Northern Agricultural Region
Final Report
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EXECUTIVE SUMMARY

The Northern Agricultural Region Grain and Graze project ran for 4 years from 1 July 2004 to 1 July 2008.

It was funded at the national level by Meat and Livestock Australia, Grains Research and Development Corporation, Australian Wool Innovation and Land and Water Australia.

It was funded at the local level by the Northern Agricultural Catchments Council, the National Landcare Programme and the Department of Agriculture and Food Western Australia.

The work was carried out by 4 grower groups (Mingenew-Irwin, Liebe, Evergreen, Victoria Plains) and DAFWA.

The objectives were to:

1. Maximise farming system profitability by introducing perennial pastures into the farming system,
2. Stimulate change in NAR farming systems so that the natural resource base is significantly improved whilst at the same time increasing production.
3. Increase the capacity of producers and service industry staff to successfully incorporate perennial pastures into farming systems.
4. Engage, through communication, extension and participation activities, at least 1000 producers in NAR Grain & Graze activities between 2004-2008 with a view to change on farm / adoption of Grain & Graze practices that are 10% more profitable and in-tune with catchment aspirations occurring on at least 450 farm businesses.

Additionally, the 3 critical success factors were to:

a) increase the adoption of subtropical perennial grasses
b) increase the adoption of grazing cereals
c) increase the matching of species to soil type, and feed supply to demand

The following research activities were undertaken:

Perennial Pasture plot trials
Grazing Cereal plot trials
Monitoring of 13 x Demonstration Farms
STEP economic analysis
Water Use of annuals vs perennials via neutron probes
Nutrient leaching monitoring via soil testing
Soil erosion monitoring via satellite imagery
Weed risk assessment via roadside and paddock surveys
The following adoption activities were undertaken:

- Field Days / Bus Tours / Seminars
- Newsletters
- Farm Weekly Pages
- Case Studies
- “Key Findings” Booklet
- Audio CD’s
- Agronomists Update
- Perennial Grasses Booklet x 2
- Grazing Cereals Booklet

The following achievements were made against the objectives:

Objective 1: Maximise farming system profitability by introducing perennial pastures into the farming system.

Our research and extension effort focused on the introduction of perennial pastures into farming systems. 100% of those who participated in the regional activities (i.e. 185) reported that they adopted the recommended practices, and 91% of these reported a profit increase averaging 3% (Read & Peterson 2008). While this is less than the 10% target, it is seen as only a preliminary figure. Perennial pastures are viewed as a long term investment that gain in profitability over time once the up-front establishment costs have been overcome.

Objective 2: Stimulate change in NAR farming systems so that the natural resource base is significantly improved whilst at the same time increasing production.

The adoption of perennial pasture systems is a keystone of the Northern Agricultural Catchment Council’s NRM plan as a means of maintaining soil health and lowering watertables to reduce the risk of salinity. Salinity in the region has not increased, and there is evidence of lowering watertables, however drought has been a major factor in this and it is simply not possible to attribute this benefit to Grain & Graze. However, reduced soil loss from wind erosion can be linked to the increase in perennial pastures, including those adopted as a result of participation in Grain & Graze. 49% of participants reported that are more confident in making NRM decisions on the basis of their participation in the program (Read & Peterson 2008).

Objective 3: Increase the capacity of producers and service industry staff to successfully incorporate perennial pastures into farming systems.
81% of Grain & Graze participants in the region reported that they are more confident (the key criteria for measuring ‘capacity’) in making mixed farming systems decisions – in this case involving the incorporation of perennial pastures into the system.

Objective 4: Engage, through communication, extension and participation activities, at least 1000 producers in NAR Grain & Graze activities between 2004-2008 with a view to change on farm / adoption of Grain & Graze practices that are 10% more profitable and in-tune with catchment aspirations occurring on at least 450 farm businesses.

Given that there are only 978 producers in the Northern Agricultural Region, it was not feasible to engage 100% (i.e. 1000) of them! Read and Peterson (2008) estimate that 185 producers were engaged (estimated from AgScan survey results), however, our estimates, which we judge to be reliable, put the number of active participants at 380. Read and Peterson also suggest that all 978 farm businesses at one time or another over the life of Grain & Graze adopted at least one farming system practice recommended by Grain & Graze. Although it is not possible to attribute all of this to participation in the program, the communication effort in the region was substantial and would have contributed significantly to the high levels of adoption.

The key research findings were:

1) Subtropical perennial grasses are best suited to the sandy soils of the higher rainfall western half of the NAR

2) Subtropical perennial grasses improve out of season production, but also growing season production in low rainfall years

3) Gatton Panic is the standout perennial pasture species based on persistence, production and feed quality. Rhodes grass is the next best species. A number of other species were tested but did not perform to the level of these two species.

4) Subtropical perennial grasses provide more consistent feed quality year round than annual pastures.

5) Subtropical perennial grasses use more water than annual pastures and recycle nutrients that have been leached past the root zone of annual pastures

6) Subtropical perennial grasses reduce the risk of erosion. However, the risk of erosion is temporarily increased during the establishment year due to the need for a weed free and consequently bare seed bed.
7) Subtropical perennial grasses do not appear to cause a weed risk to remnant or riparian vegetation, although there is evidence of invasion on roadsides where there has been soil disturbance.

8) There is still much to learn about the economics of introducing subtropical perennial pastures. That said, most producers report either an increase in stocking rate or decrease in supplementary feeding - which would translate through to higher profits.

9) Grazing cereals do have a role in the NAR

10) Cereals can be grazed without incurring a yield penalty but the window for grazing is small (due to the short growing season)

11) Grazing cereals must be sown early to maximise the grazing opportunity

12) Existing cereal varieties can be grazed although oats, barley and triticale have more early vigour (and hence early grazing) than wheat

13) Grazing cereals can be sown with clovers in paddocks coming out of crop to enhance legume content

14) Grazing cereals can be used to change the ratio of crop vs pasture tactically during the growing season to better manage seasonal variability. More work is needed to better understand this approach.

The key adoption findings were:

1) More than 100 producers in the NAR have now adopted subtropical perennial grasses

2) It is estimated that between 30 and 50 growers will plant subtropical perennial grasses for the first time in 2008

3) The interest in subtropical grasses has increased with the recent run of dry years

4) Most producers who have planted subtropical perennial pastures in the past plan to increase the area sown

5) The cost of establishment is restricting uptake

6) Producers are now more confident than in the past to sow subtropical perennials grasses due to the recent release of research results and the development of robust agronomic packages
7) The adoption of grazing cereals in the NAR has so far been slow

8) The interest in grazing cereals is increasing but it is still very early days for this technology in the NAR

9) Producers understand that crop paddocks need to be fenced in to smaller areas for grazing cereals. Sales of portable electric fencing equipment have grown as a result.
1. WHY DID WE DO IT?

**Background to the NAR region:**

7.5 million hectares of land

Runs from just north of Perth to north of Geraldton and inland to the edge of the pastoral country

50% is cleared and used for agricultural production

Large amount of remnant vegetation, both in reserves and on private land

Agriculture is the largest sector of the regional economy making up 35% or $1000 million

Rainfall declines as you head north and east. 700mm average in the SW corner of the region to 250mm in the NE corner. The climate is typically Mediterranean with cool, wet winters followed by hot, dry summers. Recent trends indicate less autumn, winter and spring rain than the long term average.

Soils types are extremely variable but there is a lot of sand, particularly in the western half of the region. The sand is typically interspersed with areas of gravel.

In the eastern half of the region there is a much greater proportion of heavier loams and clays in addition to the sand.

Broadacre cropping is the predominant agricultural enterprise. The NAR produces 35% of the state’s wheat, 50% of the state’s lupins, and 10% of the state’s oats and barley. Livestock are important and sheep are the predominant type of livestock, with the region producing 20% of the state’s sheep and wool. Cattle are present but make up a smaller share, but numbers are slowly expanding. Horticulture is a growing industry, utilising underground water. Forestry is a small sector.

60,000 people live in the region, with almost one half of these living in the only major city, Geraldton. Towns are few and far between and small (population <1000).

**NAR farming systems (back in 2004):**

Existing farming system based on annual crops and pastures

Salinity, waterlogging and soil erosion all major environmental issues

Opportunity to extend the length of the growing season, increase livestock production and stocking rate, reduce supplementary feeding, and improve soil and pasture quality through the introduction of perennial pastures.

The fodder shrub tagasaste had already showed that perennial pastures were a viable option for the region.
Herbicide resistance was a major issue affecting crop production and perennial pastures could possibly be used as a weed free phase pasture to reduce seed banks.

That said, the main initial emphasis was on removing the poor soils (unprofitable for cropping) from the annual pasture/crop rotation and planting them to permanent perennial pasture. This would improve the profitability of the cropping enterprise by removing negative gross margin (and risky) paddocks and replacing them with positive gross margin paddocks.

Some farmers had already adopted sub-tropical perennial grasses prior to the Grain and Graze project – however these farmers were clearly innovators who did not require much in the way of hard evidence. Most of the early work on this new technology had been conducted by innovative farmers working closely with one extension officer. There was almost no hard research data. But there was a reasonable amount of anecdotal evidence to suggest this technology had very real potential. Grain and Graze provided the opportunity to gather some hard data on the performance of these pastures relative to the current annual based pasture system.

**Project Partners:**

There was strong agreement that the data gathering had to be a whole lot more than just some “white peg” plot research trials. This was reflected in the mix of R,D&A activities chosen.

The region decided to have a mixed portfolio of research, development and extension activities, but with a strong emphasis of working very closely with growers through the strong grower groups. Particularly for the production orientated part of the project. The NRM monitoring activities were undertaken by DAFWA.

The grower groups had historically had little or no funding for livestock R&D. Most of their funding had been for crop R&D and NRM ("Landcare") activities. The grower groups were keen to undertake livestock work in order to better service members and to round out their group’s portfolio of work. They were also keen to work together to provide benefits to the wider region as well as their local member base.

