011, 2012 and 2013 following annual medic, wheat and annual medic respectively

<table>
<thead>
<tr>
<th>System</th>
<th>Colwell P (mg/kg)</th>
<th>Total mineral nitrogen (kg/ha)</th>
<th>Soil organic carbon (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional - grazed</td>
<td>41</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>Traditional - un-grazed</td>
<td>29</td>
<td>30</td>
<td>27</td>
</tr>
<tr>
<td>High input - grazed</td>
<td>23</td>
<td>23</td>
<td>18</td>
</tr>
<tr>
<td>High input - un-grazed</td>
<td>34</td>
<td>30</td>
<td>22</td>
</tr>
</tbody>
</table>

Table 2 Plant establishment (PE, plants/m²), biomass yield (DM, t/ha), grain heads (numbers/m²), grain yield (t/ha), protein content (%), screenings (%) and water use efficiency (WUE, kg/ha/mm of plant available water)

<table>
<thead>
<tr>
<th>System</th>
<th>PE (plts/m²)</th>
<th>DM (t/ha)</th>
<th>Heads (#/m²)</th>
<th>Yield (t/ha)</th>
<th>Protein (%)</th>
<th>Screenings (%)</th>
<th>WUE (kg/ha/mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional - grazed</td>
<td>127</td>
<td>5.3</td>
<td>208</td>
<td>1.9</td>
<td>10.3</td>
<td>5.6</td>
<td>15</td>
</tr>
<tr>
<td>Traditional - un-grazed</td>
<td>124</td>
<td>5.4</td>
<td>221</td>
<td>1.8</td>
<td>10.3</td>
<td>4.7</td>
<td>14</td>
</tr>
<tr>
<td>High input - grazed</td>
<td>175</td>
<td>6.3</td>
<td>262</td>
<td>2.1</td>
<td>11.2</td>
<td>6.3</td>
<td>16</td>
</tr>
<tr>
<td>High input - un-grazed</td>
<td>158</td>
<td>6.1</td>
<td>256</td>
<td>2.1</td>
<td>10.8</td>
<td>5.6</td>
<td>16</td>
</tr>
<tr>
<td>LSD (P=0.05)</td>
<td>33.7</td>
<td>ns</td>
<td>35.7</td>
<td>0.24</td>
<td>0.66</td>
<td>ns</td>
<td></td>
</tr>
</tbody>
</table>

Estimated water use efficiency in 2013 was correlated with yields with each treatment having similar available water.

What does this mean?

In 2011 there was a wheat yield benefit as a result of the grazing of both the sown and self-regenerated traditional medic based pastures in 2010, when compared to the un-grazed sown and self-regenerated medic. This may have been due to the higher total soil N levels measured pre-seeding in 2011. There was also a yield benefit in response to the high input treatments (high seed and fertiliser inputs, improved pasture, EPFS Summary 2011, p 113). In 2012 the self-regenerating, 2010 sown high input medic pasture reduced competing annual grass, increased biomass production and carried double the stocking rate, compared to a volunteer self-regenerating medic pasture (EPFS Summary 2012, p 92).

In 2013 the higher grain yields from the high input treatments, compared to the un-grazed traditional system, can only be credited to the 2013 inputs. Neither the grazing nor the observed increased N levels or reduced grass populations resulting from the grazing in 2012 had any yield or protein content response, as was the case in 2011.

The soil organic carbon % may be trending higher but even if this is shown to be correct in the fullness of time, this may only be a response to seasonal conditions and best practice agronomic and livestock management. If the trial continues in a new phase of Grain and Graze a heavier grazing regime on both stubbles and pastures may provide some insights into the soil organic carbon content movements in response to more intensive mixed farming systems.

Economically the high crop and pasture input treatments have produced an extra 1 t/ha of wheat from 4 crops in 6 years, irrespective of being grazed or un-grazed. The value of the extra grazing is reliant on the stocking rate and available growing season pasture area, i.e. there is no benefit unless there is a feed deficit under the current stocking rate requiring handfeeding in the winter/spring period when annual medic is productive. The cost/ha has been an extra 120 kg of DAP ($80), 80 kg of seed wheat ($20) plus the pasture establishment ($40) giving a 6 year increased gross margin of approximately $100/ha plus any increased livestock returns (assuming a wheat price of $240/t).

Acknowledgements

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Summary of paddock North 1 VRT study at MAC
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¹SARDI, Minnipa Agricultural Centre; ²Precision Ag Services, Minlaton

Almost ready

Location: Minnipa Ag Centre, N1
Rainfall
Av. Annual: 324 mm
Av. GSR: 241 mm
Paddock History
2011: Barley
2010: Wheat
2009: Wheat
2008: Wheat
Soil Type
Sandy loam to sandy clay loam
Soil Test
Outlined in article
Diseases
Rhizoctonia
Plot Size
Paddock trial, sowing widths 9 m
Yield Limiting Factors
Rhizoctonia
Dry spell in spring
Environmental Impacts
Soil Health
Soil Nutrients: Needs to be monitored
Resource Efficiency
Energy/fuel use: Standard
Clash with other farming operations: Standard
Economic
Infrastructure/operating inputs: VRT technology
Cost of adoption risk: Low if improving returns

Key messages
• The gross margin benefits of not applying fertiliser to almost 50% of the paddock was not considered sustainable as soils were testing deficient in P at the completion of the 4 year study.
• To achieve an economic benefit from higher inputs on the deep zone, a yield increase was required. Only a 5% yield improvement on the deep zone would have altered gross margins from -$22/ha to $58/ha over the 4 year period.
• VRT struggled to economically justify its implementation over a 4 year run of cropping. This particular paddock study has shown the variable rate technology (VRT) benefit was not considered adequate to justify the capital investment of approximately $25,000 plus GPS guidance if required.

Why do the trial?
Upper Eyre Peninsula is a landscape of variable soil types and land production capability zones and yet variable rate technology (VRT) is rarely practiced in the region. VRT is considered to have the potential to improve profitability and water use efficiency by more targeted placement of inputs. To assess that potential a paddock on Minnipa Agricultural Centre with a mix of land zones varying from sandy rises (which perform well in dry years) to shallow stony flats (which rarely perform well regardless of the crop or pasture choice) was selected in 2008 to investigate the performance of VRT in a situation typical of the district.

How was it done?
The selected paddock on Minnipa Agricultural Centre was segregated into 3 zones using a combination of yield, EM38 and elevation maps, and ground truthed with soil testing for subsoil constraints. The resultant common factor within each zone, as a result of the mapping, monitoring and sampling, was crop rooting depth, with 52% of the paddock designated as a deep soil type, 22% as a medium soil type and 26% as a shallow soil type.

From 2008 to 2011 three different management strategies were applied to alternating passes of a 9 m seeder across the paddock, sown with 2 cm GPS-guided auto steer on the same seeder runs each year (Figure 1). These management strategies were high input (higher fertiliser rates considered appropriate to the higher yield potential of the deep zone), district practice (what the farm manager would have used for the whole paddock if it had not been treated with VRT) and low input (lower fertiliser and seeding rates considered appropriate to the lower yield potential of the shallow zone).

This strategy resulted in the district practice being a fertiliser and seeding rate considered appropriate for the medium zone, with the high and low strategies bracketing either side of the district practice. This allowed the testing of the sensitivity of crop productivity and soil resources to inputs in each zone. The result was that for each zone in the paddock, there were three strategies imposed – one which was targeted to be appropriate for that zone and then two others to see how close to right that estimate proved to be.

