Final report

PDS – Restoring pasture productivity in the Northern Tablelands of NSW

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Abstract

The Northern Tablelands Pastures Group (NTPG) established this PDS project – "Restoring pastures in the Northern Tablelands", to support producers recovering from the severe 2018 to 2020 drought. The drought resulted in extensive damage to pastures across the region, with potential long-term detrimental effects on productivity and profitability. At three demonstration sites, a control paddock and treatment paddock were monitored for changes in production of pastures and livestock, because of fodder cropping and pasture renovation strategies. Benefit: cost analysis demonstrated the financial return from these strategies. Excellent returns on investment were demonstrated from fodder cropping, fodder conservation and sowing of permanent temperate pasture. Throughout the project, producers attended pasture walks and skills development activities to build confidence and support practice change. Producers significantly increased their skills in pasture assessment, pasture and fodder crop agronomy, weed management, Benefit: cost analysis and assessment of weather predictions throughout the project. More than 50% of producers responding to the post project survey indicated practice change because of the project.

Executive summary

Background

The Northern Tablelands of NSW covers 3.12 m hectares and is home to 1,800 livestock producers. Over the period from 2018-2020, rainfall records for a large part of the region were the lowest on record (BOM) with most properties receiving less than 25% of average annual rainfall. The degradation and death of native and improved temperate pastures and weed invasion due to the prolonged drought, was predicted to have a lasting impact on future livestock productivity and profitability across the Northern Tablelands. Producers were faced with options for pasture renovation, both native and improved, as a dramatic shift in seasonal conditions provided an opportunity to refocus on the feedbase and its recovery.

This project was established in 2020 based on a perceived need to support producers on the Northern Tablelands to restore pasture productivity post one of the worst droughts from 2018-2020. The Northern Tablelands Pastures Group (NTPG) was formed by a small group of key producers and industry advisors, with GLENRAC Inc providing the project administration.

The focus of the project was on three demonstration properties situated at Wongwibinda, Dundee and Walcha (all within the Northern Tablelands). All three properties had unique differences in approach to drought recovery including summer cropping, silage conservation and traditional pasture improvement. The project attracted other observer producers through the membership of GLENRAC Inc and the NTPG, as well as a significant number of consultants and service providers from Local Land Services (LLS), NSW DPI, New England Weeds Authority, Southern New England Landcare (SNELC), DLF seeds, Elders, GrazAg, Nutrien Ag Solutions and private sector advisors.

Objectives

To demonstrate appropriate strategies for the use of fodder crops and renovation of improved temperate pastures to restore pasture productivity, longevity and resilience in livestock grazing enterprises after drought. Fifty percent of producers will adopt best practices pasture establishment and management techniques by the end of the project.

Strategies included:

- Assessment of pasture production potential
- Development of agronomy plans, accounting for weather predictions and climate outlooks
- Monitoring performance of pastures

Methodology

1. Three sites were established to demonstrate best practice in assessing the status of temperate pastures post drought and development of agronomic plans to restore pasture productivity and increase resilience to climate variability.
2. Each site had a control (no treatment) paddock as the benchmark to monitor changes in the quantity, quality, composition, benefit: cost and stocking rates in the treatment paddock.
3. A benefit: cost analysis for re-establishing pastures and sowing fodder crops post drought was undertaken.
4. Numerous skills development and training activities were conducted to increase the confidence of core and observer producers in assessing, restoring and monitoring pasture performance.

5. The project was able to partner with extensive public and private networks to extend the findings of the project across the Northern Tablelands

Results/key findings

The project demonstrated that pasture improvement, following drought on the Northern Tablelands is profitable and can result in threefold increases in stocking rate (5 DSE/ha to 15 DSE/ha), providing excellent returns on investment, particularly when pastures persist for longer periods of time. Fodder cropping prior to sowing pastures provides excellent returns as well as beneficial weed control in the lead up to permanent pastures. Benefit: cost analysis was significantly positive for two fodder crop trials. Corn silage was identified as a cost-effective method for conserving fodder in the Northern Tablelands and provides opportunities for weed control prior to sowing down permanent pastures.

The project faced significant challenges in delivery, associated with COVID-19 restrictions and extreme wet and dry conditions throughout the period 2020 to 2023. To maintain engagement with producers and meet their needs, the project worked with multiple partners across the region and provided additional training and skills development on a range of issues that were relevant to livestock production at the time, such as drought feeding and supplementation, weed identification, bloat management and animal health.

Project participants valued the PDS project and increased their skills in assessment of the productive potential of a pasture, development of agronomy plans and monitoring pasture performance.

Sixty four percent of post project survey respondents indicated they were changing practices because of the project.

Benefits to industry

The principles for profitable fodder cropping and pasture development demonstrated in this project, reinforced MLA's objectives to support profitable and sustainable grazing industries producing high quality red meat. The technologies demonstrated in this project are not new, but it was important to remind producers of the benefits as they came out of the worst drought in living memory and struggled with how to rebuild their livestock businesses, particularly when cash reserves and flow were low. Pasture renovation remains complex, although options for fodder crops and weed control were shown to have a significant impact on its success. Adoption remains a challenge across the industry; however this project was able to demonstrate increased levels of skills and adoption of new practices that will support producers as they navigate the increasingly variable climate.

Future research and recommendations

This PDS faced multiple challenges, with commencement significantly delayed by ongoing drought and COVID-19 restrictions, quickly followed by excessively wet conditions, floods and bushfires. All these challenges made accessing sites and hosting events difficult and many events had to be cancelled at short notice. Maintaining producer interest and engagement with the project was challenging.

To remain relevant to the audience and achieve reasonable attendance levels we adopted a flexible strategy and engaged with multiple partner organisations across the region to provide additional content and skills development at Pasture Walks and Field Days. This additional content focussed on

pressing issues at the time such as supplementary feeding, use of sexed semen and fixed time AI, early weaning in the dry and animal health in the wet conditions. Without this additional content we would have struggled to continue the project.

Whilst PDS projects aim to work with a small and stable group over an extended period, this was not our experience. The site hosts, project co-ordinators and 3-4 producers were regular attendees, the rest of the group membership changed constantly. In total 229 producers and advisors attended the 11 Pasture Walks, field days and seminars, but only 28 people attended more than 2 events, demonstrating the fluidity of the group.

This fluidity and changes in group membership made evaluation of practice change extremely difficult as the pre and post survey cohort were different and only a small proportion of producers responded in each instance.

Contracting, monitoring and evaluation, reporting and management of PDS projects is not simple and relatively constrained by the form of the contract. We believe the reporting requirements are beyond the capacity of producers without the support of an experienced consultant.

Our recommendation would be for MLA to review the PDS program to;

- Simplify the contracting, monitoring and reporting processes to make the program more accessible to producers
- Allow a more flexible approach to project delivery so that PDS projects can respond to regional industry needs as they arise across the year. The importance of this recommendation is re-enforced by the structured nature of most of MLA's other extension programs that have limited capacity to respond to industry issues and needs as they arise

PDS key data summary table

*Complete all sections of the key data summary table **applicable** to your project. Refer to the 'Engagement and Adoption Performance Metrics' section of your Agreement for key metrics that are nominated for your project.*

Project Aim:
To increase producer confidence in assessing, restoring and monitoring pasture performance. Fifty percent of participants will have adopted best practice pasture establishment and management by the end of the project.