The regional Catchment Council, NACC, was keen to co-invest with the industry R&D corporations on sustainable agriculture initiatives. However, their investment timeframes did not align, meaning the project had to commence with funds solely from the R&D corporations. This produced a project in almost two halves – with the production aspect funded by the RDC’s and mainly delivered by the grower groups, while the NRM aspect was funded later by NACC and NLP and mainly delivered by DAFWA.

The different investment timeframes compromised the project’s ability to deliver production and NRM results simultaneously.
Figure 1: Wind erosion risk map for the northern subregion of the NAR showing the high risk sandplain area in purple. Source: NACC Investment Plan
2. WHAT DID WE INTEND TO ACHIEVE?

National Grain & Graze Objectives:

- A 10% increase in mixed farm profitability, driven by a 5% increase in grain yields and a 10% increase in livestock production;
- Improved condition of natural resources on mixed farms in line with regional or catchment targets; and
- Confident and knowledgeable mixed farmers making decisions and using tools that sustain production and promote biodiversity.

NAR Grain & Graze Objectives:

1. Maximise farming system profitability by introducing perennial pastures into the farming system,
2. Stimulate change in Northern Agricultural region farming systems so that the natural resource base is significantly improved whilst at the same time increasing production.
3. Increase the capacity of producers and service industry staff to successfully incorporate perennial pastures into farming systems.
4. Engage, through communication, extension and participation activities, at least 1000 producers in NAR Grain & Graze activities between 2004-2008 with a view to change on farm / adoption of Grain & Graze practices that are 10% more profitable and in-tune with catchment aspirations occurring on at least 450 farm businesses.

Sub-programs:

1. Perennial systems (subsuming research questions 1, 2 & 3)
2. NRM impacts (subsuming research questions 4, 5 & 6)
3. Adoption tool development (subsuming adoption tools 1, 2 & 3)

Research questions:

1. Which perennial pastures are best suited to the NAR and what are their likely levels of production?
2. What are the best bet grazing management strategies for the major classes of livestock to improve the whole farm feed mix and profit through the use of perennials?
3. How could perennial pastures be integrated into crop rotations?
4. What impacts are perennial pastures likely to have on water use, salinity management, nutrient loss and soil erosion when they were incorporated into farming systems?
5. What is the risk that perennial pastures could become farm and environmental weeds?
6. What impacts are perennial pastures likely to have on whole farm biodiversity and health?
Adoption tools:
1. Involve a wide range of stakeholders in the project.
2. Deliver project findings and a perennial pastures manual to industry.
3. Develop a decision support tool for producers adopting perennial pastures.

A broad objective of the project is to increase the ability of farmers to change their rotations / systems to include perennials so that success (economic and environmental) is assured. This will be done by closely involving producers in the research components as well as delivering project outcomes via a co-ordinated and focused extension effort throughout the project’s life.

Success Factors:
1: Increased sowing of sub-tropical perennial grasses
2: Increased sowing of grazing cereals
3: Better matching of feed supply to demand, and species to soil type

Figure 2: A trial site at Moora highlights the stark contrast between annual and subtropical perennial pastures following summer rain. Photo 31 Jan 06.
3. WHAT DID WE DO AND WHAT WERE THE RESULTS?

a) The delivery model

Using momentum from involvement in MLA’s Sustainable Grazing Program (SGS), of which only the southern high rainfall portion of the NAR was involved, Tim Wiley and Bob Wilson instigated a discussion between grower groups in the NAR to put forward an application to the proposed new Grain and Graze project.

The initial meetings occurred in late 2001 and early 2002 and a rough draft project proposal was written. The grower groups individually did SWOT analyses of the farming systems with particular reference to mixed farming systems.

Cameron Weeks (Mingenew-Irwin Group) and Philip Barrett-Lennard (Evergreen Group) were given the task of pulling together the final Grain and Graze submission in 2003.

From the beginnings this was very much a grower and grower group driven approach, with support from DAFWA. This shaped the proposed R,D&E activities and also the flow of funds.

Most of the funds would be allocated to grower groups to employ specific Grain and Graze staff to research and develop mixed farming systems in their local area. A Project Supervisor would be selected from one of the Grower Groups to coordinate the activities. DAFWA would assist with in-kind technical expertise and mentoring.

The grower groups were particularly keen to be involved with Grain and Graze, as up until that point, most of their activities had revolved around either cropping R,D&E or Landcare activities. They had hosted little or no livestock or mixed farming R,D&E.

The grower groups had a different skill set to DAFWA being less technical and therefore less research orientated but potentially stronger in monitoring, communication and farmer engagement.

The idea of engaging a large number of participating farmers to be actively engaged in the research became attractive and hence that model was pursued. A large focus of the project would be the monitoring of the whole farm feed supply of 20 farms from across the region. This would provide extensive data from a range of existing and emerging feed types being used on-farm.
A series of perennial pasture and (eventually grazing cereals) plot trials would augment this research to better define the strengths and weaknesses of individual varieties under a more controlled environment.

The RDC’s encouraged the Northern Agricultural Catchment Council to become involved in Grain and Graze. Much discussion and behind the scenes work was needed to forge this relationship, but eventually NACC committed in principal to investing in G&G. One difficulty was the different timelines of the RDC’s and NACC.

This was managed by splitting the R,D&E activities into two main areas: production and NRM. The grower groups were to focus on the production aspects from day one with funding coming from Grain and Graze. DAFWA were to focus on the NRM aspects when funding became available via NACC. This began with an NLP project in July 05 and continued with further direct investment from NACC in July 06.

The RDC’s (Grain and Graze) contributed $1,000,000 over 4 years.

NLP invested $185,000 over 2 years

NACC invested $577,150 over 3 years

Human resources allocated:

Grower Groups: 4 x 0.5 FTE Project Officers
1 x 0.2 FTE Regional Coordinator

DAFWA: 1 x 1.0 FTE Research Officer
1 x 0.5 FTE Development Officer
1 x 0.5 FTE Technical Officer
2 x 0.1 FTE Development Officers
1 x 0.1 FTE Technical Officer
b) Perennial Pasture Quantity and Quality (Q&Q) Trials

Aim:
To determine the seasonal feed profile (both quantity and quality) and persistence of a range of perennial pastures compared with a range of annual pastures.

Outputs would be a list of proven species (those with sufficient feed quantity, quality and persistence), an understanding of how these pastures react to different seasonal conditions, and data to compare with annual pastures.

Method:
3 Q&Q trials (Badgingarra, Mingenew and Buntine) were sown in the spring of 2004. A range of perennial species were sown at each site but were mainly sub-tropical perennial grasses with lucerne, siratro and lotononis. Establishment was good at all 3 sites. Monitoring commenced in winter 2005 and continued until autumn 2008 and included regular biomass cuts, persistence counts and feed quality assessments. Drier than average conditions occurred for the vast majority of this time except for spring 2005 and summer 2006.

Results:

(i) Key findings from each site

Irwin
- All the perennial grass species established well in spring 2004, but the more drought sensitive species declined over the first summer (2004/05) with the dry seasonal conditions.
- The mild temperatures in winter enable the sub-tropical grasses to continue growing through winter, albeit slowly in July.
- Well adapted species have very good persistence with good perennial plant densities after four summers.
- Panic grass is the best performed species taking into account persistence and biomass production.
- Trial results suggest that sub-tropical grasses have a long-term role in this region on the deep sands which are marginal for growing crops.

Buntine
- All species established well but with dry conditions in spring 2004 there was a high number of seedling deaths in late 2004. Following rain in early autumn 2005 there was a second germination and many of these plants persisted over winter.
• With cool winter conditions the sub-tropical grasses effectively stop growing over the winter period from mid-June until mid- to late August which results in much lower production over the growing season than at either Badgingarra or at Irwin.
• A small number of species (Bambatsi panic, Rhodes grass, panic grass) showed good to very good persistence over the duration of the trial.
• There is a question mark over the long-term role of sub-tropical grasses in this region taking into account their limited productivity.

Badgingarra
• All the species established well in spring 2004, but there was a decline in plant numbers over the first summer with the dry seasonal conditions, especially of the more drought sensitive species like setaria. Lucerne survival over summer was very poor.
• With mild winter temperatures, the sub-tropical grasses only stop growing for about one month in mid-winter (July) and show good growth in both late autumn and late winter and right through spring.
• Well adapted species have very good persistence with good to excellent perennial plant densities after four summers.
• Panic grass was the best performed species taking into account persistence and biomass production, while Rhodes grass had the highest production in the first two years.
• Trial results suggest that sub-tropical grasses have a long-term role in this region.

(ii) Species x region
The series of QnQ trials together with other trial results (MLA Grass Improvement Project) is providing some clear guidelines as to where the various sub-tropical grass species are well suited, where they are marginal and where they are not suited.

On balance, the panic grasses have out-performed the Rhodes grass in the Northern Agricultural Region, particularly in 2007 and 2008. Rhodes grass had the highest biomass production in the first two years across most sites but its persistence was adversely affected by the extended dry conditions in the northern agricultural region of WA from December ’06 continued into early winter 2007. For example, the frequency (groundcover) for Callide Rhodes grass and Katambora Rhodes grass declined from 100% to 51% and 100% to 24% respectively at the Badgingarra site over this period. On the other hand, there were minimal or no deaths of Panicum maximum in the QnQ trials across the three sites in the NAG and they subsequently showed good spring growth at Badgingarra and Irwin.
(iii) Improving the resilience of farming systems

There is evidence from the QnQ trials that well adapted sub-tropical grass pastures can improve the resilience of farming systems in years with difficult seasonal conditions.

The results from 2006 illustrate that as well as producing out-of-season green feed, the sub-tropical grasses had moderate biomass production in early to mid-winter when the biomass from the annual pastures was very low.

At the Badgingarra site there was good summer rains in January and February 2006, but the remainder of the year had well below average rainfall except for July, August and September. The site received 386 mm for the year until mid-December compared with the long-term average of 587 mm, with only ~300 mm between May and November.