A fertiliser and seeding rate package for each strategy was determined at the start of each year in the light of price, costs and seasonal outlook at the time. This meant that in some years, some of the strategies had similar inputs. Yield monitor data from these treatments coupled with input costs allowed a 4 year comparison of gross margins for each strategy within each zone or across the whole 61 ha paddock.
Annual fertiliser application rates (2008 – 2011) were based on current district practice of 6-8 kg of P and 5-7 of N (30-40 kg/ha DAP) respectively. They were increased to 12 and 11 kg of P and N (60 kg/ha DAP) as a high input treatment and no fertiliser was applied as a low input treatment. In crop nitrogen was applied separately to each strategy based on seasonal conditions and likely crop outcomes. The paddock received common standard weed control across all zones in all years.

**What happened?**
At the commencement of the study, April 2008, the paddock had adequate to high P and high N reserves (Table 1). Colwell P reserves were maintained at adequate levels until April 2012 when they had declined in the low input treatments in all zones and the district practice treatment in the deep and medium zones. There was a total of 48 and 30 kg/ha of P applied to the high and district practice input strategies respectively over the 4 years, the low input strategy received no P. Mineral N reserves generally declined over the first 3 cropping seasons but were maintained over the 2012 season. There were a total of 108 and 43 units of N/ha applied to the high and district practice inputs respectively, no N was applied to the low input treatment.

Wyalkatchem wheat was sown in 2008, 2009 and 2010, Hindmarsh barley in 2011. Growing season rainfall (mm) of 139, 300, 335 and 242 produced a district practice input yield of 0.5, 4, 3.4 and 2.9 t/ha in 2008, 2009, 2010 and 2011 respectively.

Over the 4 year case study the district practice input treatment produced a total yield of 10.7 t/ha (Table 2) and had an estimated water use efficiency of 17.8 kg/mm of plant available water compared to 17.6 and 18.3 for the blanket low and high input treatments respectively. With district practice inputs applied, the 4 year total grain production was similar in the deep and medium zones at 11.1 t/ha, compared to 9.5 t/ha on the shallow zone. The 1.6 t/ha total deficit from the shallow zone was made up of deficits of approximately 0.5 t/ha in 2009, 2010 and 2011.

![Figure 1 Seed and fertiliser treatment strips applied to paddock from 2008 to 2011. Dark grey signifies low input strips, light grey district practice and black high input](image)

**Table 1 Colwell P (mg/kg 0-10 cm) and mineral N (kg/ha 0-60cm) reserves in April 2008, 2009, 2010, 2011 and 2012**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Input strategy</th>
<th>Colwell P (mg/kg)</th>
<th>Mineral N (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep</td>
<td>High</td>
<td>32</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>District</td>
<td>28</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>28</td>
<td>29</td>
</tr>
<tr>
<td>Medium</td>
<td>High</td>
<td>36</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>District</td>
<td>36</td>
<td>41</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>39</td>
<td>28</td>
</tr>
<tr>
<td>Shallow*</td>
<td>High</td>
<td>39</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>District</td>
<td>48</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>37</td>
<td>37</td>
</tr>
</tbody>
</table>

*Mineral N kg/ha figures are restricted to the 40 cm soil profile depth in the shallow zone.
Table 2 Grain yield (t/ha) of the district practice, low and high crop inputs imposed on deep, medium and shallow zones in 2008, 2009, 2010 and 2011

<table>
<thead>
<tr>
<th>Deep</th>
<th>Medium</th>
<th>Shallow</th>
<th>Grain yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008</td>
<td>2009</td>
<td>2010</td>
</tr>
<tr>
<td>District practice</td>
<td>0.51</td>
<td>3.97</td>
<td>3.37</td>
</tr>
<tr>
<td>High</td>
<td>0.53</td>
<td>3.95</td>
<td>3.42</td>
</tr>
<tr>
<td>High</td>
<td>District practice</td>
<td>0.52</td>
<td>3.97</td>
</tr>
<tr>
<td>High</td>
<td>District practice</td>
<td>Low</td>
<td>0.51</td>
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<tr>
<td>High</td>
<td>Low</td>
<td>0.52</td>
<td>3.95</td>
</tr>
<tr>
<td>District practice</td>
<td>Low</td>
<td>0.48</td>
<td>3.79</td>
</tr>
</tbody>
</table>

Table 3 Gross margins ($/ha) of the district practice and $ variations following low, standard and high crop inputs imposed on deep, medium and shallow zones in 2008, 2009, 2010 and 2011

<table>
<thead>
<tr>
<th>Deep</th>
<th>Medium</th>
<th>Shallow</th>
<th>Gross margins ($/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008</td>
<td>2009</td>
<td>2010</td>
</tr>
<tr>
<td>District practice</td>
<td>130</td>
<td>884</td>
<td>1023</td>
</tr>
<tr>
<td>High</td>
<td>-33</td>
<td>-26</td>
<td>1</td>
</tr>
<tr>
<td>High</td>
<td>District practice</td>
<td>-20</td>
<td>-14</td>
</tr>
<tr>
<td>High</td>
<td>District practice</td>
<td>Low</td>
<td>-14</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
<td>-2</td>
<td>-20</td>
</tr>
<tr>
<td>District practice</td>
<td>Low</td>
<td>19</td>
<td>3</td>
</tr>
<tr>
<td>Low</td>
<td>30</td>
<td>-19</td>
<td>-58</td>
</tr>
</tbody>
</table>

*Gross margins calculated at 2008, 2009, 2010 wheat and 2011 barley December grain prices and April fertiliser prices of the respective years. The variable rate treatments include a $2/ha annual data analysis consultancy fee.

There was no benefit in applying fertilizer to the medium and shallow zones in any of the years. There was a yield benefit in applying district practice fertilizer rates on the deep zone in 2008, 2009 and 2010 but no further increase in response to high inputs on that zone (Table 2). However the 4 year total grain yields were positively correlated with increased fertilizer inputs.

Compared to a district practice blanket fertilizer application over 4 years there was a $26 ($6.50/annum/ha) benefit if fertilizer had not been applied to the 48% of the paddock that was zoned medium and shallow coupled with district practice inputs applied to the deep zone (Table 3).

**What does this mean?**

There were gross margin deficits in response to higher inputs in the deep zone. To achieve an economic benefit from higher inputs on the deep zone coupled with district practice inputs on the medium and shallow zones a yield improvement was needed; a 5% yield increase on the deep zone would have turned around gross margins from -$22/ha to $58/ha, a 10% yield increase would have improved gross margins to $135/ha.

This particular paddock study has shown the VRT benefit was not considered adequate to justify the capital investment of approximately $25,000, plus GPS guidance if required. However, the marginal benefit of not applying fertiliser to almost 50% of the paddock was not considered sustainable as at the completion of the 4 year study the soils, where no fertiliser had been applied, were testing deficient in P indicating a requirement for replacement P.

These results do not provide a long term recipe for this paddock based on district practice blanket inputs. Responses will change based on soil nutrition levels and seasonal conditions. Lower residual P and N levels may increase the response to varying levels of fertiliser rates to deliver yield variations more in line with projected land capability. Soil sampling and analysis is required to support annual decisions on fertiliser inputs based on residual nutrient levels and land capability.

As was calculated, only a 5% yield improvement on the deep zone compared to the other zones would have changed the economic outcome significantly.

**Acknowledgements**

This article was based on data collected by Mark Klante and Brett McEvoy as part of the Minnipa Agricultural Centre farm operations. Cathy Paterson, Wade Shepperd and Ian Richter collected and collated data as part of the GRDC funded project Eyre Peninsula Farming System 3 - Responsive Farming Systems. Project code UA00107.
The ‘EPFS 3 – Responsive Farming Systems’ project exceeded its target of improving crop water use efficiency across the low rainfall agricultural areas of EP by 10%. In a survey of local farmers at the beginning and end of the project, an average increase in WUE of 31% from 2007 to 2012 was recorded. The project also increased the capacity of the agricultural community by working with the extensive network of farmer groups across upper EP, collaborating with other groups and projects, providing opportunities for learning events, publication production, and having a dedicated extension officer to support groups and individuals in accessing and applying information.