	Comments		Unit
Production efficiency benefit (impact) Animal production efficiency - kg LWT/ha; kg LWT/DSE, AE or LSU Pasture productivity – kg DM/ha Stocking rate – DSE, AE or LSU/ha Reproductive efficiency – marking %, weaning % Mortality rate (%)	*Te-Angie demonstrated a 3-fold change in SR from 5 DSE to 15 DSE/ha on a year-round basis*	10	DSE/ha
Reduction in expenditure Reduction in labour i.e. DSE/FTE, LSU/FTE, AE/FTE; Reduction in other expenditure	NA	0	
Increase in income		$0.00	/ha
Additional costs (to achieve benefits)		$0.00	/ha
Net $ benefit (impact) Gross margin increase	Gross margin $62/DSE	**$620.00**	**/ha**
Number of core participants engaged in project		8	
Number of observer participants engaged in project		22	
Core group no. ha		6,600	
Observer group no. ha		18,172	
Core group no. sheep		8,458	hd sheep
Observer group no. sheep		23,261	hd sheep
Core group no. cattle		2,424	hd cattle
Observer group no. cattle		6,666	hd cattle
% change in knowledge, skill & confidence – core	*Best estimate See Table 8 and 9*	50%	
% change in knowledge, skill & confidence – observer	*Best estimate See Table 8 and 9*	50%	
% practice change adoption – core	*Best estimate*	50%	
% practice change adoption – observers	*Best estimate*	50%	
% of total ha managed that the benefit applies to	*Proportion of improved pasture from survey*	55-58 %	
Key impact data			
Net $ benefit /ha (impacted ha)	**$620.00/ha**		
Cost of production ($ / kg red meat)	**$1.88/kg red meat from fodder cropping phase**		

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1. Background

The Northern Tablelands of NSW covers 3.12 m hectares and is home to 1,800 livestock producers. The gross value of livestock production in the area is $600 million annually (ABARES). Over the period from 2018-2020, rainfall records for a large part of the region were the lowest on record (BOM) with most properties receiving less than 25% of average annual rainfall. That drought, coupled with above average summer temperatures resulted in overgrazing and degradation of native and improved temperate pastures, death of many improved temperate pastures, loss of mature tree canopies and unprecedented water shortages. Large scale destocking of both sheep and cattle occurred across the region.

The degradation and death of improved temperate pastures and weed invasion was predicted to have a lasting impact on future livestock productivity and profitability across the Northern Tablelands. Producers were faced with options for pasture renovation, both native and improved, as a dramatic shift in seasonal conditions provided an opportunity to refocus on the feedbase and its recovery.

Climate change is resulting in increased variability of temperature and rainfall and is having an impact on strategies for restoring and re-sowing pastures. This variability has increased the risks associated with re-sowing pastures or sowing short term fodder crops, which may fail to establish. Decisions about what pasture/fodder species and cultivars to sow are complex under a changing climate. The returns from pasture improvement in the Northern Tablelands are largely driven by successful establishment and retaining that pasture for more than 5-8 years. Species/cultivar choices, weed control, preparation techniques and planting strategies are multi-faceted and require considerable planning. Although the knowledge required is not new, and the technologies and practices have been developed and are commercially available to producers, there was still considerable gaps in producer knowledge and confidence.

This project was established in 2020 based on a perceived need to support producers on the Northern Tablelands to restore pasture productivity post one of the worst droughts from 2018-2020. The Northern Tablelands Pastures Group (NTPG) was formed by a small group of key producers and industry advisors, with GLENRAC Inc providing the project administration. The project had support from numerous partners including Northern Tablelands Local Land Services (LLS), NSW Department of Primary industry (DPI), DLF Seeds, Southern Australia Livestock Research Council (SALRC), Elders, GrazAg, Nutrien Ag Solutions, New England Weeds Authority, Southern New England Landcare (SNEL) and University of New England (UNE).

The focus of the project was on three demonstration properties situated at Wongwibinda, Dundee and Walcha (all within the Northern Tablelands). All three properties had unique differences in approach to drought recovery including summer cropping, silage conservation and traditional pasture improvement. The project attracted other observer producers through the membership of GLENRAC Inc and the NTPG, as well as a significant number of consultants and service providers from LLS, NSW DPI, New England Weeds Authority, SNEL, DLF seeds, Elders, GrazAg, Nutrien Ag Solutions and private sector advisors.

The project aims were to demonstrate best practice in

1. assessing the potential of drought impacted pastures
2. sowing short term fodder crops that are productive, and profitable and provide opportunities for weed control
3. restoring and re-sowing improved pastures

4. options for forage conservation

2. Objectives

By November 2025, in the Northern Tablelands of NSW;

1. Develop a novel Rapid Pasture Assessment Tool with experienced agronomists.

Objective 1 was achieved with the development of a Rapid Pasture Assessment Tool and Procedure with assistance from Carol Harris NSW DPI Glen Innes and private agronomist Mr Mick Duncan. The tool allows producers to quickly assess the productive potential of a paddock by sampling 10 sites for the percentage of sown grasses, volunteer grasses, native grasses, grass weeds, sown legumes, sown herbs, broadleaf weeds and groundcover. An average for the paddock can be simply calculated on the template. Appendix 6.1 contains a copy of the Rapid Pasture Assessment Tool and Procedure.

2. At up to 6 sites, demonstrate best practice in assessing the status of temperate pastures post drought and development of agronomic plans to restore pasture productivity and resilience to climate variability.

Objective 2 was achieved at the original 3 sites in the PDS. As per the protocol, 3 sites were established in 2020 and monitored until spring 2023. A decision was made to terminate the project in 2023 rather than continue with 3 new sites. At the 3 sites (Wongwibinda, Walcha and Dundee) the rapid assessment tool was used to make an initial assessment of each paddock. An agronomy plan was developed with the relevant agronomist for the region and the business and shared with project participants.

3. Using a control (no treatment) paddock (or part paddock) as the benchmark, monitor changes in the quantity, quality, composition, and stocking rate at the demonstration sites.

Objective 3 was achieved at 2 of the sites but not the 3rd. At Wongwibinda changes in stocking rate and animal performance were clearly demonstrated between the control and improved paddock. At Dundee the treatment paddock was sown with maize and made into silage to rebuild drought reserves. Pasture was sown down following harvesting of the maize, but there was a long delay as a consequence of wet conditions. At Walcha, an improved pasture was successfully sown in the treatment paddock but due to changes in ownership and management, the project lost access to the control paddock for comparison. Although at this site extensive pasture renovation occurred.

4. Conduct a benefit: cost analysis of the benefits of re-establishing pasture and sowing fodder crops post drought and identify the risks associated with establishment.

Objective 4 was achieved at 2 of the sites but not the 3rd. One case study and two benefit: cost analyses have been prepared for the Wongwibinda site and one case study and one benefit: cost for the Dundee site. Case studies and benefit: cost analyses are provided in Appendix 6.2.

5. Deliver 12 skills development and training activities (4 per site) each year, to increase the confidence of 12 core producers and 40 observer producers in assessing, restoring and monitoring pasture performance. Fifty percent of the core and observer producers will have adopted best practice pasture establishment and management techniques by the end of the project.