Rhodes grass and the Panics had the highest biomass production in 2006 with 7.4, 5.2, 7.0 and 5.7 t DM/ha respectively which compares with 2.26 t DM/ha from the annual volunteer control (Table 4). On the other hand, the annual legumes struggled with a low number of seeds germinating in late autumn to early winter which resulted in low plant densities and poor stands even though there was good rainfall in August and September with 95 mm and 62 mm respectively.

Table 1: Seasonal production of the perennial pasture Q&Q trial at Badgingarra in 2006

<table>
<thead>
<tr>
<th>Variety</th>
<th>Harvest date and biomass of sown species (kg DM/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16/02/06</td>
</tr>
<tr>
<td>Annual volunteer</td>
<td>0</td>
</tr>
<tr>
<td>Katambora Rhodes</td>
<td>1303</td>
</tr>
<tr>
<td>Gatton panic</td>
<td>2153</td>
</tr>
<tr>
<td>Callide Rhodes</td>
<td>722</td>
</tr>
<tr>
<td>Green panic</td>
<td>2214</td>
</tr>
<tr>
<td>Narok setaria</td>
<td>2156</td>
</tr>
<tr>
<td>Premier digit</td>
<td>2131</td>
</tr>
<tr>
<td>Splenda setaria</td>
<td>1424</td>
</tr>
<tr>
<td>Bambatsi</td>
<td>2406</td>
</tr>
<tr>
<td>Kikuyu</td>
<td>199</td>
</tr>
<tr>
<td>Signal grass</td>
<td>1649</td>
</tr>
<tr>
<td>Strickland finger grass</td>
<td>681</td>
</tr>
<tr>
<td>Lucerne - spring</td>
<td>3</td>
</tr>
<tr>
<td>Veldt grass</td>
<td>123</td>
</tr>
</tbody>
</table>
(iv) Summer production

The widespread rain in January to early February 2006 was an opportunity to measure the summer production of sub-tropical grasses through the network of Quantity and Quality sites (QnQ). All three sites in the northern agricultural region received between 60-90 mm in the period from January to early February. This was preceded by a dry period in December and early January and was followed by a six week dry, hot spell from mid-February until the end of March, so the summer production was clearly associated with the January - February rainfall.

Table 2: The average biomass production (kg DM/ha) in January-February 2006 at the Quantity and Quality sites north of Perth.

<table>
<thead>
<tr>
<th>Species – variety</th>
<th>Badgingarra RS</th>
<th>Buntine</th>
<th>Irwin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Callide Rhodes grass</td>
<td>720</td>
<td>1010</td>
<td>1250</td>
</tr>
<tr>
<td>Gatton panic</td>
<td>2200</td>
<td>Not sown</td>
<td>1650</td>
</tr>
<tr>
<td>Green panic</td>
<td>2200</td>
<td>540</td>
<td>1680</td>
</tr>
<tr>
<td>Katambora Rhodes grass</td>
<td>1300</td>
<td>1570</td>
<td>1790</td>
</tr>
<tr>
<td>Signal grass</td>
<td>1650 (Poor persistence)</td>
<td>40</td>
<td>680</td>
</tr>
<tr>
<td>Annual volunteer</td>
<td>0</td>
<td>460</td>
<td>0</td>
</tr>
</tbody>
</table>

What is the expected production from a sub-tropical grass pasture after summer rain?

From the results of the QnQ trials, the highest yielding treatments produced 33, 25 and 19 kg dry matter/ha per mm of rainfall at Badgingarra, Irwin and Buntine respectively. These figures could be an over-estimate as the grasses may have been accessing some moisture in the subsoil.

Rule of thumb: Overall, sub-tropical grass pastures with a high plant density can be expected to produce in the order of 20 to 30 kg/ha DM per mm of rainfall over the summer-early autumn period (assuming rainfall events of >20 mm over 7 days). For example, 35 mm over three days should produce between 700 to 1050 kg/ha of DM if there is a good perennial plant density.

Rainfall Deciles 1, 5 and 9 by month for Badgingarra

<table>
<thead>
<tr>
<th>Decile</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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<tbody>
<tr>
<td>1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.2</td>
<td>5.2</td>
<td>21.3</td>
<td>35.0</td>
<td>50.2</td>
<td>48.7</td>
<td>20.7</td>
<td>9.4</td>
<td>2.2</td>
<td>0.4</td>
</tr>
<tr>
<td>5</td>
<td>2.2</td>
<td>6.1</td>
<td>9.4</td>
<td>20.6</td>
<td>63.0</td>
<td>104.8</td>
<td>104.3</td>
<td>83.9</td>
<td>53.0</td>
<td>28.2</td>
<td>13.5</td>
<td>3.5</td>
</tr>
<tr>
<td>9</td>
<td>31.5</td>
<td>35.7</td>
<td>47.2</td>
<td>59.6</td>
<td>128.6</td>
<td>180.3</td>
<td>161.8</td>
<td>120.2</td>
<td>76.8</td>
<td>59.4</td>
<td>41.9</td>
<td>26.5</td>
</tr>
</tbody>
</table>

Nov to Apr rain:
Decile 1 = 10mm = ~200 to 300 kg/ha pasture growth @ 20 to 30 kg/ha per mm
Decile 5 = 45mm = ~900 to 1350 kg/ha
Decile 9 = 242mm = ~4850 to 7260 kg/ha
(v) Feed quality

The results to date show that the feed quality of sub-tropical grasses is stable through the year with only small seasonal fluctuations. The feed quality is generally suitable for at least maintaining weight over the summer-autumn period, if not growing animals slowly.

The annual pastures maintain very good to excellent feed quality during the growing season but after they have senesced the quality rapidly declines to low levels (<45% dry matter digestibility) which is inadequate for animals to maintain weight.

Within the growing season the feed quality of the sub-tropical grasses is lower than the annual pastures but it is still generally adequate to grow animals. However, outside the growing season the sub-tropical grasses maintain their quality and are suitable for maintaining weight and often suitable for growing animals slowly, while the annual pastures have low feed quality (inadequate to maintain weight) (Table 6).

Table 3: A summary of the feed quality of sub-tropical perennial grasses and annual pastures from the Q&Q sites in the northern agricultural region

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of samples</th>
<th>Crude protein % (av. ± SD)</th>
<th>Digestibility % (av. ± SD)</th>
<th>DMD high (%)</th>
<th>Low DMD (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Perennial grasses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signal grass</td>
<td>4</td>
<td>12.2 ± 1.2</td>
<td>68.2 ± 1.4</td>
<td>69.8</td>
<td>66.4</td>
</tr>
<tr>
<td>Katambora Rhodes</td>
<td>15</td>
<td>11.2 ± 2.6</td>
<td>62.0 ± 2.7</td>
<td>67.6</td>
<td>58.2</td>
</tr>
<tr>
<td>Green panic</td>
<td>15</td>
<td>14.3 ± 5.3</td>
<td>64.7 ± 4.7</td>
<td>73.0</td>
<td>58.0</td>
</tr>
<tr>
<td>Gatton panic</td>
<td>4</td>
<td>13.8 ± 6.7</td>
<td>70.3 ± 3.4</td>
<td>75.4</td>
<td>68.4</td>
</tr>
<tr>
<td>Callide Rhodes grass</td>
<td>15</td>
<td>11.8 ± 3.5</td>
<td>63.1 ± 3.6</td>
<td>69.9</td>
<td>55.7</td>
</tr>
<tr>
<td><strong>Annual pastures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safeguard ryegrass</td>
<td>12</td>
<td>8.2 ± 4.3</td>
<td>67.0 ± 15.0</td>
<td>89.7</td>
<td>42.0</td>
</tr>
<tr>
<td>Dalkeith sub. clover</td>
<td>8</td>
<td>18.6 ± 7.2</td>
<td>60.7 ± 18.3</td>
<td>79.7</td>
<td>38.6</td>
</tr>
<tr>
<td>Cadiz serradella</td>
<td>10</td>
<td>18.5 ± 8.2</td>
<td>69.9 ± 18.0</td>
<td>80.6</td>
<td>34.1</td>
</tr>
</tbody>
</table>
c) Grazing Cereals Trials

Aim:
To determine the grain yield penalty (if any) from grazing common WA cereal varieties

Method:
Small plot grazing cereals trials were conducted at Badgingarra, Mingenew and Dalwallinu in both 2006 and 2007. These were sown as per a normal crop in May or June. Grazing treatments were simulated using a lawnmower. The feed quality of the grazed dry matter was analysed. The crops were fertilised as per a normal crop and at maturity harvested with small plot headers.

Results:
Data from Mingenew and Badgingarra is presented. Drought conditions at Dalwallinu in both 2006 and 2007 resulted in those trials failing.