Project aims and structure
The Eyre Peninsula Farming Systems 3 – Responsive Farming Systems’ (EPFS 3) project was funded by GRDC as part of the national Water Use Efficiency Initiative, commencing in 2008 and concluding in 2013. The project was a collaboration between the University of Adelaide (UoA) (proponent), SARDI Minnipa Agricultural Centre (delivery), CSIRO (modelling) and the Eyre Peninsula Agricultural Research Foundation (EPARF) (industry relevance).

The project had 2 major objectives:
1. Increase capacity of the agricultural community across the low rainfall agricultural areas of Eyre Peninsula to participate in RD&E, access information and training and benefit from the full spectrum of GRDC supported low rainfall research.
2. Measurable improvements in crop and systems water use efficiency across the low rainfall agricultural areas (<375 mm) of Eyre Peninsula.

Project management and review was undertaken via a Steering Committee made up of EP farmers, researchers, consultants and project partners. This committee operated as a sub-committee of EPARF, and provided research direction and support to the project team and ensured relevance to industry and applicability to farmers of project activities. The Steering Committee conducted a mid-term review process in July 2011 and final project review in March 2013.

The project provided funds for a Project Manager (Naomi Scholz), Research Officer (Cathy Paterson), Technical Officer (Wade Shepperd) and Farming Systems Specialist (Linden Masters). SARDI in-kind research support was provided by Roy Latta and Nigel Wilhelm. CSIRO support was provided by Anthony Whitbread, followed by Therese McBeath. Annie McNeill (UoA) provided project supervision, and the project provided funds for a Laboratory Technician at UoA to analyse soil samples.

Research and development activities were undertaken across 3 ‘focus sites’ - Minnipa, Mudamuckla and Wharminda to determine improvements in water use efficiency (Objective 2). Extension activities based on Objective 2 outcomes were undertaken across upper EP to increase the capacity of farmers, researchers and advisors (Objective 1). To monitor and evaluate the success of the project, a knowledge, attitudes, skills and aspiration (KASA) survey was undertaken towards the beginning and at the conclusion of the project (EPFS Summary 2011 p 95, EPFS Summary 2013). Individual activities and events were also recorded and evaluated where possible, to determine success of delivery methods.

This project also created opportunities for adding extra value to many activities. For example, funds from the Eyre Peninsula Natural Resources Management Board (EPNRM) supported the Farming Systems Specialist position and SAGIT funded the complementary “Developing robust and lower risk farming systems by understanding the impact of soil carbon” project.
Other project collaborations included the Low Rainfall Collaboration Project (GRDC), LRCP Profitability and Risk project (GRDC); Baldock (CSIRO Soil Organic Matter Group) - measuring carbon fractions; Eglington – (UoA Barley Breeding Program) assessing the role, water use efficiency and profitability of ultra-early season barley varieties; Kuchel – (AGT), assessing the role, water use efficiency and profitability of early season wheat varieties; Bennet - Increasing profitability and reducing erosion with No-tillage on Eyre Peninsula (Caring for Our Country); SPAA Training and Demonstration of PA in Practice (GRDC SPA00010); the Eyre Peninsula Grain &Graze 2 project (GRDC/Caring for Our Country UA00117); McNeill - DGT as the soil test of choice for predicting phosphorus requirements (GRDC UA00103); Mason - Using PBI and DGT for accurately predicting phosphorous fertiliser rates (SAGIT UA0511); McDonald – P use efficiency of cereals (SAGIT UA1201).

Research and development
Research activities addressed current and seemingly ongoing seasonal constraints imposed by the millennium drought. It looked for adaptation through crops and management strategies to maximize the utilisation of the plant available water, to improve water use efficiency, but not necessarily to increase total production, but rather sustaining production from a diminishing resource.

Dual purpose peas and early maturing barley were considered as options. Soil protection to limit evaporation, and increase moisture availability later in the season through seeding row direction and width was also evaluated. Developing the correlation between time of sowing and a correlation with wheat maturity type was considered to address the variables associated with time of sowing and the timing of the first effective rain event.

The most significant crop input that was considered suitable for adjustment was fertiliser. Included in the options that were assessed was the comparative P efficiency of alternative wheat varieties, the maintenance of grain production by utilising residual P levels, and the application of a P rate based on previous crop removal. The option most extensively evaluated was the potential for variable rate technology supported by soil chemical analysis, yield mapping, EM38 and elevation maps, and applying fertiliser rates based on the productive capability of the land to improve production and economic outcomes.

It was found that in low rainfall seasons, lines of early maturing peas and barley outperformed current commercial cultivars. They also showed yield benefits of an early maturing cereal in the event of a late sowing.

Fertiliser studies found there was an opportunity to limit, or even delay for several years, P inputs in the presence of high residual P levels in the soil (as measured by either commercial soil test, Colwell or DGT P) without losing production, giving growers financial options to consider after poor years. They also identified that some wheat varieties performed better on low P than others and that still others responded better with added P. These genetic differences will be used to produce more efficient P varieties in the future.

The variable rate studies revealed opportunities to maintain production in the presence of high residual P and N levels by reducing fertiliser rates on zones within paddocks that had less plant available water. However only in one case did they report increased production in response to higher application of fertiliser on the more productive soils within a paddock.

The research outcomes from an industry perspective have been the ongoing development of early maturing barley cultivars through the University of Adelaide barley breeding program. Pulse Breeding Australia has developed a forage pea variety as a response to the call for a dual purpose attribute in the event of seasonal failure. Both introductions utilised data outputs from this project.

The very early maturing Axe wheat variety is a management tool which many EP growers now use to mitigate the impacts of a late break to the season, or as a late sowing option to maintain yield and address other farming system issues like grass control.

There has been an expanded use of variable rate technology, albeit slowly, along with an increased use of soil testing for residual levels. Farmers are making more informed decisions on the fertiliser rates as opposed to using blanket application rates.

Extension
A dedicated extension officer has allowed a better flow of information to the many farming groups linked to the EPFS 3 project. Having two satellite sites beyond the key research site at Minnipa Agricultural Centre increased the opportunity to examine different soil types and farming systems in local areas. Surrounding Farming Systems groups were able to view the trials and talk about water use efficiency (WUE) and be encouraged to increase their WUE. These sites provided an opportunity to view Yield Prophet®, VRT, EM38 mapping and soil testing to land capability. These concepts are still new for most farm managers on upper EP. The Wharminda site allowed good discussion on soil amelioration leading to linking and collaborating with two EP Natural Resources Management soil projects (Soilsmart, Building living soils) which further benefitted the improvement in WUE. A new group of farmers in the Lock district was formed to provide better understanding in overcoming soil constraints and improving their farming systems.
For many groups the WUE project became a forum to examine better practices in soil health, soil and plant nutrition and understand how to better manage risk in different soil types. The EPFS 3 project provided support to and utilised the existing network of farmer groups (mostly agricultural bureau based) across upper EP for extension of research results, input into research being conducted and issues arising in their farming systems. Further to this, field days and targeted workshops, such as the Introduction to Farm Finances workshops developed in the Profitability & Risk project, were held throughout the life of the project.

Overall, 10 major field days were conducted over the life of the project, 68 planning and review/harvest report farmer meetings held, 63 sticky beak days supported and 33 workshops delivered. Products included 8 field day booklets, 5 EPFS Summaries, 39 newspaper articles, 2 Ground Cover articles, 5 presentations at GRDC advisor and farmer updates and 3 conference papers. In the final years of the project, EPARF developed a website, which was also used to provide information and updates on the project, as well as Yield Prophet® reports for the focus sites. An e-newsletter is now also being used to extend information to grower members.