Objective 5 has been partially achieved with 11 skills development and training activities delivered to 229 core and observer producers between 2020 and 2023 (Section 4.3). This outcome has been achieved despite long periods when COVID-19 restrictions made face to face activities impossible and significant threats of both floods and bushfire which resulted in the cancellation of multiple events. Whilst there have been changes in practices as evidenced by the post-project survey (Section 4.4), it is unlikely that 50% of participants are now at best practice in terms of pasture establishment and management. Determining practice change is very difficult due to the fact that the core and observer producers have changed over the duration of the project. Of the 229 participants throughout the project, only 28 attended more than 2 project events. This issue is discussed further in Section 5.2. Our best estimate is that 50% of 28 participating producers have adopted best practice because of the project.

6. Extend the findings of the project to an additional 100 producers across the Northern Tablelands through annual field days at the demonstration sites and visits to other pasture research sites in the region. Increase the knowledge and skills of these producers in assessing pastures and developing agronomic plans for pasture restoration.

Objective 6 has been achieved with 144 producers and students increasing their skills and knowledge through access to annual field days and workshops supported or facilitated by the PDS project (Section 4.3). Field days were hosted at the UNE SMART Farms and DLF Research sites, and the Resilient Livestock Systems workshops reached producers at three locations – Walcha, Armidale and Glen Innes. This outcome has been achieved despite long periods when COVID restrictions made face to face activities impossible and clashes with other industry events which resulted in the cancellation of 3 events.

3. Demonstration Site Design

3.1 Methodology

At each demonstration site;

- a control and treatment paddock (or part paddock) was selected
- using the Rapid Pasture Assessment Tool developed for the project, the remnant pasture was assessed for species composition; weeds; ground cover, litter, green and dead components
- soil tests were taken

Using the information gathered, the host producer in consultation with their agronomist and project co-ordinators developed a plan for renovating the pasture. Across the 3 sites there was generally a common approach adopted.

Year 1 - Spraying out of existing pasture and sowing of one or two short-term fodder crops or annual pasture species (ryegrass) across summer and winter.

Year 2 - Permanent pasture was sown down. In some cases, the permanent sowing was delayed to Year 3 due to excessively wet conditions that occurred from autumn 2020 to 2022.

The agronomy plans included recommendations for species/cultivars, fertiliser, correction of soil ameliorants and weed control. Candidate species included perennial temperate grasses (eg cocksfoot, tall fescue, perennial ryegrass) and tropical grasses (eg rhodes and premier digit), annual and perennial legumes (eg white, red and sub clover, lucerne, serradella, biserrula) and deep-rooted broadleaf plants (eg plantain, chicory and brassicas). Fodder crop species for consideration included cereals, turnips, forage rape, millet, sorghum, maize and lucerne.

The selection of fodder crops and pasture species/cultivars sown was made by each host in consultation with their agronomist and the project co-ordinators.

Species sown were as follows;

Site	Fodder crop phase	Permanent pasture phase
Te-Angie Wongwibinda	Millet (summer) and Wheat (winter)	White, sub and red clover, Tall Fescue, Perennial Ryegrass, Cocksfoot, Phalaris, Plantain and Chicory
Bridgewater Dundee	Maize (summer)	Ryegrass, clover and brassica
Cairnie Walcha	Oats (winter)	Cocksfoot, fescue, plantain, perennial rye and clover

Once sown, each site was monitored to assess pasture production and composition on the control and treatment paddock. Records of livestock grazing the control and treatment paddock were kept demonstrating the productivity change because of the intervention. Where possible animal weights were also recorded before and after grazing, by the producer, and shared with the group.

Agronomy plans, soil test results and production data were shared with core and observer producers at each extension event.

3.2 Economic analysis

The project planned to prepare a case study and benefit: cost analysis for each of the 3 sites, using actual costs and changes in production (DSE/ha and kg meat produced/ha) between the control and treatment paddocks.

3.3 Extension and communication

A quarterly visit to each host site was planned throughout the project. In general, this was adhered to but was limited by COVID-19 restrictions, flooding rains and bushfire risks throughout the project. If a visit was not possible then the project team kept in touch with each host by phone. These contacts/visits were undertaken by either the project co-ordinators, Local Land Services staff or the host's agronomist.

For the first three years of the project the following extension and communication activities were planned.

- An annual field day at each site
- An annual producer update on the project
- Three case studies including benefit: cost analysis
- Project fact sheet

- Regular social media posts
- Promote field days at related research sites across the region
- Feedback article

3.4 Monitoring and evaluation

The following data was collected to inform monitoring and evaluation of project

- Pre and post surveys of core and observer producers to assess changes in demographics, production, knowledge, skills and practices
- Pasture assessment, stocking rate and livestock performance data at each host site to determine changes in productivity because of pasture improvement
- Soil testing for each host site
- Agronomy plans for each host site
- Numbers of producers and service providers engaging with the project events
- Key Performance Metrics
    - Productivity - Pasture (kg DM/ha), Stocking rate (DSE/ha) and Liveweight gain (kg/ha)
    - Profitability - Benefit: Cost Analysis
    - Environmental - Groundcover %

4. Results

4.1 Demonstration site results

Appendix 6.3 provides a record of all the agronomy, pasture assessment and animal performance data collected during the project.

In summary;

- At Te-Angie Wongwibinda, fodder cropping with millet produced 23,683 kg liveweight gain at a cost of $1.88/kg in addition to providing weed control prior to sowing down permanent pasture.
- At Te-Angie Wongwibinda, fodder cropping with winter wheat was disappointing due to late sowing and wet conditions which limited growth. Despite these unfavourable conditions the wheat produced 10,205 kg of liveweight gain in weaner cattle and carried 380 lambing ewes for 6 weeks and 47 calving cows for 7 weeks. In addition to this grazing performance, the winter crop provided another opportunity for weed control.
- At Te-Angie Wongwibinda permanent pastures sown down after the fodder cropping phases resulted in stocking rates ranging from 12 to 17.5 DSE/ha throughout the project compared to 5 DSE/ha for unimproved pasture in the control paddock.
- At Te-Angie Wongwibinda, a second paddock (75 ha) was fodder cropped with millet, producing 10,360 kg (1.09 kg/animal/day) of liveweight gain.
- At Bridgewater Dundee, maize was successfully grown and stored as silage at a cost of $133/dry tonne ($67/wet tonne), which compares favourably with the cost of purchased fodder during the drought. The silage yielded 19.5 t/ha dry (39 t/ha wet) Approximately 600

of the 900 tonnes of silage produced at the start of the PDS project was fed out during the dry winter of 2023.

- At Bridgewater Dundee the ryegrass, clover and brassica pasture, sown in March 2023 carried an average of 13.3 DSE/ha over the 12-month period to Feb 2024, an increase of approximately 8.3 DSE/ha on unimproved pastures in the district.

4.2 Economic analysis

For the Wongwibinda and Dundee sites all costs associated with the pasture improvement were recorded as well as changes in stocking rate, meat production and yields of silage. This data was used to prepare a benefit: cost analysis for the interventions undertaken. Two case studies and benefit: cost analysis were published during the project (Appendix 6.2.1 and 62.2). A third benefit: cost analysis for summer fodder cropping at Te-Angie Wongwibinda is provided in Appendix 6.2.3.