Table 4: Graze and grain yields from a range of cereal varieties in 2007 at Badgingarra

<table>
<thead>
<tr>
<th>Variety</th>
<th>Graze Yield (kg/ha)</th>
<th>Grain Yield (ton/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st graze 3 July 07</td>
<td>2nd graze 30 July 07</td>
</tr>
<tr>
<td>EGA Eagle Rock wheat</td>
<td>615</td>
<td>1609</td>
</tr>
<tr>
<td>Wyalkatchem wheat</td>
<td>724</td>
<td>1939</td>
</tr>
<tr>
<td>Baroota Wonder wheat</td>
<td>732</td>
<td>1856</td>
</tr>
<tr>
<td>Calingiri wheat</td>
<td>850</td>
<td>1202</td>
</tr>
<tr>
<td>Cereal Rye</td>
<td>910</td>
<td>1689</td>
</tr>
<tr>
<td>Carrolup oats</td>
<td>975</td>
<td>1574</td>
</tr>
<tr>
<td>Saia oats</td>
<td>1059</td>
<td>1688</td>
</tr>
<tr>
<td>Taipan oats</td>
<td>1120</td>
<td>2110</td>
</tr>
<tr>
<td>Pallinup oats</td>
<td>1529</td>
<td>1284</td>
</tr>
<tr>
<td>Monstress triticale</td>
<td>938</td>
<td>1422</td>
</tr>
<tr>
<td>Speedee triticale</td>
<td>1537</td>
<td>1165</td>
</tr>
<tr>
<td>Barque barley</td>
<td>1333</td>
<td>1673</td>
</tr>
<tr>
<td>Ryegrass/Cadiz serradella</td>
<td>792</td>
<td>1554</td>
</tr>
<tr>
<td>Volunteer pasture</td>
<td>2505</td>
<td>1856</td>
</tr>
</tbody>
</table>

The results from Badgingarra show how an early sown crop (May) that was grazed early (early July) will suffer no yield penalty.
Table 5: Graze and grain yields from a range of cereal varieties in 2007 at Mingenew

<table>
<thead>
<tr>
<th>Variety</th>
<th>Graze Yield (kg/ha)</th>
<th>Grain Yield (ton/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st graze 31 Jul 07</td>
<td>2nd graze 21 Aug 07</td>
</tr>
<tr>
<td>Wyalkatchem wheat</td>
<td>800</td>
<td>500</td>
</tr>
<tr>
<td>Pallinup oats</td>
<td>790</td>
<td>500</td>
</tr>
<tr>
<td>Speedee triticale</td>
<td>970</td>
<td>n/a</td>
</tr>
<tr>
<td>Barque barley</td>
<td>850</td>
<td>780</td>
</tr>
</tbody>
</table>

The results from Mingenew show how a later sown crop (June) that was grazed late (late July) will suffer a significant yield penalty.

All varieties had acceptable levels of Metabolisable Energy and Crude Protein when sampled for feed quality at the mid-winter grazing. They were the equivalent of good annual pasture at this time and would therefore produce good live weight gains in both sheep and cattle.

Full reports of these trials were published in the DAFWA Trials and Demo’s Booklet and in the Mingenew-Irwin Group’s Farming Systems booklet.

Figure 3: Sheep grazing cereals undersown with clover at Wongan Hills. Photo 31 Jul 07.
d) Demonstration Farms

Aim:
To determine the grazing value of perennial pastures on farms that had already adopted perennial pastures. The plan was to augment the replicated small plot trial data with real world data coming from the early adopters. This allowed us to collect whole farm grazing data (never done before), and to get a better feel for the value of traditional feed types such as annual pastures and crop stubbles.

Method:
We started out with 20 Demonstration farms (5 per grower group). In the end, we ended up with useful data from 13 of these farms. This data is generally for 3 whole years (March 2005 to February 2008).
Each farm was digitally mapped at the start of the project to calculate the area of each paddock. Paddock movements for all livestock on each farm were recorded. DSE ratings were assigned to each mob of livestock and regularly updated as live weight and physiological state changed. The level of supplementary feeding was recorded and accounted for when determining stocking rates. Paddocks with the same feed type were aggregated together to be analysed.
Subsequently, each feed type was analysed for the number of grazing days and stocking rate (DSE/ha) for each season (e.g. winter, spring, etc) over the 3 years. A full methodology appears in the “Key Findings” booklet.

The Demonstration Farms also hosted other research such as BIGG and the water use and nutrient leaching monitoring, and were used for field days.

Results:
Following is data from 3 of the Demo Farms. They demonstrate some of the key messages that emerged from all 13 farms. The results (with discussion) from all 13 Demo Farms can be found in the “Key Findings” booklet.

Bob and Anne Wilson, Lancelin

Bob and Anne Wilson operate a 2000 hectare grazing property east of Lancelin in the high rainfall, south west corner of the NAR. They run cattle, and changed from a mainly trading operation to a breeding dominant operation during 2006. Half the area was established to the fodder shrub tagasaste in the 1980’s and 90’s, while subtropical perennial grasses have been added since 2003.
Table 6: Bob Wilson grazing results by pasture type, from February 2005 to January 2008

<table>
<thead>
<tr>
<th>Pasture type</th>
<th>DSE / ha</th>
<th>DSE grazing days</th>
<th>Area (ha)</th>
<th>% of area</th>
<th>% of grazing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual volunteer</td>
<td>5.74</td>
<td>1,671,045</td>
<td>798</td>
<td>46</td>
<td>44</td>
</tr>
<tr>
<td>2005 Tagasaste</td>
<td>6.12</td>
<td>1,964,878</td>
<td>880</td>
<td>51</td>
<td>52</td>
</tr>
<tr>
<td>Perennial grass</td>
<td>5.55</td>
<td>125,514</td>
<td>62</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Annual volunteer</td>
<td>3.39</td>
<td>902,690</td>
<td>729</td>
<td>42</td>
<td>26</td>
</tr>
<tr>
<td>2006 Tagasaste</td>
<td>6.99</td>
<td>2,246,067</td>
<td>880</td>
<td>51</td>
<td>65</td>
</tr>
<tr>
<td>Perennial grass</td>
<td>6.94</td>
<td>332,020</td>
<td>131</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Annual volunteer</td>
<td>6.40</td>
<td>1,703,776</td>
<td>729</td>
<td>42</td>
<td>35</td>
</tr>
<tr>
<td>2007 Tagasaste</td>
<td>9.02</td>
<td>2,897,953</td>
<td>880</td>
<td>51</td>
<td>59</td>
</tr>
<tr>
<td>Perennial grass</td>
<td>6.69</td>
<td>319,714</td>
<td>131</td>
<td>8</td>
<td>6</td>
</tr>
</tbody>
</table>

This data highlights the value of the fodder shrub tagasaste and the relatively poor production from the annual pastures, especially during 2006.

Table 7: Bob and Anne Wilson, Lancelin, Seasonal stocking rates by pasture type, measured in DSE/ha

<table>
<thead>
<tr>
<th>Pasture type</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>autumn</td>
<td>winter</td>
<td>spring</td>
</tr>
<tr>
<td>Annual Volunteer</td>
<td>2.2</td>
<td>8.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Tagasaste</td>
<td>2.8</td>
<td>5.6</td>
<td>11.5</td>
</tr>
<tr>
<td>Perennial grass</td>
<td>6.4</td>
<td>5.1</td>
<td>6.4</td>
</tr>
</tbody>
</table>

This data highlights the value of the fodder shrub tagasaste in maintaining high stocking rates year round (especially from mid 2006 onwards when whole farm stock numbers were high). It also highlights the benefits of perennial grasses over annual pastures in the autumn following a wet summer/autumn (2006).
Alan and Joy Heitman, Mingenew

Alan and Joy Heitman operate a 2700ha mixed farming business at Mingenew. The better soil types are cropped to wheat, barley, oats and lupins and these are rotated with sub clover based pastures. The worst of the poorer unproductive cropping country was planted to tagasaste in the late 90’s while, more recently, perennial grasses have been sown on more marginal cropping paddocks. Both sheep and cattle are run.

Table 8: Alan and Joy Heitman, Mingenew, Grazing from different feed types

<table>
<thead>
<tr>
<th>Fodder</th>
<th>Dry Sheep Equivalents/Ha</th>
<th>Area in ha of each Pasture Type</th>
<th>% by Area</th>
<th>% by Grazing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>05/06 06/07 07/08</td>
<td>05/06 06/07 07/08</td>
<td>05/06 06/07 07/08</td>
<td>05/06 06/07 07/08</td>
</tr>
<tr>
<td>Annual Pasture</td>
<td>3.6 1.5 1.6</td>
<td>992 1276 969</td>
<td>39 41 38</td>
<td>46 40 37</td>
</tr>
<tr>
<td>Wheat Stubble</td>
<td>0.5 0.4 0.3</td>
<td>303 404 203</td>
<td>12 10 8</td>
<td>2 2 1</td>
</tr>
<tr>
<td>Barley Stubble</td>
<td>1.6 n/a n/a</td>
<td>258 n/a n/a</td>
<td>10 n/a n/a</td>
<td>5 n/a n/a</td>
</tr>
<tr>
<td>Lupin Stubble</td>
<td>0.7 0.4 0.4</td>
<td>304 102 613</td>
<td>12 3 24</td>
<td>3 1 5</td>
</tr>
<tr>
<td>Oats</td>
<td>4.0 0.5 0.7</td>
<td>133 100 204</td>
<td>5 29 8</td>
<td>7 10 3</td>
</tr>
<tr>
<td>Tagasaste</td>
<td>5.9 4.8 5.1</td>
<td>364 364 364</td>
<td>14 12 14</td>
<td>27 36 43</td>
</tr>
<tr>
<td>New Perennial</td>
<td>2.8 n/a n/a</td>
<td>87 n/a n/a</td>
<td>3 n/a n/a</td>
<td>3 n/a n/a</td>
</tr>
<tr>
<td>Perennial Grass</td>
<td>5.9 2.8 2.5</td>
<td>96 183 183</td>
<td>4 6 7</td>
<td>7 10 10</td>
</tr>
</tbody>
</table>

This data shows just how productive tagasaste is for the Heitman’s. It only takes up 14% of the farm, but provides over one third of the farm’s grazing, and maintained a stocking rate of almost 5 DSE/ha right through 2 very dry years.

Table 9: Alan and Joy Heitman, Mingenew, Average stocking rate for each pasture type from June 2005 to February 2008

<table>
<thead>
<tr>
<th>Fodder</th>
<th>05/06</th>
<th>06/07</th>
<th>07/08</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Winter</td>
<td>Spring</td>
<td>Summer</td>
</tr>
<tr>
<td>Annual Pasture</td>
<td>6.6</td>
<td>6.2</td>
<td>0.5</td>
</tr>
<tr>
<td>Wheat Stubble</td>
<td>0.0</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Barley Stubble</td>
<td>0.0</td>
<td>0.8</td>
<td>3.0</td>
</tr>
<tr>
<td>Lupin Stubble</td>
<td>0.0</td>
<td>0.0</td>
<td>1.2</td>
</tr>
<tr>
<td>Oats</td>
<td>6.5</td>
<td>4.3</td>
<td>1.6</td>
</tr>
<tr>
<td>Tagasaste</td>
<td>6.2</td>
<td>4.8</td>
<td>8.4</td>
</tr>
<tr>
<td>Perennial Grass</td>
<td>7.5</td>
<td>9.9</td>
<td>4.0</td>
</tr>
</tbody>
</table>
Adrian and Fiona Brennan, Calingiri

Adrian and Fiona Brennan farm 3400ha at Calingiri in the south east corner of the NAR. It is a cropping dominant operation with 70% of land annually in crop, the majority of which is cereals. Merino sheep are run on the remaining pasture land which includes some saltland. Grazing cereals undersown with clovers have replaced lupins in the rotation in recent years. The grazing cereals are used exclusively for grazing with no intention of harvest. Their role is to boost the productivity of the sub clover based pastures.