A grand total of 238,000 people attended events or received information over the life of the project (obviously a lot of upper EP farmers and advisers attended more than one event or received information several times). 235,000 of these were ‘passive’, where farmers were provided information in the form of written information (research articles, media articles) or attended events that did not involve interaction with presenters. 3,000 people actively participated in events where there was direct interaction with those providing information. There are approximately 600 farmers on upper EP, so this means people attended multiple events over the life of the project.

**Outcomes**

An entry and exit survey was conducted on EP in 2010 (48 farmers) and 2013 (38 farmers). WUE of farmer wheat crops, as measured by French-Schultz, increased by 31% from entry (average 36% of potential yield) to exit survey (average 47% of potential yield). This shows for the industry and the community at large what is obvious to those close to the coal face – that modern farming systems are making much more efficient use of one of our scarcest natural resources (rainfall) than ever before.

According to the surveys, the main ways farmers have tried to increase WUE of crops in recent years have been to; seed early if season allows – before mid-May, keeping ground free of weeds over summer to store moisture, keep up the fertiliser use and use no till methods. With regards to fertiliser use, none had reduced their P rates. Six percent increased their P rates by an average of 20%. Sixty-eight percent had kept the same P rate, but all of them had redistributed by land zone. Sixty-three percent apply N in-crop in some situations (same as entry survey 65%).

Fifty-five percent of farmers surveyed match sowing date to variety (compared to less than half in entry survey), 53% use two year breaks and 34% dry sow wheat (other than for sheep feed).

Yield map use increased from 20 to 45%, and the use of variable rate prescription maps increased from 10 to 16%. Sixty-one percent use auto boom shut off, 24% use variable rate seeding (automatically controlled) and 92% used autosteer with corrected GPS (2-30 cm).

The main sources of technical information of farm practices, in order of importance were the EP Farming Systems Summary, other farmers, EPARF/Minnipa Field Days, Ag Bureau/Farm Systems groups, farm consultants, the Stock Journal, GRDC Ground Cover magazine, EPARF Newsletters, internet, other GRDC publications/media vehicles, radio/TV and apps on smart phones.

**Recommendations**

Messages and recommendations made at events such as farmer meetings and field days included:

- **VRT tips for success:** Have clear plan on what you are aiming to achieve; back up all data (CD, USB, external hard drive); keep it simple; employ a consultant to get the best out of the technology; reassess zones seasonally to make sure you are getting the best “bang for your buck”.
- **Zone management:**
  - Poor Zone - If an annual system, manage to reduce risk and costs - reduce seeding/fertiliser rate. If an option, change land use.
  - Medium Zone - Manage zone strategically, in season decisions (graze/cut for hay or apply N), options could include short season varieties, dual purpose cereals, sowing early.
  - Good Zone - Intensively crop, soil test, fertilise, consider in-season N application.
- **Time of sowing:** Sow early, use varieties to match sowing date (i.e. sow long season varieties earliest, short season towards end of sowing program).
- **Best bets for minimising Rhizoctonia inoculum levels are:** rotation (grass free break crops), summer rainfall, summer weed control, controlling the green bridge. Factors to reduce the impact of Rhizoctonia infection in the crop include: nutrition, ‘directed or targeted’ disturbance (tillage), reducing herbicide residues especially SU’s, seed placement (depth – below 2 cm but not too deep), early sowing (warmer soil temp), new fungicide products and placement.
• Know your nutrition levels to manage inputs effectively.
• P replacement strategy: P replacement works in soils with high P reserves, but in the long term P declines under current replacement calculations (3 kg P/t grain), it’s a good responsive strategy in tight times - low cost in low production years. Compared to district practice, WUE has not increased using a replacement P strategy. Economically this strategy has performed better over 3 years.
• Residual P: In a paddock with adequate soil P levels, no extra P is required (no difference in yields between freshly applied P and soil P).
• P nutrition in general: In soils with a HIGH level of soil available P you don’t need to add much fertiliser if any to achieve same yield (BUT be prepared to soil test!). Replacement P can be used as a tool to maintain production. In wet years more applied fertiliser P is used (up to 30%) compared to dry years (as little as 3%). DGT is a new tool we can use to assess available P. Phosphorus use efficiency of cereals (some variation in varieties). P rundown is work in progress (T McBeath modelling).
• Predicting yield: Provision of data to validate APSIM. Getting more accurate predictions. APSIM is accurate in higher yielding years and less accurate in low yielding years. Some issues with phenology are being addressed.

Conclusions
In low rainfall farming systems, there are opportunities to improve profitability by reducing input costs, however we were only able to show very limited benefits from increasing inputs.

The capacity to meaningfully engage with farmers has been demonstrated through this project, with increased adoption of practices to increase water use efficiency.

The final GRDC report for this project UA00107 was submitted in November 2013.

Acknowledgements
Thanks very much to EPARF Board members and Steering Committee members for project review and direction. In particular big thanks to the focus site farmers and workers, Peter Kuhlmann, Andre Eylward, Paulus Viljoen, Mark Klante, Brett McEvoy, Trent Brace, Ed Hunt, Ian Noble. Stuart Kears GRDC, Sam Doudle and Alison Frischke (project development). Research support from Roy Latta, Nigel Wilhelm, Cathy Paterson, Annie McNeill, Amanda Cook, Anthony Whitbread, Therese McBeath, Peter Treloar, Sean Mason, Ben Jones, Stewart Coventry, Jason Eglinton, Haydn Kuchel. Extension delivery Linden Masters, Chris Lynnd, Andy Bates, Ed Hunt. Technical support from Wade Shepperd, Ian Richter, Willie Shoobridge, Sue Budarick, Jake Pecina, Alex Watts, Kay Brace, Cilla King, Brenton Spriggs, Leigh Davis. KASA survey design and analysis Chris Dyson, Nigel Wilhelm, Geoff Thomas, Michael Moodie.
Key messages

• A survey was conducted in early 2010 to determine the management practices of farmers and the average water use efficiency of farms on upper Eyre Peninsula. The survey was repeated in 2013 to see if there were any changes in management practices and water use efficiency.

• Actual wheat yields were 36% of potential yield in the 2010 survey, increasing to 47% of potential yield in the 2013 survey.

How was it done?
In both 2010 and 2013 a comprehensive 50 question survey was emailed or posted as an excel spreadsheet to the same group of 200 farmers across upper EP.

Information was collected on demographics of people employed on farms; income from different enterprises, changes to farm businesses being made or planned, yields, methods used to increase WUE of cropping and livestock enterprises, stubble management, management over summer, time of sowing, in-crop management, break crops, use of technology, managing risk and future challenges to farming systems on EP.

Individual information is being kept strictly confidential.

What happened?
In 2013, 38 farmers out of 200 responded to the survey, giving a response rate of 19%. The response rate in 2010 was 25%. Figure 1 shows the location (nearest town) of respondents in 2010 and 2013.

Information was collected on demographics of people employed on farms; income from different enterprises, changes to farm businesses being made or planned, yields, methods used to increase WUE of cropping and livestock enterprises, stubble management, management over summer, time of sowing, in-crop management, break crops, use of technology, managing risk and future challenges to farming systems on EP.

Why do the survey?
The Minnipa Agricultural Centre (MAC) was funded by Grains Research and Development Corporation (GRDC) to run a research and extension program (Eyre Peninsula Farming Systems 3 – Responsive Farming Systems) to improve water use efficiency on upper Eyre Peninsula (EP) farms by 10%.

An essential part of this program was to determine on farm water use efficiency (WUE) and what practices farmers are using which are thought to improve WUE. A survey was deemed the most efficient method to collect this information from a sample of all farmers across upper EP.

Farmers were surveyed in 2010, and again in 2013, to see if there have been any changes in practices and subsequent changes in overall water use efficiency.