In summary;

- At Te-Angie Wongwibinda, the first millet phase returned a gross margin of $390/ha and a 126% return on investment in addition to weed control for later sowings
- At Te-Angie Wongwibinda, the winter wheat phase made a gross margin loss of $21/ha and a -7% return on investment and provided further weed control
- At Te-Angie Wongwibinda assuming the permanent pasture persists for 10 years it will return $588/ha/year and a return on investment of 436%
- At Te-Angie Wongwibinda, the second paddock of millet returned a gross margin of $319.26/ha and a 325% return on investment
- At Bridgewater Dundee, the corn silage yielded 19.5 dry tonnes per ha at a cost of $133 per dry tonne. A very favourable comparison to the cost of purchased fodder and an important drought reserve for the property. Much of the conserved silage was fed out on the property during the dry winter of 2023.

4.3 Extension and communication

Table 1 summarises the extension activities that were undertaken throughout the project. In total 13 skills development and training days were planned at the 3 host sites. Two events had to be cancelled, one due to flooding rains and the other due to a bushfire risk. In total 229 producers and service providers attended the 11 events that took place. Each event was promoted using an event notice that was distributed to the projects email distribution list by GLENRAC. Events were also promoted using the GLENRAC Facebook page and website and on occasions paid advertising in local newspapers. Post each event, photos and key messages were posted on the GLENRAC social media pages.

GLENRAC distributed 11 project newsletters to project participants via the email distribution list throughout the project. Copies of these newsletters can be linked below:

1) 10/16/2023 - Northern Tablelands Pastures Group - Wongwibinda Pasture Walk
2) 10/04/2023 - Northern Tablelands Pastures Group - October 2023 Newletter
3) 05/05/2023 - Northern Tablelands Pasture Group- May 2023 Newsletter
4) 03/07/2023 - Northern Tablelands Pasture Group- March 223 Newsletter
5) 01/31/2023 - Northern Tablelands Pasture Group- February 2023 Newsletter
6) 11/30/2022 - Northern Tablelands Pasture Group- December 2022 Newsletter
7) 11/01/2022 - Northern Tablelands Pasture Group- November Newsletter
8) 10/03/2022 - NTPG- Upcoming Pasture Walks
9) 09/12/2022 - Northern Tablelands Pasture Group- September 2022 Newsletter
10) 08/01/2022 - Northern Tablelands Pasture Group- August 2022 Newsletter
11) 05/18/2022 - NTPG Update - May 2022

An article was also produced for MLA's Feedback Magazine Winter 2023 edition Meat & Livestock Australia : Feedback Magazine : Winter 2023 by Meat... - Flipsnack or Feedback magazine | Meat & Livestock Australia (mla.com.au)

Table 1: Summary of skills development and training events at host sites

Event	Date	Location	Event	Key topics	Attendees
1	Oct 29 2020	Walcha – Cairnie	Pasture walk	Pasture biomass assessment Agronomy plans	15
2	Dec 9 2020	Wongwibinda – Te Angie	Pasture walk	Pasture biomass assessment Agronomy plans	20
3	April 28 2021	Wongwibinda – Te Angie	Pasture walk	Pasture biomass assessment Phosphorus requirements for pastures Returns from fertiliser Benefit:cost of weaner cattle on millet Ag360 Winter wheat sowing plans	14
4	May 20 2021	Dundee - Bridgewater	Pasture walk	Pasture biomass assessment	44

				The value of ground cover Interpreting soil tests Agronomy plans for degraded lucerne/grass pastures Results of chemical control for African Love Grass followed by direct drilling oats Calving intervals Supplementing stock with cereals	
5	Sept 2021	Zoom webinar	Project update	Remote event due to COVID restrictions 3 site updates provided by the hosts Weed control prior to sowing pastures Webinar recording distributed to all participants Link: Northern Tablelands Pasture Group - Spring Update on Vimeo	49
6	Nov 19 2021	Wongwibinda – Te Angie	Pasture walk	Demonstration site paddock inspections DLF fescue trial site inspection Selection of fescue varieties Bloat management Weed management	14
7	Nov 21 2021	Walcha – Cairnie	Pasture walk	Event cancelled at last minute due to flooding rains	-
8	Feb 21 2022	Dundee – Bridgewater	Pasture walk	Growing and making corn silage Estimated cost benefit of corn silage Inspection of African Love Grass paddock and corn crop Supplementation strategies for stock grazing African Love Grass and other poor-quality pasture Meat Standards Australia	18
9	May 27 2022	Wongwibinda – Te Angie	Pasture walk	Cost benefit analysis of 3 stages of pasture improvement Pasture inspection Southern New England Landcare activities	8
10	Oct 12 2022	Dundee – Bridgewater	Pasture walk	Results of corn silage and cost benefit Case Study Te Angie African Love Grass management	14

				New project opportunities with GLENRAC Weed identification Inspection of corn silage pit	
11	Oct 13 2022	Walcha – Cairnie	Pasture walk	Corn silage cost benefit Te-Angie case study Paddock inspection Water infrastructure and sheep yards inspection New project opportunities with GLENRAC Weed identification	16
12	Oct 23 2023	Wongwibinda – Te Angie	Pasture walk	Drought feeding Early weaning Animal health in dry times Drones for weed control Pasture inspection Event cut short by local bushfire	17
13	Mid Nov 2023	Dundee – Bridgewater	Pasture walk	Cancelled due to high bushfire risk	-
				Total attendees	229

Table 2 summarises additional industry engagement activities undertaken by the PDS project. Partnering with UNE SMART Farms, DLF Seeds and the Armidale Node of the SQNNNSW Innovation Hub, the project supported the delivery of 4 major industry field days and workshops attended by 92 producers. A further 3 major industry events had to be cancelled due to COVID and clashes with other industry events. The PDS project also hosted 3 producer groups and one group of students to visit project host sites and project participants and hear about pasture improvement strategies, drought resilience and enterprise performance. In total 144 producers and students attended these additional events supported by the PDS project.

Table 2: Summary of additional industry engagement activities undertaken by the PDS project

Event	Date	Location	Event	Key topics	Attendees
1	Nov 26 2020	UNE SMART Farms & DLF Seeds	Pasture Field Day	Pasture improvement strategies DLF pasture research trials Drought impacts on pastures	38
2	Spring 2021	NSW DPI Glen Innes Research Station	Field day	Event cancelled due to COVID restrictions	-
3	Spring 2021	UNE SMART Farms	Pasture walk	Event cancelled due to COVID restrictions	-
4	Spring 2022	UNE SMART Farms & DLF Seeds	Pasture walk	Cancelled when it was discovered that DLF Seeds were already hosting 3 pastures field days in the same month with Grazag, Elders and Nutrien Ag Solutions.	-
5-8	March 27,28 and 29 2023	Glen Innes, Walcha and Armidale	Resilient Livestock Systems Workshops	Complexity and interactions in livestock systems Effective Decision Making Feed demand and nutritional requirements Assessing pastures, feed budgeting and supplementation Pasture improvement options Animal health and preventing key diseases Weed control Backgrounding for feedlot entry	54
9	Feb 15 2023	Wongwibinda – Te Angie	Producer group visit	Visit by farmer group undertaking Farming Family Reboot training program	13
10	May 2 2023	Armidale	Better Beef Group	Visiting Victorian Better Beef Group. John Webb-Ware co-ordinator	12
11	May 2023	Uralla	UNE students farm visit	UNE students visited Gordon Williams a PDS group member to discuss grazing management, natural capital and profit margins	20
12	Aug 2 2023	Wongwibinda – Te Angie	Producer group visit	Visit by farmer group undertaking Farming Family Reboot training program	7
				Total attendees	144

4.4 Monitoring and evaluation

Despite the significant challenges associated with COVID-19, the weather, floods and bushfires, the project was able to achieve substantive engagement across the region with producers, agricultural students and associated service providers. The most significant impacts on the core and observer producer group were awareness and action to control weeds, fodder cropping, forage conservation and pasture renovation.