Figure 4: DSE grazing days per pasture type from the Brennan farm, Calingiri

Table 10: Stocking rate by pasture by season from the Brennan farm, Calingiri

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Volunteer annuals</td>
<td>8.0</td>
<td>6.8</td>
<td>1.6</td>
<td>1.1</td>
<td>5.0</td>
<td>4.7</td>
<td>1.1</td>
<td>0.6</td>
<td>1.7</td>
<td>5.5</td>
<td>1.2</td>
</tr>
<tr>
<td>Crop stubbles</td>
<td>0.0</td>
<td>0.0</td>
<td>1.9</td>
<td>2.2</td>
<td>0.0</td>
<td>0.6</td>
<td>3.2</td>
<td>0.8</td>
<td>0.0</td>
<td>0.5</td>
<td>2.4</td>
</tr>
<tr>
<td>Lucerne &amp; wheat stubble</td>
<td>0.0</td>
<td>0.0</td>
<td>4.7</td>
<td>1.2</td>
<td>0.0</td>
<td>0.0</td>
<td>2.3</td>
<td>0.8</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Saltland pastures</td>
<td>0.0</td>
<td>0.2</td>
<td>0.0</td>
<td>0.1</td>
<td>1.1</td>
<td>0.2</td>
<td>0.1</td>
<td>0.3</td>
<td>0.7</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Saltland pastures &amp; grazing cereals/clover</td>
<td>1.7</td>
<td>2.0</td>
<td>1.1</td>
<td>1.3</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Grazing cereals &amp; clover</td>
<td>8.8</td>
<td>6.3</td>
<td>6.5</td>
<td>1.3</td>
<td>0.5</td>
<td>7.5</td>
<td>2.3</td>
<td>0.1</td>
<td>8.3</td>
<td>4.8</td>
<td>1.7</td>
</tr>
</tbody>
</table>
e) STEP economic analysis

Aim:

To determine the economic impacts of adopting perennial pastures and grazing cereals.

Method:

STEP (simulated transition economic planning) is an economic planning tool developed by DAFWA. It allows the economic impacts of a practise change to be assessed over a 10 year timeframe, incorporating cash flow issues resulting from the transition from the old farming system to the new one.

Each grower group worked closely with local growers and DAFWA economist Rob Grima to develop a “model” farm for their area. This model farm featured a representative mix of soil types and enterprises for the area, and included realistic grain yields, stocking rates, input costs and commodity prices.

The growers identified a number of new practises they wanted to assess. These were tested against the current farming system. Data from the research trials and Demonstration Farms was used to quantify the new practise.

Results:

Liebe Group:

The impact of adopting grazing cereals and saltbush was assessed by the Liebe Group.

By replacing volunteer pasture on the lower yielding soil types (e.g. sand over gravel) with grazing cereals during the pasture phase, whole farm profit was increased by $27,000. The main driver of this was an increased summer stocking rate, as the cereal crop was locked up after one grazing in winter and carried into summer as a standing fodder crop. This allowed an extra 1000 ewes to be run.

By replacing volunteer pasture on the salt flats with saltbush, whole farm profit was increased by $21,500. The main driver of this was an increased summer carrying capacity, as the saltbush significantly increased carrying capacity on this country and was stored up and only grazed in summer and autumn. This allowed an extra 600 ewes to be run.

Mingenew-Irwin Group:

The impact of adopting tagasaste and subtropical perennial grasses was assessed by the Mingenew-Irwin Group.
By planting the very worst poor sands on the farm to tagasaste, whole farm profit was increased by $5000. The main driver of this was an increased summer carrying capacity, as the tagasaste could support 6 DSE/ha over summer vs 0.5 DSE/ha for the volunteer pasture. This allowed an extra 75 breeding cows to be run.

By planting perennial grasses on the next worst soil type (a mixed sand), in addition to planting tagasaste on the worst soil, whole farm profit was only increased by $2000. The main driver of this was an increased summer carrying capacity. The reason this increase is less than the tagasaste only option, is that cropping is a more profitable option than livestock on the mixed sand soil type.

However, with rapidly rising input costs and the recent dry seasons, further analysis is needed to assess the relative economics of cropping and livestock from perennial pastures on these marginal for cropping soil types.

Victoria Plains:

The impact of adopting grazing cereals and saltbush was assessed by the Victoria Plains group.

By replacing volunteer annual pastures with grazing cereals on all paddocks in the pasture phase of the rotation, whole farm profit deceased by $6000 when stocking rates were increased by approx. 15%, and only increased by $1000 when stocking rates were increased by approx. 30%. This is due to the extra cost of fuel and seed needed to sow grazing cereals. The volunteer pastures they replaced had lower stocking rates but had no fuel and seed costs.

By replacing volunteer pasture on the salt flats with saltbush, whole farm profit was increased by 10%. The main driver was an increase in both summer and winter carrying capacity, allowing an increase in ewe numbers.

Detailed reports on the STEP analysis can be found in the “Key Findings” booklet.
f) Water use of perennial pastures

Total water extraction under perennial grass pastures is greater than under an annual system.

Six sites located between latitude 28°S and 31°S on deep, free-draining sands were monitored for seasonal soil water changes under sown perennial and annual pastures, using the neutron moisture meter (NMM) technique over three years. As perennial shrubs may extract water to depths of over 5 metres, calibration of subsoils was achieved indirectly, using the seasonally lowest soil water values within the known root zone as the wilting point and the highest soil water values as the drained upper limit for calibration. This is a winter-dominant rainfall region. Soils wetted up from June to August, and dried down thereafter till the following autumn rains (varying between May to July). In the past thirty years local climates have become warmer and winter rainfall less. These conditions favour a change to perennial rather than annual pasture species. As the monitoring period coincided with drier than average years, there was an overall downward trend in total soil water storage from the starting date at most sites and treatments. This dry period provided an opportunity to document the water requirements and grazing regimes needed for perennial pasture survival. Total plant water extraction was least under annual pastures, greater in perennial pastures, greater still under tagasaste (*Chaemecytisus palmensis*), and greatest under native *Banksia* heath. Some evidence suggested the woody shrubs were capable of extracting water >9m, and perennial pastures to >4.5m. Perennial grass and lucerne pastures have survived on as little as 130mm in a year on these deep sands where roots can extract water from these depths.

![Figure 5: Preliminary results from the northern most property of the six monitored, Carson’s of Binnu. Showing total water in the soil profile to a depth of 4.75m, in each of an annual and perennial pasture, remnant vegetation and between rows and within row of tagasaste, from December 2005 to March 2008.](image-url)
During this period perennial grass pasture utilises 402 mm more water than an annual system.

Perennial grasses access water from a greater depth of soil than an annual system. Therefore using more water in the profile and having a greater impact on lowering recharge. Perennial grasses have potential to reduce rate of soil loss to water logging and salinity thereby improving farm health. Current gaps exist in understanding soil water content of perennial grasses during a wetter than average season. To date all sampling and calibrations have taken place during the driest two seasons on record.

Funding for this monitoring has been extended to December 2008 so that another season’s worth of rainfall movement can be recorded.

A full report on the NRM aspects of perennial pastures will be published by DAFWA in December 2008.
g) Nutrient leaching under perennial pastures

Preliminary results from New Norcia and Mingenew indicate that perennial C4 grass pastures can use significantly more soil water and capture greater amounts of nitrate when compared to annual pastures and tagasaste.

In this research the volume and fluxes of water, and NO3 leaching through, and beyond, the root-zone (1.6m depth) were assessed. Drainage was measured and calculated based on rainfall, evapotranspiration and change in soil water content to a depth of 5.5m.

The amount of NO3 in soil at the start of the season was affected by previous crops and pastures. NO3 was found to be lowered more under the perennial grasses than annual pastures and tagasastes.

This trial is being continued to enable a much clearer picture of the quantity of Nitrate leaching under annual pasture, perennial grass and tagasaste

There are lower levels of nitrate loss under perennial pastures when compared to an annual system or tagasaste pasture.

![Figure 7: Map of NO3 concentration down the soil profile beneath an annual, perennial and Tagasaste system. A snapshot in time, on the 14th September 2007. Note the greater concentration of NO3 in the annual system when compared to the perennial grass.](image)

Changes in soil nitrate are the result of a) leaching due to rainfall exceeding evapotranspiration, b) uptake of nitrate by the plants and c) input of Nitrate from the decomposition of organic matter. Figure (X) shows the soil nitrate-N under
three different pastures. Total soil Nitrate levels are lower under perennial grasses compared to annual pasture and tagasaste. In general loss of NO$_3$ is twice as great beneath annual pastures compared to tagasaste and perennial pastures. The magnitude of leaching losses is affected by level and timing of rainfall. Nitrate leaching losses below 1.4m increase during January and February on all pastures due to the frequent heavy rainfall resulting in drainage of soil water down the profile. Perennial grasses have the ability to use the most water in the months of summer and greater ability to uptake nitrogen at this time.

A full report on the NRM aspects of perennial pastures will be published by DAFWA in December 2008.

Figure 8: Annual pasture (foreground) suffers from wind erosion while perennial pasture (background) provides both ground cover and feed for livestock following a summer rain event. Photo 29 Feb 08.
h) Soil erosion with perennial pastures

Perennial grasses, correctly sown and established, have the ability to reduce total area of soil exposed to erosion in the northern agricultural region.