Managing risk
In order to manage risk in 2010, farmers said that they use only higher value, lower risk crops (wheat and barley), sow early, reduce expenditure on fertiliser and defer machinery purchases. In 2013, sowing cereals, maintaining their own machinery, altering the crop/livestock balance and forward selling products were the most common options listed to reduce risk.

Practices to increase WUE
In both the opening and closing surveys, farmers thought the following three practices are the most important practices for increasing water use efficiency of crops:
• Seed early if season allows – before mid May
• Keeping ground free of weeds over summer to store moisture
• Use no till methods

In the closing survey however, a greater emphasis was also placed on keeping up fertiliser use and retaining stubble.

Farmers consistently thought the most important practices for increasing WUE of livestock enterprises were dry sowing feed crops, improved grazing management and pasture improvement. Other important improved production practices recorded in the closing survey were feed lotting and adjusting time of lambing.
Summer weeds
All farmers controlled their summer weeds to some extent, with 85% controlling weeds in more than half of their paddocks. By the closing survey, farmers had increased the proportion of their farm on which they were controlling summer weeds. The main reasons farmers controlled their summer weeds were to conserve moisture and to allow earlier sowing. Summer weeds are controlled with herbicides, either alone or in combination with livestock.

Sowing
The number of farmers matching variety to sowing date increased by 7%. Sowing systems have remained the same, 54% use no till on the majority of their farm, almost no discs are used and there is almost no conventional tillage.

The length of seeding time was consistent across surveys, with an average of 24 days, but the average gap from the seasonal break to seeding reduced from 8 days to 4 days, with an average of 85 hectares sown in a day.

The percentage of farmers prepared to dry sow declined from 54% in 2010 to 35% in 2013, citing waiting for weeds to germinate as the main reason for delayed sowing.

Yield constraints
In the entry survey, yield constraints were listed as weather, root diseases and nitrogen and phosphorus nutrition. The same constraints were cited in the exit survey, with the addition of grassy weeds.

Nutrition
Seventy-five percent of respondents had reduced their phosphorus rates in the entry survey, by an average of 30%, as a result of the sharp increase in phosphorus fertiliser prices. Extra nitrogen application was limited on red soils, but more common on grey soils at seeding and mid-season, and common practice on sands mid-season. In the closing survey, none had reduced phosphorus applications; they had mostly kept the same rates or redistributed their P depending on production zones. Nitrogen is now commonly applied, two thirds of it in crop rather than at sowing.

Disease
Practices remained similar between entry and exit surveys, with cultivation, rotation, nutrition, grass free medic and weed control commonly used to control disease. Using fungicide sprays, different varieties and rotations are still used to manage leaf diseases.

Rotations
The majority believe cereal on cereal is fine for 1 - 3 years, but in the exit survey 30% of respondents thought having greater than 4 years of cereals in a row was achievable. The majority of farmers did not use two break crops (from cereals) in a row in the entry survey, but half indicated they would use two break crops in a row in the exit survey. Preferred break crops are currently medics, peas and canola. The reasons for using breaks remained consistent between surveys; grass clean-up, increasing N supply, root disease management and rotating herbicide groups.
**Precision agriculture technology**

In the entry survey, 43% of the farmers surveyed managed their paddocks by zones, but mostly manually. The exit survey showed 55% of farmers managed their paddocks by zones. Guidance was not uncommon but yield mapping and variable rate were rare in 2010. In 2013, 90% had some precision agriculture equipment, more with higher technology options, 63% have maps of various kinds, but no NDVI or gamma maps.

**Stubble management**

A range of new stubble management questions were asked in the 2013 survey, prior to delivery of the new EP Farming Systems 4 project – Maintaining profitable farming systems with retained stubble. The majority said they treat their stubbles with grazing, with the rest harvesting short or leaving them standing. Farmers handle heavy stubbles (which they said was not common) by harvesting low and grazing, slashing or interrow seeding. Some would never consider cultivating or burning their stubbles, but others would for weeds, especially woody weeds, snails and mice. Farmers will occasionally burn stubbles to manage grass weeds.

All types of stubble are grazed by all types of stock, with famers selecting rotational grazing and maintaining a minimum level of groundcover as methods to avoid uneven grazing. Stock are taken off stubbles depending on erosion risk, when there is insufficient feed, or when livestock condition declines. Ground cover is mainly assessed visually.

**Sources of information**

In 2013, farmers recorded their main sources of technical information of farm practices as being the EP Farming Systems Summary, other farmers, EPARF/Minnipa Ag Centre Field Days, their farm consultant and Ag Bureau groups. Almost all respondents had heard of the EP Farming Systems and EP Grain & Graze projects.

**Changes to farming systems**

In the entry survey, some of the main changes farmers had made to their farming programs over the past 5 years (2005-2010) were to fine-tune tillage, agronomy and livestock practices, and changing cropping intensity (up or down).

According to the exit survey, the 3 main changes farmers had made in the past 3 years (2010-2013) were reported as upgraded machinery and agronomy practices, purchased land and changed cropping intensity (up or down).

When asked where they saw themselves in 5 years, the 2010 survey respondents were aiming to be at least as large or many larger, with more cropping area but no drastic changes in enterprise mix, whereas the 2013 respondents aimed to be at least as large or many larger, with more sheep.

**What does this mean?**

Overall, the survey shows that farmers have increased their wheat water use efficiency by 31%. It appears that key messages and recommendations generated in projects such as EP Farming Systems 3, EP Grain & Graze 2 and Crop Sequencing are having an impact. According to the WUE survey, the increase in WUE has been achieved with improved applications of nutrition (rate and placement), earlier time of sowing, the use of precision agriculture technology and managing land based on production zones, continued use of no-till, a greater area of summer weed control, and the use of rotations. Improvements in WUE could also have been made with the adoption of better varieties and improved agronomic options and advice, which would at least partly be the result of an increased capacity of farmers, researchers and advisors supported by the strong extension network across Eyre Peninsula.

**Acknowledgements**

Thanks very much to the farmers that took the time to fill in the surveys, your efforts were vital to the success of this project. Thanks to Anthony Whitbread, Geoff Thomas and Michael Moodie for assistance with survey design and analysis. The Low Rainfall Collaboration project, GRDC and EP Farming Systems 3 (UA00107) have provided support for this evaluation.
Key messages

- A new GRDC funded project has begun on upper Eyre Peninsula. The project will run for 5 years, and will produce guidelines to overcome the problems with retaining stubble in EP farming systems.

- EPARF have received funding for the project, and are engaging SARDI Minnipa Agriculture Centre staff to deliver the project. The EPARF Board and sub-committees will provide oversight and direction for project activities.

Project aims

The project ‘Maintaining profitable farming systems with retained stubble - upper Eyre Peninsula’ aims to produce sustainable management guidelines to control pests, weeds and diseases while retaining stubble to maintain or improve soil health, and reduce exposure to wind erosion. The major outcome to be achieved is increased knowledge and skills allowing farmers and advisers to improve farm profitability while retaining stubble in farming systems on upper Eyre Peninsula (EP).

While providing benefits such as increased ground cover and soil protection, retained stubble farming systems present unique challenges compared to conventional or traditional farming systems where cultivation/stubble removal has been an important component of pest and disease management strategies. The local management guidelines developed in this project will include strategic approaches to address locally relevant issues on upper EP in retained stubble systems, in order to maintain or improve profitability and sustainability.

Guidelines will be developed with the use of local advisers, growers, collaboration with other low rainfall farming systems groups and past research findings, and further validated and demonstrated through the development component of this project. Supported with economic and risk analyses to determine profitability of practices adapted to local situations, they will be extended to the local farming and agribusiness community via our already established EP Farming Systems networks, publications and events. They will also utilise social media such as YouTube videos, an e-newsletter and the Eyre Peninsula Agricultural Research Foundation (EPARF) website www.minnipaagriculturalcentre.com.au.