After the drought, weeds in the Northern Tablelands became very topical centred on the dramatic increase in African Love Grass, St John's Wort, Chilean Needle Grass, Serrated Tussock and Fireweed across the region. The identification and management options for the highly invasive weeds was a key issue for producers in addressing pasture productivity. These weeds have the potential to decrease stocking rates by as much as 80% in some areas.

Fodder conversation through silage production was highlighted at the Dundee site. The cost of sileage production ($133/t dry) was well below the costs of hay ($400 - $700/t) delivered in 2023. Several producers are now considering options for fodder conservation. Currently quoted values of $200-400 a tonne for purchased hay and silage make on-farm silage production and storage viable.

Pasture renovation remains one of the most variable activities that occur in Northern Tablelands. Despite solid information from this project, private agronomists still dominate pasture improvement and management decisions. The shot-gun approach to pasture species mixes for sowing is still the most widely accepted practice and potentially has merit with continuing climate variability across 2023/24 including an intense dry period from February 2023 to November 2023 followed by above average rainfall to June 2024.

Risk of pasture failure continues to be high and with lower livestock and wool prices the availability of cashflow to spend on pasture renovation is still limited. Notably the dry period in 2023 resulted in a significant destocking as producers were wary of the impact of a multiyear drought. Stocking rates have decreased as a result, and this combined with low prices resulted in the lamb enterprise being removed from the Te-Ange property with a higher focus on trade cattle to manage feed availability. The use of short-term summer crops as a component of pasture renovation, particularly for weed control has increased within the group.

Advice on pasture renovation continues to be very varied. At the Te-Ange site, recommended sowing rates ranged between 25-35kg of seed per ha. A small trial was conducted with a sowing rate of 14-18kg with no visible change in pasture density or viability. At seed costs of $15/kg this resulted in a 7-17kg/ha saving or between $105-255/ha.

4.4.1 Analysis of Pre and Post Project Surveys

Data from the Pre and Post Project Surveys is provided in Tables 3- 8 and discussed in this section. It is important to note that 13 producers completed the pre-project survey and 14 completed the post-project survey. A total of 18 replies were received to the post-project survey. Two of those responses were not suitable as not all questions had been answered and 2 respondents identified that they did not want data shared or collected and did not provide further information. That left a total of 14 viable responses to the post project survey.

It is important to note that the group of participants completing the pre- and post-project surveys are not identical and so the ability to compare pre and post behaviours and practice change is limited.

Despite 229 producers and service providers attending PDS pasture walk events between 2020 and 2023, only 28 participants attended more than 2 events. Membership of the group changed substantially throughout the project because of extremely challenging weather conditions and changing priorities. The project co-ordinators-maintained interest in the project by engaging with other local organisations and providing skills development activities relevant to producers at the time. Examples of topics covered include bloat management, weed management, heifer joining practices, early weaning, supplementation and fodder conservation.

Table 3 shows the demographic data for the two cohorts of survey respondents. The average property size between the pre- and post-survey cohort declined by 26% from 1,114 ha to 826 ha. The proportion of the property sown to improved pasture also declined from 55% to 40%. At both surveys more than 50% of respondents reported extensive or significant damage to improved and native pastures because of drought. Several producers indicated that they have still not recovered full pasture productivity since the drought broke. This is reflected in the changes in livestock numbers with breeder numbers and total numbers consistently lower post-drought than pre-drought. The post project survey indicated that total cattle and sheep numbers were down 36% and 24% respectively since the drought. Breeder numbers were also down, with the post project survey indicating a 50% decline in cows and a 15% decline in ewes.

Table 3 Demographic data from the pre and post surveys.

Indicator	**Pre-Survey** n = 13	**Post Survey** n = 14
Average property size (ha)	1,114	826
Average area of improved pasture (ha)	614	333
Average area of native pasture (ha)	437	479
Producers reporting extensive or significant damage to improved pastures during drought (%)	69	79
Producers reporting extensive or significant damage to native pastures during drought (%)	62	57
Producers carrying cattle (%)	69	100
Average number of cows pre-drought (Respondents with cattle)	169	190
Average number of cows post-drought (Respondents with cattle)	59	96
Total number of cattle pre drought (Respondents with cattle)	337	467
Total number of cattle post drought (Respondents with cattle)	181	303
Producers carrying sheep (%)	62	57
Average number of ewes pre-drought (Respondents with sheep)	1,919	1,353
Average number of ewes post-drought (Respondents with sheep)	1,737	1,156
Total number of sheep pre drought (Respondents with sheep)	3,700	2,426
Total number of sheep post drought (Respondents with sheep)	3,097	1,855

Table 4 describes what respondents considered to be the 3 most important factors in assessing the productive potential of a pasture. For both surveys current pasture biomass, species composition

and plant density were considered within the top 3 factors. Between the first and second surveys, ground cover shifted to being an important factor and stocking rate history dropped off the list, suggesting that respondents' understanding of the factors driving future pasture productivity had strengthened. It also highlighted the impact of drought on stocking rates with several producers adopting a more conservative approach.

Table 4: The three most important factors in assessing the productive potential of a pasture in Pre and Post Surveys (% of respondents)

Factor	Pre Rank 1	Pre Rank 2	Pre Rank 3		Post Rank 1	Post Rank 2	Post Rank 3
Current pasture biomass			27				29
Species composition	38				21	28	
Past rainfall events							
Stocking rate history		20					
Weed infestation							
Soil test results							
Plant density		30				35	
Ground cover					36		
Unsure							

Table 5 describes what respondents considered to be the three most important factors in selecting species and varieties for sowing. Between the first and second surveys there was a strong shift towards identifying soil type and grazing management practices as important factors in selections for pasture improvement, indicating that the project had been successful in building knowledge and skills around the importance of the having the right species in the right place and management for longevity. Experience with species and cultivars was also considered important. The drought impacted producer's perceptions, with commentary often received on the need for persistence over productivity.