The first summer after sowing perennial grass, the establishment phase, poses greatest risk to soil loss through erosion. To establish a perennial grass in the NAR requires soil temperatures above 15°, moist soil within the top 10mm of the soil surface and no competition from mature plants. This requires sowing during early – mid spring after a non selective knockdown with follow up rain after sowing. The greatest risk for perennial grasses contributing to an erosion event occurs during the first summer following sowing when plants are small and there is little vegetation for ground cover.

When compared to the years prior to sowing perennial grass total farm area exposed to erosion reduces in the second and subsequent years after establishment. The speed that this occurs relates strongly to the region in which it is sown. For purposes of analysis the northern agricultural region was broken into three regions, Binnu, Irwin and Badgingarra. These regions equate to three different climate zones. In terms of climate and rainfall, Binnu has the longest summer and lowest rainfall, Badgingarra has the longest winter and highest rainfall while Irwin sits between these two.

Table 11: The normalised mean area of total exposed soil for each region and years since perennial grass was established. The SED and LSD are to be used when comparing the 1-5 years of perennial grass with 0 years of perennial grass.

<table>
<thead>
<tr>
<th>Region</th>
<th>Total Years of perennial grass</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Binnu</td>
<td>18.40</td>
</tr>
<tr>
<td>Irwin</td>
<td>9.75</td>
</tr>
<tr>
<td>Badgingarra</td>
<td>7.00</td>
</tr>
<tr>
<td>SED</td>
<td>2.7</td>
</tr>
<tr>
<td>LSD</td>
<td>5.4</td>
</tr>
</tbody>
</table>

Growers have adopted minimum tillage sowing techniques to prevent erosion susceptibility. 70 growers attended a workshop held at the Perennial Pastures Field day, 31st March 2008, focusing solely on machinery modifications for sowing perennial pastures. Improvements to sowing techniques continues throughout the region.

A full report on the NRM aspects of perennial pastures will be published by DAFWA in December 2008.
i) Weed potential of perennial pastures

The sub-tropical perennial grass species sown in the NAR for pasture were not found as paddock ‘escapees’ in any remnant vegetation. Of the 20 surveys conducted in remnant vegetation during the Biodiversity in Grain and Graze project no perennial grass species, of interest to this project, were found.

Numerous individual plants of Gatton panic (*Megathyrsus maximus*), Signal grass (*Urochloa decumbens*) and Rhodes grass (*Chloris gayana*) were identified established on road verges. The bare soil as found on road verges assists in establishment of an invading perennial grass as there is no competition for resources. Neither persistence nor growth of these findings has been noted after detection.

From the herbicide efficacy trial conducted it can be concluded that herbicides cannot be solely relied upon for control of perennial grasses. Cultural methods, tillage or burning or grazing for example, are necessary to be used in conjunction with herbicides for complete control of the grass.

A logarithmic sprayer was used to isolate efficacy of nine grass selective and non selective herbicides. Definitive, statistically significant results were not achieved for any one herbicide given the patchiness, almost randomness, of grass emergence. The following observations were made for future research.

Signal grass proved most susceptible to herbicide control. It showed the greater damage at lower herbicide rates. Gatton panic the least susceptible to herbicide control. It showed low damage and earliest regrowth.

**Table 12: Herbicides tested using a logarithmic sprayer. Observations taken at high, medium and low herbicide rate in trial plot.**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Herbicide</th>
<th>Rate in L/ha or kg/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>High</td>
</tr>
<tr>
<td>1</td>
<td>Basta</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Roundup ct</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>SpraySeed</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Simazine</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Atrazine</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>Fusion super</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>Velpar</td>
<td>50</td>
</tr>
<tr>
<td>9</td>
<td>Select</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td>Verdict</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>Roundup Power Max</td>
<td>10</td>
</tr>
<tr>
<td>12</td>
<td>Simazine + Roundup Power Max</td>
<td>10</td>
</tr>
<tr>
<td>13</td>
<td>Roundup CT + LI</td>
<td>10</td>
</tr>
<tr>
<td>14</td>
<td>Roundup CT + SoA + LI</td>
<td>10</td>
</tr>
</tbody>
</table>
Table 13: The minimum rates required by the herbicide treatments in Table 12 (above) to give suppression of grass species.

<table>
<thead>
<tr>
<th>Species</th>
<th>Rate of treatment giving suppression</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Gatton panic (<em>Megathyrsus maximus</em>)</td>
<td>13</td>
</tr>
<tr>
<td>Rhodes grass (<em>Chloris gayana</em>)</td>
<td>13, 14, 11, 3</td>
</tr>
<tr>
<td>Signal grass (<em>Urochloa decumbens</em>)</td>
<td>14, 13, 10, 8, 3, 1</td>
</tr>
<tr>
<td>Bambatsi panic (<em>Panicum coloratum</em>)</td>
<td>NA</td>
</tr>
</tbody>
</table>

Further work is required to find optimum, economic spray rates for each of the herbicides showing potential for perennial grass control. These techniques will be adopted by local agencies responsible for control of road verge weeds provided cost can be established.

A full report on the NRM aspects of perennial pastures will be published by DAFWA in December 2008.

Figure 9: A Grain and Graze field day at the Irwin perennial pasture Q&Q trial site
j) Change on farm activities

Field Days / Bus Tours

Each grower group run a number of field days and bus tours as part of the Grain and Graze project. They helped producers learn about Grain and Graze research findings and to visit other farms to discuss the on-ground application.

Newsletters

The Grower Groups involved in Grain and Graze all produced quarterly newsletters. Grain and Graze research results, case studies and activity reports regularly featured in these Newsletters.

Case Studies

Two case studies were written about each of the 13 Demonstration Farms. These were added to the grower group websites, printed in the grower group newsletters and formed a large section in the final “Key Results” booklet.

Seminars

The Evergreen Farming group ran three “Pasture for Profit” seminars during the Grain and Graze era. All three featured Grain and Graze topics which were often presented by speakers from other G&G regions across Australia. Cam Nicholson from Corangamite spoke on IPM and the Practise Change model, David Marsh from Central West spoke on Perennial Pastures, and Colin Seis from Central West spoke on Pasture Cropping.

The Liebe Group and DAFWA also ran 3 Grazing Cereals seminars featuring Leonard Vallance from the Mallee region, and Simon Falkiner and Nathan Scott from Corangamite.

Farm Weekly Page

7 Grain and Graze “Farm Weekly Pages” were published in Farm Weekly during the life of the Grain and Graze project. These highlighted research results, farmer case studies, and local activities. Each edition of Farm Weekly is read by over 11,000 rural Western Australians.

Perennial Pastures Booklet

Two versions of “Your Guide to Perennial Grasses in the Northern Agricultural Area” were produced during the Grain and Graze project. The latest version being an update of the first. 1000 copies of each booklet were produced and distributed to farmers in the region.
Key Findings Booklet

A booklet titled “Grain and Graze – key findings from research in the Northern Agricultural Region 2005 to 2008” was published in August 2008 and distributed to 1000 producers in the region. This 130 page booklet contained all the Demonstration Farm grazing records analysis, case studies, discussion papers and economic analysis.

Audio CD’s

Three Audio CD’s were produced and distributed with the Key Findings booklet to 1000 producers in the region. In addition, another 1000 copies of 2 of the CD’s were sent to the other regions in Australia for distribution. The CD’s were titled “Talking… Perennial Pastures” (interviews with farmers who have adopted perennial pastures), “Talking… Decision Making” (a joint project with Nigel McGuckian featuring interviews with farmers discussing how they make decisions), and “Grain and Graze Snapshots” (interviews with farmers from around Australia who have adopted practises promoted by Grain and Graze).

Agronomists Update

The project held one update meeting for agronomists and farm consultants in February 2007. Research findings were presented and discussed and Nigel McGuckian stimulated thinking about farmer decision and the type of advice given by agronomists and how it is used by farmers.

Figure 10: Mingenew-Irwin Group farmers discussing tagasaste at a Grain & Graze field day
k) Decision Support Tool

The development of a decision support tool for growers and their advisors was outsourced to local farm management and agronomic consultant Richard Quinlan, of Planfarm, Geraldton. This was done in early 2008, once the majority of the research data had been collected.

The aim of the Decision Support Tool is to help producers and their advisors quickly decide if Grain and Graze technologies are suitable for their business. And, if they are, provide them with links to further sources of information.

Richard attended the Stakeholder Forum in April 2008 at Jurien Bay where all the project findings were presented and discussed. He then went about putting the key practise changes into a decision making framework.

The Decision Support Tool will be web based, and housed on the Mingenew-Irwin Group website. It will contain links to further sources of information, and be easy to update. It is still in production and will be posted on the web in October 2008.

The DST will be an important additional tool to growers considering the adoption of practises such as perennial grasses and grazing cereals.

Cattle patiently waiting to be moved at Joe de Pledge’s Grain & Graze Demonstration Farm at Badgingarra. Photo 1 Feb 06.
4. WHAT DO THE RESULTS MEAN FOR HOW WE MANAGE MIXED FARMS?

Sub-Tropical Perennial Grasses

We now know that sub-tropical perennial grasses are a sustainable addition to NAR farming systems. Data from this project confirms their ability to lengthen the growing season, provide out of season green feed, reduce the need for supplementary feeding, use considerable soil water, slow nitrate leaching and reduce erosion.

We have also confirmed that they are most suited to the sandy soils of the higher rainfall western half of the NAR. Low production and difficulties with establishment limit their suitability in the lower rainfall eastern half of the NAR.

Farmers now have confidence to remove poor sandy soil types from traditional crop : annual pasture rotations and sow them to perennial grasses. This helps both crop and livestock enterprises as both were relatively unprofitable on these soil types. Cropping is now focussed on better soil types (e.g. gravel) where yields are consistently higher.

Gatton Panic and Rhodes Grass are the standout species based on both trial results and on-farm experience. Gatton Panic is the more persistent species and is likely to become the dominant species over time. Rhodes grass is easier to establish and can rapidly compensate from a poor establishment. Signal Grass is often added as a minor component in a mix because it has a large seed size and can germinate from depth.