Why do the project?

The greatest potential for land degradation on EP is related to wind erosion. There are 834,000 ha (29% of cleared land) in the region with moderate or higher potential for wind erosion (DWLBC 2007). The most vulnerable areas are the sandy soils, particularly water repellent sands, of eastern and upper EP.

The move to conservation farming systems, with reduced tillage and retaining of stubble residues, has improved soil moisture conservation, which has shown significant yield benefits in dry seasons. More recently, the move to no-till farming systems has further improved moisture and soil conservation across the farming districts. This technology has also significantly reduced soil erosion through lower levels of soil disturbance and higher levels of surface cover. (State of our Resources: Natural Resources Management Plan for the Eyre Peninsula Natural Resources Management Region 2009).

However, on upper EP there are significant issues arising from adopting practices associated with conservation farming systems (based on reduced tillage) and no-till farming. These issues include, but are not limited to, the build-up of snails, fungal disease carryover on cereal stubble and increasing in-crop weed infestation; all with costly but often poor chemical control. Stubble removal by burning and/or cultivation are generally seen by growers and their advisers as short term robust solutions. Growers with a long term history of no-till systems are finding it expedient to cultivate selected paddocks to remove woody weeds and discourage mice and snail infestations.

Other issues associated with the retention of stubble include the recent occurrence of the white grain fungal disease, difficulty of establishing crops into medic pasture residue and grower and adviser perceptions that burning stubbles sterilises barley grass seed. Growers have also made observations that suggest retaining stubble increases the water repellence of non-wetting soils.
Research and development
The guidelines will be developed from field based activities, using the MAC facility and two regional sites on eastern and western EP, concentrating on specific localised issues. At the major MAC site the development work will be based on demonstrating opportunities to address pest, weed (in particular grasses), disease and crop productivity issues that are considered to be jeopardising the stubble retention systems. Stubble management options will be imposed on a range of field crops at harvest or post-harvest and stubble removal options pre-seeding also tested in representative commercial paddocks. The resultant pest, disease, weed and nutrient outcomes will be monitored and will provide validation for local guidelines and recommendations.

The regional sites will focus on specific local issues limiting profitability in stubble retained situations. On eastern EP the interaction between non-wetting soils and stubble retention with establishment will be a key issue for demonstration. On western EP stubble retention is being viewed as a constraint to effective herbicide use for summer/autumn and in crop weed control. Stubbles are also increasing snail and mice populations while pasture residues can delay the seeding program, by requiring a mechanical chaining.

At a national level, CSIRO has been contracted to assist groups participating in the Stubble Initiative with research expertise and techniques, to encourage consistency and rigour across the projects.

What has happened so far?
Development sites have been established at three regional locations, Mt Cooper, Lock and Minnipa Agricultural Centre. In 2013 both wheat and pasture trial sites were commenced. Initial treatments included reaping wheat at different heights and in pastures pasture-topping and grazing versus selective grass control versus hay-cutting. New treatments will then be imposed in 2014 on those previously established and will include comparisons between crop and pasture residue retention, disturbance or removal prior to seeding. Improved establishment options on non-wetting sands will be assessed through a comparative evaluation of seeding rate, depth and position. The project will continue to consult with growers at March meetings as to regional issues associated with stubble retention and where possible assist with developing and delivering regional demonstrations.

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The Eyre Peninsula Grain & Graze 2 project officially commenced on 31 March 2010. The aim of the project was to develop and promote the adoption of production practices in mixed farming systems on Eyre Peninsula that improve whole farm profitability and sustainability and increase the efficient use of water and nutrients. The work was to focus specifically on the management of groundcover and biomass by integrating cropping and livestock within conservation farming systems.

The Grains Research & Development Corporation (GRDC) and the Australian Government’s Caring for Our Country program provided funding of $808,118, which provided a full time research officer (Jessica Crettenden) and half time project coordinator (Naomi Scholz), project management for the University of Adelaide, funds to partially support a Steering Committee and contracting of consultants to deliver specific works such as Sheep Groups and Profitability & Risk workshops. Cash and in-kind support was provided by SARDI for research support (Roy Latta), technical support, overheads and operating; EPNRM provided cash for extension support via the Regional Landcare Facilitator (Linden Masters) and the University of Adelaide provided administration support and project supervision (Glenn McDonald).

The EP Grain & Graze 2 project has enjoyed strong collaboration with a number of organisations including the Eyre Peninsula Agricultural Research Foundation (EPARF), Lower Eyre Agricultural Development Association (LEADA), Eyre Peninsula Natural Resources Management Board (EPNRM), Ag Ex Alliance (AEA), Low Rainfall Collaboration Group (LRCG), Rural Solutions SA (RSSA) and the CRC for Future Farm Industries (CRC FFI). There were also interactions and collaborations with a large range of projects, including the Eyre Peninsula Farming Systems 3 project and SheepConnect SA.

Outcomes from research

*Enrich Perennial Forage Shrub Trial – a program to identify novel native forage species.*

Fifteen species of either Atriplex, Rhagodia, Eremophila and Medicago forage shrubs were established at Minnipa and Piednippie in 2009 to measure their persistence, productivity and palatability to support the establishment of both shrubs and herbaceous perennials for grazing and/or carbon sequestration and soil remediation on low production, constrained soils. Sites were monitored and measured in spring and autumn of 2010, 2011 and 2012. Both sites were grazed for the first time in autumn 2011 and again in 2012; subsequently their recovery was monitored to decide which lines progress to further establishment and evaluation studies. Supported by the national CRC for Future Farm Industries Enrich program it has shown that it is best to have mixed species stands rather than single species. A mix of *A. nummularia*, *R. preissii*, *A. semibaccata*, *E. tomentosa* and *A. amnicola* has been the most productive, calculated by plant establishment, biomass, persistence and palatability. As a progression, three direct seeding trials to investigate low risk/low cost perennial establishment methodology were established from 2011-2013 with the most productive perennial forage shrubs selected from the results of two of the trial sites. Production and persistence will be monitored on these sites and grazing in their second year of growth will allow further assessments of grazing preference.

The Enrich sites provided excellent information to assist with shrub selection and management, however establishing shrubs from seed appears one of the major hurdles in the further adoption of forage shrubs and more research is required. These sites were used as a ‘trial and error’ opportunity to understand what the major hurdles for shrub establishment on the EP are. An important conclusion from the demonstration sites was that more work needs to be done on more workable direct seeding practices before promoting it as a cost and production efficient option to growers, especially on time of sowing, site preparation and design and weed management.

*Annual and Perennial Species Evaluation Trials*

Establishment of a trial to evaluate the potential of alternative herbaceous perennials (Sulla, Tedera and Cullen) compared to lucerne commenced in 2009 with 4 sites sown encompassing low to high EP rainfall zones and alkaline to acidic soil types. After 4 years of evaluation, it has been established that lucerne is well adapted to the better, deeper cropping soils on EP. However it lacks persistence on the shallow soils as opposed to Tedera, which is well adapted in neutral to acid soil types and Cullen to more alkaline soil types. Sulla was highly productive on the neutral to alkaline soil types and is well adapted to a 2-3 year break in an intensive cropping system, not necessarily as a longer term crop replacement on retired cropping land.
The slow rate and lack of commercial development of the Tedera and Cullen species respectively has meant that there has been little opportunity to promote the species as alternative pastures on their specific niches. As a result of this project, Sulla has been included in crop rotation studies as a phase pasture and is being assessed as an alternative break crop, with weed control and animal production benefits, to annual pastures.