Table 5: The three most important factors in selecting species/varieties to sow in Pre and Post Surveys (% of respondents)

Factor	Pre Rank 1	Pre Rank 2	Pre Rank 3		Post Rank 1	Post Rank 2	Post Rank 3
Soil types	18	10			46	43	
Pasture trial results from other regions							
Advertising for species/cultivars							
Information on future climate in the region							
Past experience with species/varieties	8		21		26		
Grazing management practices		15				29	35
Livestock enterprises and production objectives							
Prices for pasture seeds							
Unsure							

Table 6 describes what respondents considered to be the three most important factors in preparing a feed budget. Between the first and second surveys there was a decline in the number of producers selecting "Understanding the seasonal growth patterns of different pasture species" as the most important. Knowing the feed requirements of different livestock and taking account of the future weather forecast remained important factors. It was pleasing to note that exceeding 80% pasture utilisation did not rank in the top 3 factors in the post-project survey, which suggests that producers did respond to messages about long term sustainability and persistence.

Table 6: The three most important factors in preparing a feed budget for your property (% of respondents)

Factor	Pre Rank 1	Pre Rank 2	Pre Rank 3		Post Rank 1	Post Rank 2	Post Rank 3
Understanding the seasonal growth patterns of different pasture species	41				29		
Knowing the feed requirements of different livestock		38				36	
Lambing and calving to sell stock at peak prices							
The future weather forecast			28				29
Planning to use more than 80% of pasture grown in a year			20				
Maintaining all livestock on the property throughout the year							
Keeping stock in fat condition all year round							
Keeping stock evenly spread across all paddocks throughout the year							
Unsure							

Table 7 describes respondents confidence levels for assessing pastures and developing an agronomy plan in the pre- and post-project surveys. The average score for confidence assessing the productive potential of a pasture increased from 6 to 7.2. The average score for confidence in developing an agronomy plan increased from 6 to 7.4 These improvements in confidence levels reflect the project focus on teaching pasture assessment skills and agronomic planning skills at each project event. It also highlights the importance of having reputable trained agronomists or consultants assisting producers with pasture assessment skills.

Table 7: Producer confidence levels (Average out of 10)

	Pre Survey		Post Survey
Confidence in assessing the productive potential of a pasture	6		7.2
Confidence in developing an agronomy plan to increase pasture productivity	6		7.4

Table 8 describes respondents' practices and the change in practices between pre and post-project surveys.

It is encouraging to see;

- an increase in respondents making use of pasture assessment tools as either Normal Practice (13% change) or Sometimes (27% change)
- an increase in respondents making use of a weather forecast for feed budgeting as Normal Practice (34% change)
- an increase in respondents Sometimes using a feed budgeting tool (41% change)
- an increase in respondents Sometimes seeking agronomy advice (29% change)

The use of soil tests and an agronomy plan prior to applying fertiliser have not changed greatly. This may reflect the strong influence that local agronomists have on pasture renovation practices.

Consideration of climate variability in as Normal Practice for pasture selection seems to have declined between the two surveys (change 11%)

Table 8: Practice use for key agronomic tools used in pasture management – Pre and Post Surveys (% of respondents)

Use of practice	Assessment tool for pasture	Soil tests before applying fertiliser	Agronomy plan before sowing	Feed budgeting tool	Weather forecast for feed budgeting	Climate variability considered in selecting pasture species	Seek agronomy advice
Pre - Normal practice	8	38	69	23	23	54	54
Post – Normal practice	21	36	57	21	57	43	36
Pre - Sometimes	23	31	15	23	54	23	31
Post – Sometimes	50	43	21	64	36	36	50
Pre -Rarely	46	23	8	38	15	8	8
Post - Rarely	14	14	0	0	0	21	7
Pre – Never	23	8	8	15	8	8	8
Post – Never	14	7	21	14	7	0	0

Table 9: Assessment of skill levels by producers Pre and Post Surveys (% of respondents)

Practice	Pre – Good	Pre – Average	Pre – Poor		Post – Good	Post – Average	Post – Poor
Pasture assessment skills	33	58	8		71	21	7
Species identification & selection	33	42	25		43	57	0
Developing an agronomy plan	25	58	17		64	29	7
Animal requirements and feed budgeting	42	50	8		71	21	7
BCA of pasture improvement	50	17	33		64	29	7

Table 9 describes producers' assessment of their skill levels pre- and post-action project. There were substantive improvements in the ratings of pasture assessment (Good rating 38% change) and agronomy skills (Good rating 39% change) with most participants now having average or good skills. Ratings for species identification and selection (Good rating 10% increase) and cost benefit analysis (Good rating 14% change). BCA awareness is particularly important as it shows that participants valued the cost benefit approach used in case studies.

Nine of the fourteen respondents (64%) to the post-project survey indicated that they are making changes because of participation in the PDS. Producers are now implementing various strategies to manage the boom-bust rainfall cycle, including better identification of weeds and weed control, pasture improvement with fodder crops for weed control, using weather forecasts better and using drought-resilient species. Some producers were looking to expand their business by leasing or agistment and hence knowledge of variable pasture quality and quantity is very important. Silage production and conservation was a key outcome for some producers.

The average rating for value of the PDS in managing the livestock enterprise was 7.5/10. The lowest rating was 5 which was moderately useful. This shows that the PDS did have an impact, which was backed up by the 7.5/10 rating for the satisfaction with the PDS. The lowest score for satisfaction with the PDS was moderately satisfied from 2 respondents. All the 14 respondents to the second survey would recommend the MLA's PDS program to others which is an excellent outcome.

Respondents were invited to provide additional feedback. Additional comments can be summarised as;

- the focus should be on adoption impact rather than reporting.
- Financial returns from different strategies should be analysed to determine if optimising production at 80% maximum is better than always maximising production.

Ten out of the 14 respondents are available to be contacted by MLA.

5. Conclusion

The project clearly demonstrated the production and financial benefits resulting from fodder cropping and pasture improvement using temperate species on the Northern Tablelands, with up to three-fold increases in stocking rate and associated improvements in liveweight gain due to improved pasture quality. The opportunity to cost effectively build drought fodder reserves with corn silage was another clear outcome from the project. Across the project activities, participants'-built skills in pasture assessment, feed budgeting, developing agronomy plans, undertaking benefit: cost analysis and taking account of weather forecasts and climate outlooks in planning. Despite the

clear benefits from improving pasture productivity and building fodder reserves, broad scale adoption of pasture improvement and fodder cropping remain challenging.

5.1Key Findings

The key insights from the demonstration site activities are as follows;

- Fodder cropping in summer and winter provides an important weed control phase prior to sowing down permanent pasture and can also provide profitable returns in terms of stock rates and liveweight gain.
- Pasture improvement on the Northern Tablelands using temperate species results in threefold increases in stocking rate (5 DSE/ha to 15 DSE/ha), providing excellent return on investment particularly when pastures persist for longer periods of time. The improved pasture quality also results in increased weight gains and breeder condition scores.
- Corn silage is a cost-effective method for conserving fodder in the Northern Tablelands and provides opportunities for weed control prior to sowing down permanent pastures.
- Pasture productivity can be profitably restored following drought with good planning and preparation.