Commercial seed mixes (shaped by this research) that comprise these 3 key species have been available to growers since 2007.

The recent development of highly reliable establishment methods has also significantly reduced one of the major risks faced by growers – establishment failure.

The results suggest the sub-tropical perennial grasses are more consistent year to year relative to annual pastures. They produced more than annuals during the “drought” years of 2006 and 2007 but less during 2005 (an average year). This is in addition to their more even growth pattern throughout the year. This smoothing of the feed profile (reducing the size of peaks and troughs) both between season and between years may assist growers in managing feed supply risk.

It is apparent that sub-tropical grasses, even with their summer activity, do not reliably provide large amounts of summer and autumn grazing. This is due to the unreliability of summer and autumn rain in the NAR.
Based on Grain and Graze research, a rule of thumb for “out of season” production by sub-tropical perennial grasses has been developed: 20 to 30 kg/ha of dry matter will be produced per mm of summer rain (for rain events > 20mm). So, a 50mm summer rain event will produce between 1000 and 1500 kg/ha of green feed.

Median November to April rainfall for Badgingarra and Geraldton suggests that approx. 1 ton/ha of out of season feed would be produced in a typical summer. In a very dry summer there would be minimal feed produced, while in a wet summer there could be up to 5 ton/ha of out of season feed produced.

Even though the summer / autumn production from sub-tropical perennial grasses is unreliable and unpredictable, it is still very valuable when it occurs. Summer rainfall events significantly reduce both the quantity and quality of dry annual pasture and crop stubble, leading to a reduction in livestock performance and the need for greater hay and grain supplementation. This equation is turned around with a sub-tropical perennial grass pasture, with greater livestock production and the need for fewer supplements when out of season rain occurs.

There are potentially two ways farmers can respond to this new feed supply. One is to increase stocking rate to make use of this extra feed. But given the unpredictability of this summer and autumn feed, supplementation would still be needed in many years. The other response is to replace current supplementation with feed produced by the perennial pastures. Stocking rate would stay at current levels. This would reduce the labour demands of the livestock enterprise, and also reduce the exposure to high hay and grain prices. Some supplementation would still be needed in the worst 20% of years, but much less than traditionally. In years with good summer and autumn rainfall, livestock production per head would increase and act as a buffer for poorer times ahead.

With a more variable climate a very real possibility in the future, the second response is likely to be increasingly adopted rather than the more traditional response of increasing stocking rate. Many producers have been “burnt” by the high input costs associated with drought feeding in their livestock enterprises over the last few years. Livestock are typically run to help reduce overall business risk, so increasing stocking rate and pursuing a similar high input / high risk approach as their cropping enterprise, without the potential returns from cropping, seems folly.

Anecdotal evidence suggests that the annual pasture component in sub-tropical perennial grass paddocks (they are never a mono-culture) improves over time. This is probably due to an improvement in soil fertility (from nutrient recycling and organic matter build-up) and a more stable soil surface.

This improvement produces extra feed in winter and spring, a time when the sub-tropical grasses are least active. We expect this to become more apparent over
time as many of the paddocks studied in this project were only a few years old and were yet to have a significant effect on soil fertility and stability.

All this suggests that sub-tropical perennial grasses will only partially fill the large autumn feed gap, and that other species (e.g. Tagasaste) or management practises (e.g. Trading of stock) are needed. It appears that the combination of trading stock and perennial pastures works well. Stock numbers are significantly increased during the winter and spring when pasture production is greatest and then rapidly reduced for summer and autumn. Perennials offer an extended growing season in which to trade stock, giving more flexibility in buy/sell date and a subsequent reduction in market risk.

The results from the Demonstration Farms (Wilson, Heitman and Forsyth) indicate that tagasaste is an excellent option to significantly increase year round carrying capacity on the very deep sands. Its ability to reliably support high stocking rates in summer and autumn gives it an advantage over the sub-tropical perennial grasses.

Tagasaste, however, does not grow well on shallow sands (overlying gravel and clay), and the perennial grasses are likely to be the better option on this soil type.

Tagasaste is well suited to cattle but less so for sheep, which does limit its scope.

Farmers are likely to use sub-tropical perennial grasses over the summer and autumn to support young, growing animals rather than older breeding animals. The green feed will allow weaner sheep and cattle to be grown out over summer at a lower cost than the alternative of supplementary feeding. The perennial pastures also contains high levels of Vitamin E, a common supplement for weaners grazing dry annual pastures and crop stubbles in the NAR. Reducing the need to supplement grain and Vitamin E will save not only money but also significantly labour.
**Pros and cons of sub-tropical perennial grasses:**

The table below outlines the positives and negatives of adopting subtropical perennial grasses in the NAR.

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater summer / autumn pasture prodn</td>
<td>Need for rotational grazing</td>
</tr>
<tr>
<td>Greater weight gain over summer / autumn</td>
<td>Need for smaller paddocks and larger mobs</td>
</tr>
<tr>
<td>Greater winter pasture prodn in poor years</td>
<td>Need for more stock water infrastructure</td>
</tr>
<tr>
<td>Higher year round stocking rates</td>
<td>Risk of establishment failure</td>
</tr>
<tr>
<td>Better annual pasture density and prodn</td>
<td>Cost of establishment</td>
</tr>
<tr>
<td>Higher water use</td>
<td>Need for specialised seeding machinery</td>
</tr>
<tr>
<td>More ground cover</td>
<td>Difficulty in returning to cropping</td>
</tr>
<tr>
<td>Recycling of nutrients from depth</td>
<td>Deeper water table (soaks dry up)</td>
</tr>
<tr>
<td>Less soil acidification</td>
<td></td>
</tr>
<tr>
<td>Less supplementary feeding</td>
<td></td>
</tr>
<tr>
<td>Less waterlogging and salinity</td>
<td></td>
</tr>
<tr>
<td>Less soil erosion</td>
<td></td>
</tr>
<tr>
<td>Less vitamin and mineral supplementation</td>
<td></td>
</tr>
<tr>
<td>Fewer broad leaf weeds</td>
<td></td>
</tr>
<tr>
<td>More soil organic matter</td>
<td></td>
</tr>
<tr>
<td>More “feel good factor” over summer</td>
<td></td>
</tr>
<tr>
<td>Less need for pasture renovation</td>
<td></td>
</tr>
<tr>
<td>Less ill thrift in weaners</td>
<td></td>
</tr>
<tr>
<td>More beneficial insects</td>
<td></td>
</tr>
</tbody>
</table>
**Grazing Cereals**

The data suggests grazing cereals have a significant fit with our production systems, especially in the lower rainfall areas. They will be utilised in a multitude of ways – as a replacement for volunteer pastures, to assist weed control, as a dual purpose graze/grain crop, conserved as hay, or grazed as a standing fodder crop. In most cases they will be used for early winter feed due to their rapid early growth.

Grazing cereals offer mixed farmers the chance to change crop : pasture mix within season. If pasture is in short supply, cereals can be grazed reducing the area of crop. Alternatively if pasture is abundant, cereals can be taken through to harvest with nil or minimal grazing. This flexibility may be a key to maximising profits in good years and minimising losses in bad years.

Further work is needed to better understand this innovative approach.

The cost of establishing the crop with high input prices is likely to limit this application and make feed produced from these crops expensive when compared to volunteer annual pasture.

The main benefit of grazing cereals is likely to be the improvement in annual pasture growth rates from the spelling they receive while the crop is being grazed. This has two effects. The first is greater seasonal production from the volunteer annual pasture which allows greater stocking rates to be carried. The other is, that by deferring, the Feed on Offer (kg/ha DM) of the volunteer annual pasture will be greater which will support greater per head productivity.

The proviso on the ability to increase stocking rate is that this is restricted to winter and spring. So if the enterprise is always constrained by summer / autumn feed then this issue will only be further exacerbated. A trading operation will be one way to utilise this extra winter and spring feed, without creating a large summer / autumn feed gap. Likewise, an increase in winter and spring feed is most likely to suit a farm with a high percentage of land in crop. Winter / spring stocking rates can be increased with the knowledge that a large amount of stubble is available in summer / autumn feed.

Grazing cereals does run the risk of exacerbating the late autumn / early winter feed gap because volunteer pastures are sprayed out and sown to a cereal crop. The feed from these paddocks is not available until at least 4 weeks after sowing. In years with a late break, there will be little grazing from cereal crops until early July. So, for a producer to increase whole farm stocking rate in expectation of using grazing cereals every winter, a provision for late break years would be essential.
Saltbush and other fodder shrubs could be particularly useful in reliably filling this late Autumn feed gap. Stock can be placed in areas of saltbush when the cropping program commences, and supplemented with some hay and grain. Lambing could also take place at this time, making use of this protected lambing environment. See Butcher Case Study.

Conversely, in years with an early autumn break and early sowing opportunities, extra paddocks could be sown to crop. Cereal crops could be then grazed in early winter to help carry the now higher than average stocking rate on annual pasture.

Compared to many regions in Australia, the window for grazing cereals in the NAR before a grain yield penalty is incurred is small. This is due to the short growing season. It is likely that grazing anytime after mid July would risk a yield penalty in most locations.

Another application for grazing cereals is to reduce the opportunity cost when sowing annual legumes such as sub-clover at the end of the crop phase. Typically newly establishing annual legume pastures carry only low stocking rates in their first year. Extra grazing value is generated when grazing cereals are sown with the clovers. The clovers are still able to set a large amount of seed, vital for the next few years of the pasture phase, if the cereals are heavily grazed in winter and early spring. This system is more applicable to the medium and high rainfall zone where annual clovers are still an integral part of the rotation.

Trial data suggests variety selection is not that critical and that many of the commonly used WA cereal varieties are suitable for grazing as well as grain. This is significant as it means seed is cheap and readily available.