Grazing Crops
Several trials were established from 2010 to 2013 to evaluate a range of dual purpose crops (cereals and broad-leaf) measuring early biomass production for grazing, biomass production at anthesis for hay making, and subsequent grain yield from both grazed and un-grazed plots. Four paddocks were sown to barley in 2011, which were split for plus and minus grazing prior growth stage 31. There was delayed crop development and reduced lodging as a result of grazing, which also provided a feed source to fill the winter feed gap. There were also significant yield losses in response to late, untimely, continued grazing.

A canola grazing trial established near Cummins on lower EP in the same year measured a 60% yield loss in response to untimely and continued grazing. In a barley grazing trial at Wangary in 2011 the grower made the decision to utilise the paddock as a winter feed resource as opposed to an opportunistic grazing resource with grain production as the primary aim. The decision was supported by a delayed sowing date which reduced the early biomass production and the weed infestation which limited the yield in the un-grazed section to 2 t/ha. Grazing until ear emergence reduced yield to an estimated 0.7 t/ha.

In 2012 the same 4 paddocks used for the 2011 trial were sown to canola and medic, which aimed to demonstrate the impact of grazing a grain crop at the optimal stage of growth (6-8 leaf stage for canola) and compare grazed versus un-grazed systems. Due to seasonal conditions, poor early vigour and poor overall growth in the canola, the paddocks were not grazed. Biomass was still measured throughout the year and harvest yields were recorded to report on the decision making process of the trial. This decision making process was documented in the EP Farming Systems Summary 2012, in the article “Grain and Graze – who, what, when, where, why, how?” p 126.

In 2013, a broad acre demonstration site was established at Lock with barley, which was sown with the intent to graze for sheep feed with the opportunity to remove stock and cut for hay or harvest grain if the season allowed. Technical advice was provided to the farmer, exclusion cages were placed in the paddock and biomass measurements and feed tests were taken to assist in the decision making process. Results showed 1085 kg/ha higher dry matter in the exclusion area at harvest and 285 kg/ha more yield than measurements taken from the grazed area in the paddock. This showed that grazing has not impacted drastically on grain yields or biomass when compared to the substantial feed utilisation throughout the grazing period.

The in-season decision was to leave the northern side for hay or harvest with the southern side grazed down too far for either end use. Conversely, the opportunity to utilise the northern area as a standing feed source to finish lambs on over the summer period was decided to be the best value for the residual crop with 927 kg/ha of barley grain and roughly 5.8 t/ha of dry matter remaining in this area of the paddock.

Although using the cereal as a forage crop has somewhat affected a higher yield result, the feed value over this time needs to be considered as a beneficial outcome as well as additional advantages of livestock delaying grass growth and the on-set of weed seed set, offering the opportunity to spray-top later in the season. Furthermore, this end use will provide a valuable and substantial feed source for livestock over the summer and will also prevent other stubbles from being over-grazed, thus benefits of this practice need to be understood from a whole mixed farming system perspective (EP Farming Systems Summary 2013, Flexibility in grazing cereals: the yin-yang effect, Crettenden).

Impact of Livestock on Soil Health
A trial was established on Minnipa Agricultural Centre in 2008 to test whether soil fertility and health could be improved under a higher input system compared to a lower input and more traditional system. Interposed on the input level comparison was the impact of livestock in a pasture-crop rotation to address the perceptions (often negative) associated with animals and soil health. The 6 year wheat, wheat, pasture (annual medic), wheat, pasture (annual medic), wheat rotation was split for plus and minus grazing in both the high and low input systems to establish the impact of grazing between the 2 treatments. Plant production along with soil nutrition has been monitored over the period of the trial. There had been no measured change in soil organic carbon content in response to high and low input systems with or without grazing until 2013 when a higher trend in the 0-20 cm profile was estimated in the 2 grazing treatments (0.15-0.2%), compared to the un-grazed treatments. The study measured increased pasture biomass in 2010 and higher wheat yields in 2011 response to both increased inputs, and grazing. The 2012 pasture phase of the rotation increased pasture biomass production in response to higher plant numbers from the 2010 annual medic establishment, high input treatments. There was increased plant available nitrogen at the 2013 seeding from the 2012 grazing treatments but no increased plant available N in response to higher 2012 biomass production. Grain yield, protein content and screening % following grazing the high input treatment in 2012 was higher than the high input un-grazed treatment, which was higher than the grazed low input treatment which was higher than the low input un-grazed treatment. Grazing has benefited both production and soil health outcomes.
Economically the high crop and pasture input treatments have produced an extra 1 t/ha of wheat from 4 crops in 6 years, irrespective of being grazed or un-grazed. The value of the extra grazing is reliant on the stocking rate and available growing season pasture area, i.e. there is no benefit unless there is a feed deficit under the current stocking rate requiring hand-feeding in the winter/spring period when annual medic is productive. The cost/ha has been an extra 120 kg of DAP ($80), 80 kg of seed wheat ($20) plus the pasture establishment ($40), giving a 6 year increased gross margin of approximately $110/ha plus any increased livestock returns (assuming a wheat price of $250/t).

Other related research is reported elsewhere in the document: Crop sequencing; Extending best practice wool innovations on Eyre Peninsula; Demonstration and extension of flock management strategies to improve lamb weaning percentages in low rainfall mixed farming regions.

Delivery to growers
The Eyre Peninsula Grain & Graze 2 project has had access to the extension networks established by the Eyre Peninsula Farming Systems projects; key messages, research results and new information has been provided to growers throughout the region and over the life of the project.

Each year, growers from 14 agricultural bureaus and groups on upper EP attended harvest report meetings, where research results were presented from the previous season, and grower issues and questions recorded to inform further research, development and extension. A field day showcasing trials and presenting information was held annually at Minnipa Agricultural Centre (MAC Field Day), EPARF hosted an annual targeted workshop (EPARF day) and a Women’s Field Day was held every 2 years. Individual group ‘Sticky beak days’ were held in spring, where growers visited local properties and discussed trials or issues. Growers had access to the EPARF website www.minnipaagriculturalcentre.com.au and an e-newsletter was distributed each month. A Winter Newsletter was produced annually, detailing trials on EP and a couple of feature articles. All research results were published in the Eyre Peninsula Farming Systems Summary, which was available free to all farmers and consultants on EP and interested parties both inter and intrastate. 1200 hard copies were distributed annually and it was posted on the EPARF and SARDI websites. An email distribution list of 345 farmers was established specifically for EP Grain & Graze 2. This list was used to provide mixed farming information and notify people of coming events. The Eyre Peninsula component of the national Grain & Graze 2 website has been maintained, with publications, events and photos uploaded.

In March 2011, 4 Sheep Forums titled ‘More Profit, Less Hassle’ were held for growers on Eyre Peninsula. From these events, interest was gauged for the formation of ‘Sheep Groups’, or mixed Farmer Forums, with 4 groups being established at Cummins, Burtleboo, Poochera and Penong. Since then, 2 more groups have formed around the Kimba and Lock districts. The Sheep Groups are coordinated and facilitated by Mary Crawford, Land Management Consultant with Rural Solutions SA. Members of the Sheep Groups are mixed farmers, and each group determines their own agenda for the coming year.

Funding for the operation of the Sheep Groups was provided by EP Grain & Graze 2, SheepConnect SA and the Eyre Peninsula Natural Resources Management Board. This was a very important collaboration as the pooled funds provided flexibility (Sheep Group members were able to determine their own agendas), a greater number of serviced groups and greater ability to attract professional support.

Sheep groups generally met 3 times a year, with the first meeting being a planning session with invited guest speakers, the second was usually a benchmarking session undertaken with Daniel Schuppan, Livestock Consultant with Landmark where growers compared their livestock production to each other and saw changes in their own business over time, and the third was a technical session, usually held in the field visiting grower’s properties.

The Sheep Groups explored a range of topics to improve production, profitability and sustainability. Items included animal health and nutrition, soil cover and health, feed availability, new sheep handling technology and innovations, grazing management, Australian Standard Breeding Values, grazing cereals and so on.