The key insights from the evaluation surveys (pre and post) are as follows:

- The impact of the 2018/19 drought on the productivity of improved pastures was rated as significant, while the impact on native pastures was rated as significant to very significant.
- Respondents increased their confidence in assessing the productive potential of a pasture and developing an agronomy plan because of the project.
- Most respondents answered "Yes" when asked if they would recommend the MLA's PDS program to others.
- The average rating for the value of the PDS program in assisting respondents to manage their livestock enterprise was 7.5 out of 10.
- The respondents increased their use of pasture assessment, agronomy plans and advice, feed budgeting and weather forecasts throughout the project.
- The respondents generally rated their use of assessment tools, soil tests, and agronomy plans in pasture management and improvement as well as their practice of taking account of weather forecasts and climate variability in feed budgeting as average to good after the project
- 64% of post project respondents indicated they were making changes to management because of the PDS project

5.2Benefits to industry

This project should be recognised for the engagement that occurred despite the challenges of COVID-19, weather variability, floods, fire and property ownership changes. A key element of this PDS' success was the ability to rapidly respond to changing producer requirements for information. Aspects such as weed control, weaner and heifer management, animal health and disease, MSA compliance, fodder conservation, fixed time artificial insemination with sexed semen all became key topics for the group, as they navigated the wildly variable seasonal conditions between 2020 and 2023. Having a multifaceted approach to field day content and access to high quality speakers through partner organisations was invaluable to the project.

To retain the interest of producer groups, future projects should focus on having flexibility to respond to high priority issues that emerge at the local level and developing partnerships that allow

additional expertise to be engaged in projects. The addition of multiple supporting partners across this project was a key element of its success. Examples of this include;

- engagement of New England Weeds Authority to raise awareness of major weed issues and control was highly valued and appreciated
- providing vital information on early weaning and supplementation was highly valued when seasonal conditions turned dry again in mid to late 2023
- providing information on bloat management post drought

The project was able to achieve strong practice change and improvements in skills. Weed identification and control became highly topical and relevant. The long-term impacts and management implications for weeds such as St John's Wort and Chilean Needle grass which have seed reserves that can stretch across decades, promoted producers to become much more engaged. The implications are that weed control and management should be elevated in most temperate pasture improvement programs to ensure long term pasture viability and stock health.

Pasture renovation remains complex. The addition of a summer fodder crops not only allows for more effective weed control but is also a valuable profit driver within the pasture renovation cycle. That additional cash flow was significant to the host producer and allowed the pasture renovation phase to continue (with confidence) despite a decline in stock prices.

A key challenge with this project was the number of competing events that other agencies provided across the project period. There are a vast number of agencies that are now 'competing' for producer's time not only in pasture management, but in areas such as genetics, NLIS compliance, carbon accounting, natural capital management, stock water management and drought preparedness. Coordination becomes difficult when those agencies have reporting and engagement targets to meet. Having the ability to rapidly respond to producer needs and expectations as well as seeking collaborative opportunities will be important in future PDS programs.

The complexity of project management and reporting was also a key issue that emerged in the generation of this final report. The project was fortunate to have experienced consultants that provided time in kind to complete the project reporting (50% of nominated daily rates). Producer groups that don't have access to outside help and the substantive extension and administrative support that GLENRAC provided would struggle to meet PDS project expectations.

2 Appendix

5.3 Rapid Pasture Assessment Tool

Downloadable version available here

Northern Pastures Group – Rapid Paddock Assessment

(Provided by Carol Harris – NSW DPI Glen Innes)

Paddock Assessment Procedure

In the allocated paddock(s)

1. Select a measurement transect across the paddock - ideally this transect should be marked in a physical way or by GPS so it can be located again down the track (this will be important in paddocks where pasture renovation strategies will used other than a complete re-sow). The easiest transect is corner to corner, but will depend on paddock variability – avoid areas that are obviously different i.e. stock camps, tracks, waterlogged areas etc.

2. Walk the transect stopping every 20-25 steps, each time you stop record the species groups present in a 50 X 50 cm square around your right toe. (Enter as % for each species group – each sampling point should add to 100%).

   At each point also assess groundcover and express in a %.

3. Repeat this process 10 times (maybe more times if paddock is very large or quiet variable i.e. two different aspects).

4. Before starting the assessment have a quick walk around and decide on the species that make up the species groupings eg Sown Grasses = tall fescue, cocksfoot. Grass weeds=Chilean needle grass, African lovegrass etc.

5. Total each column and then divide by 10 to get the average % for each species group and groundcover.

   Date: Paddock:

Sample No	Sown grasses %	Volunteer Grasses %	Native grasses %	Grass Weeds %	Sown Legume %	Sown Herbs %	Broadleaf Weeds %		Groundcover (%)
1									
2									
3									
4									
5									
6									
7									

2.1Case Studies and Benefit Cost Analysis

5.3.1 Te-Angie Case Study # 1.

Pasture improvement using fodder cropping for weed control ensures good returns

Richard and Kerryn Ogilvie moved from South Australia in 2013, when they purchased Te-Angie and Forest Lodge, near Ebor on the northern tablelands of NSW. Together with their son Michael and his partner Claire they run a Hereford stud, commercial Herefords, a composite prime lamb flock and trade cattle and lambs on 4,050 ha.

The soils across the properties are mixture of grey loams, light trap and basalt. The average annual rainfall is 1,000 mm.

The properties had historically been used for grazing fine wool Merinos with limited applications of superphosphate. The average stocking rate was 5 dse/ha.

Richard believed he could substantially improve the productivity of the property through a program of pasture improvement and associated application of fertiliser, using his cropping skills gained from farming in South Australia.

As part of the MLA funded Producer Demonstration Site program, we monitored the productivity and returns from a 120ha paddock through three phases of pasture improvement.

Phase 1 - The paddock was sprayed with Roundup, Cutless and insecticide in October 2020 and sown with millet in November 2020. The millet was grazed with trade cattle until the autumn of 2021.

Phase 2 – The paddock was sprayed out in autumn 2021 and sown with Bennett's Wheat. The wheat was grazed with cows and calves, ewes and lambs and trade cattle until spring 2021.

Phase 3 – The paddock was sprayed out again in spring 2021 and fallowed until January 2022 when it was sown with a mix of Tower Fescue, Prairie Grass, Holdfast Phalaris, Howlong Cocksfoot, chicory, plantain and red clover at a rate of 16 kg/ha. This sowing was brought forward because of the wet conditions in the summer of 2021/22 and concerns about trafficability in the autumn. From March 2022 the paddock was stocked with heifers.

The returns from each phase of pasture improvement, detailed in Table 1, are based on actual weight gains of trade cattle and agistment rates applied for grazing by breeding cows and ewes. No allowance has been made for changes in livestock inventory value during the period of grazing.

Summary	Gross Margin/ha/year	Return on investment
Millet phase	$390	126%
Wheat phase	-$21	-7%
Permanent pasture - 5years	$558	317%
Permanent pasture - 10 years	$558	436%
Permanent pasture - 15 years	$558	499%

The millet phase of grazing produced 23,683 kg of liveweight gain at an average cost of $1.88 per kg of liveweight gain. The weight gain was valued between $4.20 and $5.20/kg liveweight at the point of sale. The gross margin was $390/ha and the return on investment in the millet phase 126%.

The wheat phase was disappointing; conditions were wet and crop growth disappointing. Agistment rates were applied to cows and calves and ewes and lambs grazing the paddock. Actual liveweight gain for trade cattle was valued at $5/kg. The wheat phase made a small loss of $21/ha but allowed for additional weed control. In future Richard will use Triticale rather than winter wheat as he believes it will handle the cold wet conditions better.