It is apparent that one variety in particular, Pallinup Oats, is less palatable than other varieties. Farmers sowing Pallinup have observed that sheep preferentially graze the weeds first, avoiding the oats.

This selective grazing may provide an opportunity for novel in-crop grazing to be used to remove herbicide resistant radish and ryegrass from weedy paddocks. This could allow problem paddocks to remain in the crop rotation longer, rather than be taken out of the rotation prematurely because of weed resistance.

Further work is needed to demonstrate the practicalities of grazing weeds from crops destined for harvest.

The work of the Feedbase team on grazing cereals in the NAR clearly shows that grazing will often be more profitable than harvesting a crop on poor paddocks (where yield prospects are low) in low rainfall regions. The proviso is that young fast growing trading stock are used. This is a big “but” given the predominance of breeding flocks in the low rainfall regions.
Data from one of our Demonstration Farms showed that trade cattle (in this case light weight ex-pastoral bulls) can turn grazing cereals (and volunteer pastures) in the low rainfall wheatbelt into good profits. A live weight gain of 300 kg/ha was achieved in the 2005 growing season, albeit with very little surplus pasture at the end.

The increase in use of grazing cereals is a reflection of a partial failure of annual pasture legumes in our system. Annual legumes are still a vital component in our system providing feed for livestock and nitrogen for subsequent crops. But their low production both early in the season and in dry years and the difficulty faced cheaply removing certain weeds from them means their popularity is waning.

**Pros and Cons of Grazing Cereals:**

The table below outlines the positives and negatives of adopting grazing cereals in the NAR.

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Better annual pasture growth from deferral</td>
<td>Risk of yield penalty</td>
</tr>
<tr>
<td>Higher winter / spring stocking rates</td>
<td>Risk of soil compaction</td>
</tr>
<tr>
<td>Can change crop:pasture % within year</td>
<td>Scouring and dagginess in sheep</td>
</tr>
<tr>
<td>Reduce weed seed set (esp. radish)</td>
<td>Need for mineral supplementation</td>
</tr>
<tr>
<td>Less stubble</td>
<td>Need for bigger mobs or electric fencing</td>
</tr>
<tr>
<td>Less frost risk</td>
<td>Increased weed seed set (esp. ryegrass)</td>
</tr>
<tr>
<td>Lower worm burdens in stock</td>
<td>Less straw to bale or graze over summer</td>
</tr>
<tr>
<td>Less opportunity cost when sowing clovers</td>
<td>Uneven crop maturation if grazing uneven</td>
</tr>
<tr>
<td>Easy to adopt with existing varieties</td>
<td>Less flexibility with lambing time</td>
</tr>
<tr>
<td></td>
<td>Only suits early sown crops</td>
</tr>
<tr>
<td></td>
<td>Short grazing window before GS 30</td>
</tr>
<tr>
<td></td>
<td>Expensive pasture if crop isn’t harvested</td>
</tr>
</tbody>
</table>
5. TO WHAT EXTENT DID WE ACHIEVE WHAT WE INTENDED TO?

A survey of 17 NAR producers in early 2008 by the National Evaluation team found that:

- 47% of participants were testing sub-tropical perennial grasses and, on average, expect to sow 178ha each within 10 years
- 18% of participants were using sub-tropical perennial grasses and, on average, expect to sow 400ha each within 12 months.
- 18% of participants were unsure if they would sow sub-tropical perennial grasses
- 18% of participants have no intention of sowing sub-tropical perennial grasses
- 65% of participants said Grain and Graze played a role in their decision to sow sub-tropical perennial grasses
- 18% of participants were testing grazing cereals and, on average, expect to sow 400ha each within 10 years
- 47% of participants were using grazing cereals and, on average, expect to sow 350ha each within 10 years
- 12% of participants were researching the use of grazing cereals
- 18% of participants were unsure if they would sow grazing cereals
- 47% of participants said Grain and Graze played a role in their decision to sow grazing cereals

A survey of 41 Mingenew-Irwin Group producers in early 2008 found that:

- 94% of participants were aware of the Grain and Graze project
- 38% of participants had attended a Grain and Graze Field Day
- 29% of participants had already sown sub-tropical perennial grasses (average 188ha, range 15 to 360ha)
- 34% of participants plan to sow sub-tropical perennial grasses in the next 5 years (average 198ha, range 30 to 350ha)
- 32% of participants had already planted fodder shrubs (average 146ha, range 5 to 400ha)
- 29% of participants plan to plant fodder shrubs in the next 5 years (average 139ha, 4 to 300ha)
- 37% of participants had already planted grazing cereals (average 222ha, range 100 to 580ha)
- 39% of participants plan to sow grazing cereals in the next 5 years (average 400ha, range 100 to 1000ha)
- 44% of participants plan to use rotational grazing in the next 5 years
- 32% of participants plan to use agistment to better match feed supply and demand in the next 5 years
A survey of 26 Evergreen Farming Group producers in December 2007 found that:

- 88% of participants intend to sow perennial pastures in 2008
- 8% of participants intend to sow at least 500ha of perennial pastures each in 2008
- 16% of participants intend to sow between 100 and 500ha of perennial pastures each in 2008
- 31% of participants intend to sow between 50 and 100ha of perennial pastures each in 2008
- 38% of participants intend to sow between 10 and 50ha of perennial pastures each in 2008

A survey of 51 Liebe Group producers in February 2008 found that:

- 98% of participants were aware of the Grain and Graze project
- 45% of participants had planted saltbush over the last 4 years
- 14% of participants had sown sub-tropical perennial grasses over the last 4 years
- 49% of participants had not sown any perennial pastures or fodder shrubs over the last 4 years
- 59% of participants had sown oats as a grazing cereal over the last 4 years
- 22% of participants had sown barley as a grazing cereal over the last 4 years
- 8% of participants had sown triticale as a grazing cereal over the last 4 years
- only 16% of participants had not sown a grazing cereal over the last 4 years

These surveys, plus local knowledge and market information, suggest that at least 100 producers in the NAR have now adopted subtropical perennial grasses. We also know that a large number of people (estimated to be between 30 and 50) plan to sow subtropical perennial grasses for the first time in 2008. Similarly, most producers who have sowed perennial grasses in previous years, plan to sow more in coming years. Accurate, region wide data on this level of adoption is not available, but we believe the above local survey data (and sales data below) to be very indicative of the widespread adoption occurring.

A Geraldton based rural merchandise store (the largest seed supplier in the north of the NAR) supplied the project with sales figures of subtropical perennial grasses over the last 6 years. When converted to area sown, the below graph shows the exponential adoption that took place during the Grain and Graze project.
Estimated area of perennial pastures in the Mid West of WA

Quotes from NAR producers:

Craig Forsyth, Irwin

“We’ve gradually got bigger and bigger, sowing up to 160ha of perennial pastures each year.”

“The annuals actually improve under the perennial system. There’s a symbiosis.”

“The main advantage is we’ve got so much more ground cover.”

John Willmott, Eneabba

“We can keep our animals growing year round now with perennials. It’s great!”

“This year just gone, we’d normally use 1500 to 2000 rolls of hay, but only used 200. That’s a saving of $150,000!”
Don Nairn, Binnu

“The grazing cereals have replaced all the clovers and serradellas on the farm.”

“We’ll sow oats and wheat, graze them once in winter, and then leave them for standing fodder over summer.”

“We sow tagasaste on the worst parts of the farm, those not suitable for cropping, areas prone to wind erosion. I’ve been able to control the erosion completely.”

“I know where I want to go. And I know what I was doing in the past wasn’t working for me.”

David Steadman, Gingin

“We recognised that there is opportunity in this light country with perennial pastures”

“We can grow our stock a lot better without having to feed hay”.

Bob Wilson, Lancelin

“Tagasaste – it provides good high quality green feed for most of the year”

“It’s been quite interesting. We’ve had an amazing amount of out of season rain since first sowing subtropical perennial grasses. So they’ve been responding the whole way through.”

“Even when we’ve had dry summers, the perennials have given us a bit of feed in summer, especially if we rest them a bit.”
6. WHAT HAVE WE LEARNT AS PARTICIPANTS IN A HIGHLY COMPLEX PROJECT/PROGRAM?

The NAR regional project

Grain and Graze was seen as a very positive project for the region, and one that was highly owned by the grower groups. It was a first time many of these groups have worked in pastures and livestock. This allowed these groups to expand their knowledge base and to better service their farmer members. Good cross fertilisation of ideas occurred between the 4 grower groups, DAFWA and NACC.

We conducted some novel work which was fairly ambitious. This took time to get right. We went up a few blind alleys in the process. In hindsight, we should probably have been quicker to get some of the initial results out to industry (particularly from the Demonstration Farms).

Project management was under budgeted at only 0.2 FTE.

Splitting the NRM and production components achieved an end in terms of the funding timeframe but didn’t help in creating the most integrated project. Some staff changes at DAFWA did not help the NRM project deliver results early on.

NACC and NLP have invested heavily in the NRM component of the research. There was no way both production and NRM aspects of perennials could have been thoroughly investigated with just the Grain and Graze funds. We have had strong support from one of the NACC board members, and this personal interest greatly helped.

Overall, it was considered there was a good balance of activities covering the Triple Bottom Line. There could perhaps have been more survey work looking at the KASA (knowledge, attitude, skills, aspirations) of producers

The National project

Cross-fertilisation between different regions has been excellent. As a result, we have invited speakers from 4 other regions to present at Grain and Graze events in the NAR. The other regions have also had very useful ideas and techniques that we picked up on and utilised.

In hindsight, we think that the National Research Projects should have focused solely on assisting the regional projects rather than also having to answer a research question of their own. These research questions were so broad that the answers ended up too generic to be of great use.
It would be useful to know what the rate of adoption of principles that emanate from such “national” research is.

Having the expertise and critical nature of the National Research teams available to more thoroughly analyse our systems would have been excellent.

Having said this, we did form useful relationships with the Social and Feedbase teams.

Conversely, we believe the National Extension Coordinator needed to take a more strategic approach in identifying common issues and opportunities from across the regions to champion and promote.