A total of 94,968 growers, researchers, consultants and agribusiness and NRM representatives attended or received Grain & Graze related events and publications. 1476 of those people actively participated in events such as workshops, Sheep Group discussions and training sessions e.g. measuring ground cover and determining feed availability.

Profitability & Risk
A dedicated forum with banks, accountants and whole farm consultants on EP demonstrating the ‘@risk’ approach used in Southern Victoria was held in 2012. The aim of the forum was to raise awareness of the availability of a new tool ‘@risk’ to examine production and financial risks of farming businesses to bankers, accountants and consultants on Eyre Peninsula. None of the participants had encountered ‘@risk’ prior to this session, so awareness increased 100% amongst participants. Participants were interested in this type of risk analysis for their clients, but needed more exposure to the program to determine whether they would like to learn to use the tool.
To date, 6 groups of young farmers have participated in ‘Introduction to Farm Finance and Risk Management’ workshops, presented by Andy Bates (Ag Consultant) and either Brian Wibberley (Accountant) or Phil Stephens (Accountant). The aim was to introduce a group of younger farmers to the basic principles of financial management, with a longer term view to improved risk assessment and management. The workshops were aimed at whole farm business management, and participants were introduced to business structures, tax, measuring equity, cost of production, types of farm finance, common farm business financial tools, cash flow budgets and how to use them, identifying & managing farm business risks, interpreting financial statements and key business measures.

A series of 3 day Profitability & Risk workshops were run in 2009 at Cummins, Kimba, Wudinna, Streaky Bay and Tumby Bay, following the success of the workshops delivered as part of EP Grain & Graze 1, by Mike Krause and Brenton Lynch. Further Plan 2 Profit workshops are being held across Eyre Peninsula in 2014, under the Agrifood Skills Eyre Peninsula project.

Adoption/Change in practice
A KASA (knowledge, awareness, skills and attitude) exit survey was undertaken in March 2013 as part of the EP Farming Systems 3 project in conjunction with the Low Rainfall Collaboration project. 38 growers responded to the survey. A very small component of the growers that responded to the KASA survey were Sheep Group participants, but many had attended events that presented outcomes from Grain & Graze 2. 97% of respondents had heard of the EP Grain & Graze 2 project. The survey investigated changes in practices or attitudes over the previous 5 years.

According to the survey, the percentage of income from pasture/sheep remained the same at around 17%, the area for pasture/sheep declined to 33% of the total farm area (increase in cropping area). The three major changes people had made recently were purchasing land, upgrading equipment and increasing their livestock numbers. Lambing percentages fluctuated with the seasons, with the average being 99%.

To improve their livestock water use efficiency, 19 growers improved their pastures, 16 used containment areas, 15 dry seeded feed crops, 13 sowed cereals for grazing only, 13 had improved their grazing management and 10 had changed their stock management (e.g. timing of lambing) and 9 sowed dual purpose cereals. Other ways growers stated they had improved their livestock water use efficiency were by including the use of perennial shrubs, legumes and native grasses, fencing to smaller paddocks to improve feed utilisation, managing the feedbase better or supplementary feeding.

In March 2013, 29 Sheep Group participants responded to a written questionnaire. They found the most useful components of being part of a Sheep Group were benchmarking their enterprise against others in the district; talking to other farmers in the district and presentations from a range of different speakers. 58% of respondents had made changes to their sheep enterprise/s since they became involved in a sheep group. Those that had not made changes were generally members of the more recently formed groups.

Some of the changes people had made included changed shearing time, increased stocking rates, use of electric fencing, general planning and nutrition, planting feed early (e.g. barley for grazing), changed lambing time, fenced paddocks to better utilise feed and protect sandhills, improved weaner growth rates with higher protein supplements, improved fencing and watering systems, feed budgeting and condition scoring ewes. Being involved in a sheep group helped 83% make decisions about their sheep enterprise, and all of the respondents thought that Sheep Groups should continue in the future.

A further Sheep Group evaluation was carried out in September 2013. Sheep Group members were invited to provide feedback about how they think being involved in a Sheep Group has helped them improve their mixed farming business. Several local businesses provided prizes for the best responses, to encourage participation. Some of the comments included:

- “Several decisions were made after our benchmarking meeting and one of them was to mate our ewes to type rather than age. The second decision was to try lambing a bit later…with far less mortality (and) as a result we should see a huge lift in our production with more wether lambs to sell and more young ewes to shear and breed from.”
- “The sheep group meetings allow us as members to see in the plainest of terms, where our own operations sit compared to our surrounding neighbours. We receive a quantitative figure, and no mistake can be made as to how we are performing. It is a safe, confidential environment, which facilitates discussion that delves quite deep into some producers systems, a depth which wouldn’t be reached in general discussion over a beer at the local. The group meetings highlight the top producers, who we can then delve into what they may be doing differently to gain this edge.”
• “Planting early feed has saved us time, through shortened hand feeding. It has saved us money, because we need to hand feed less. We are now losing less condition from the sheep as a result of this and consequently growing more wool from healthier ewes and lambs, resulting in favourable financial outcomes. The costs are mainly fuel and labour, and these don’t compare to the gains we receive as a result of doing it, not to mention the peace of mind we get from having the sheep on decent feed.”

• “Before we started benchmarking two years ago I had no idea how the sheep enterprise on our mixed farm was performing. After two years of data I now know that there is plenty of room for improvement and I now have a clear plan to make the enterprise profitable into the future. The two key areas I identified for improvement were to improve wool cut and to try and run more sheep through better grazing management.”

• “Through the sheep group and EPNRM I applied for funding to make a central water point and a dividing fence to make four 100 hectare paddocks to be able to rotational graze and help prevent erosion on sand hills. This project has allowed me to run more sheep in a more environmentally friendly manner and has been so successful it has inspired me to re-fence and add more troughs to other areas of my farm to be able to graze sheep in individual paddocks which I am in the process of doing now.”

Benchmarking undertaken by the Sheep Group members has been seen as very beneficial. Many producers in the groups commented that it was good to improve their understanding of their sheep enterprise and get a handle on what their sheep enterprise is returning on a $ per DSE and $ per winter grazed hectare ($/WG ha) basis.

The variation observed between producers within the same rainfall environment provides some opportunities for producers to be more productive and profitable. Producers can control the areas where the largest variations occurred including sheep losses and marking percentages. There were some small variations in sheep sale price, wool price and kg of wool/DSE. The big influence on gross margin per ha was the stocking rate, which influenced the number of lambs per ha and the wool production per ha. Therefore pastures, grazing management, animal health and genetics are the keys to optimising income from the sheep enterprise.

Risk management is also important and this will be determined by the management capabilities and the amount of risk that a producer is willing to take. The higher the stocking rate, the higher the risk and more management required. Some producers have low stocking rates as it makes it easier to get through the “poor season”. Many producers have an idea in their minds of what they will do in the “poor season” but there is no written strategy to implement ‘back door’ or exit strategies.

Some producers have started to implement changes to their enterprise after the first year of benchmarking their sheep enterprise. These changes have resulted in an improvement in their second year figures. The changes included improving pastures, monitoring ewe condition score and focusing on genetic improvement. The local information from the group allowed these producers to focus on targets that are being achieved in their own district and give them confidence to implement the change as they have the support of the local group members and advisors.

Following the success of the Eyre Peninsula Grain & Graze 2 project, GRDC have chosen to invest in a third program (Grain & Graze 3), of which EP will be a part. Other groups involved are East SA managed by Ag Excellence Alliance, BCG, Southern Farming Systems and Mallee Sustainable Farming. EP Grain & Graze 3 will focus on grazing cereals, pastures in the crop rotation and improving farm business decision making skills.

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