The permanent pasture was sown in January 2022 and has been grazed since March. The stocking rate of the paddock is conservatively estimated to have increased from 5 dse/ha to 14 dse/ha on a year-round basis. Using an average gross margin value of $62/dse, the value of the additional 9 dse/ha carrying capacity is $558/ha/year after allowing for maintenance applications of fertiliser. The returns in the first year pay for the pasture improvement costs. The return on investment increases the longer the period until the pasture has to be renovated. Even with a 5-year lifespan the return on investment is $317%.

The Northern Pastures Group will continue to monitor the performance of this paddock to confirm the estimated improvement in carrying capacity and returns.

Richard has identified additional benefits from pasture improvement. Calf weaning weights from improved pastures are up to 100 kg higher than calves from unimproved paddocks. Similarly, cows weaning calves off improved pastures are significantly heavier. The pasture improvement program at Te-Angie is also contributing to the capital value of the farms.

5.3.2 Bridgewater Case Study.

Corn silage a cost-effective fodder reserve at Dundee

John and Caroline Chappell run 320 Angus breeders and 2,000 Westvale blood Merino ewes on 1,400 ha at "Bridgewater" Dundee in the Northern Tablelands of NSW. The soils are a mix of granites ranging from course to blue. The annual average rainfall for the region is 825mm (Glen Innes).

In 2020, the Chappell's agreed to become a demonstration site for the MLA funded Northern Pastures Group, investigating pasture improvement strategies, after the drought of 2018 and 2019.

A 23ha paddock that had been sown with lucerne and brassica in 2016 was chosen for renovation. The initial plan was to re-sow the paddock with Lucerne. However Chilean Needle Grass was discovered in spring 2021. The need to control the Chilean Needle Grass combined with a desire to re-plenish fodder reserves post drought led to the decision to sow corn for silage in spring 2021.

Corn silage can yield up to 22 t/DM/ha. It has high phosphorus and potassium requirements and provides a range of options for chemical control of weeds pre and post emergence. Prior to sowing, feedlot manure was spread on the paddock at a rate of 22 t/ha and the paddock was sprayed twice with Roundup. After sowing in November, Dual Gold and Prime Extra Gold was applied for post emergent weed control.

The wet conditions during the summer of 2021/22 (rainfall 452mm across the growing season) made weed control less effective. As a result, approximately 2ha of the paddock could not be harvested.

Contractors harvested the corn in May 2022, delivered it to the pit, rolled and inoculated the silage with 3 bacteria. The total yield of corn silage was 900 t wet, which represents a wet yield of 39 t/ha over the area sown. At 50% moisture this equates to 19.5 t DM/ha.

The total cost of silage delivered to the pit was $67/t wet and $133/t dry assuming 50% dry matter.

John's silage has not been feed tested, however advice from his agronomist indicates that corn silage normally provides 10 MJ/kg DM of energy and 7.5% crude protein. He is delighted to have re-stocked his drought reserves in such a cost-effective manner, with silage of reasonable nutritional value.

John indicated that the advice from Paul Tudor (Grazag Glen Innes) was critical to this successful corn crop. Thanks also to the Peitch family for contract planting and post plant spraying, and the Judd Brothers Contracting for the chopping and ensiling.

The paddock has been subsequently sprayed with Roundup and direct drilled with oats.

Corn Silage – Cost Benefit

Growing Costs	**Cost/ha**
Feedlot manure - spread	648
Pre-crop Roundup X 2	115
Disc paddock X 2	132
Seed, sowing & post emergent chemical	522
Sub total	**$1,417**
Ensiling Costs	
Plastic	99
Fuel	106
Chop, transport and roll	818
Inoculant	159
Sub total	**$1,181**
Total cost per ha	**$2,598**
Total cost per wet tonne ensiled	**$67**
Total Cost per estimated dry tonne ensiled	**$133**

5.3.3 Te-Angie Case Study # 2

In December 2023, after an extensive dry spell that lasted 12 months, a decision was made to commence the renovation of 75 hectares of pasture. The 1st phase of this renovation commenced with the establishment of a short-term millet crop to allow effective control of weeds. Two sprays were used to prepare the site. Millet was sown at a cost of $50/ha for seed; fertiliser costs of $125.45/ha and sowing costs (owner equipment and labour) at $110/ha. Total costs of establishment were $339.29/ha or $25,446.

A decision was made to purchase 148 cross-bred steers for an average price of $710 at an average weight of 310kg ($2.29/kg). Those steers were grazed continuously on the millet for a period of 64 days. Weight gain averaged 1.09kg/day with the exit weight being 380 kg. Those steers were sold into a feedlot at an average of $3.34/kg or $1,269.20 resulting in $559.20 per head increase. Including health and sale costs of $68 per head resulted in a net benefit of $47,250 or $319.26/ha. This equates to a benefit: cost of 3.25:1 for the summer period (3 months). The cost per kg of gain was $2.46.

For comparative reasons, an alternative way of valuing the cattle increase is the determine the weight gain and multiply by the sale price, this gives a value of $34,602. However, as the owner pointed out, there is the value generated in changing the sale price of the steers from $2.29 to $3.34 as the article has gone from a weaner steer to feedlot entry weight. If that value is included (148 x 310 x 1.05) of $48,174 then total value is $82,776 which is the same as the difference of $559.20.

5.4 Agronomy, pasture and animal data collected at the 3 host sites throughout the project

Host Site – Cairnie, Walcha

Project Start to June 2022

Treatment Paddock – The Drain – Pasture assessment using Rapid Assessment Tool

Date	Sown grasses %	Volunteer grasses %	Native grasses %	Grass weeds %	Sown legumes %	Sown herbs %	Broadleaf weeds %	Groundcover %
4th June 2020	0	63	17	0	0	0	20	100
29th Oct 2020	2	54	0	0	0	0	44	100
11th Feb 2021	0	0	0	0	0	0	0	0

- At June 2020, the predominant species in the paddock were – couch grass, cud weed, sedge, Parramatta Grass, Button Grass
- Paddock history – oats (2012/13), fescue & rye (2014), cocksfoot, chicory, plantain & clover (2016)
- Recent grazing - minimal
- Agronomy plan
    - Sprayed 3 times with Roundup (3L) between November 2020 and Feb 2021
    - Sown with oats in 11th Feb 2021 along with 60kg/ha of seed coating (insecticide Howbray) and 125 kg/ha of Starter 15 fertiliser
    - Graze oats for winter 2021 and continue broadleaf weed control
    - Sow down to permanent pasture in spring 2021

Control Paddock – Top Jimmy's – Pasture assessment using Rapid Assessment Tool

Date	Sown grasses %	Volunteer grasses %	Native grasses	Grass weeds %	Sown legumes %	Sown herbs %	Broadleaf weeds %	Groundcover %
19th June 2020	7	0	4	0	50	7	32	100
29th Oct 2020	24	22	11	0	14	0	29	100
11th Feb 2021	4	78	0	12	0	0	6	100

- Predominant species in paddock cocksfoot, fescue, white clover, chicory
- Agronomy plan – retain the pasture and monitor species composition. Consider sub lethal application of Paraquat in spring and direct drill improved pasture species to improve composition
- Pasture biomass 11th Feb 2021 was 1920 kg/ha.
- Control paddock no longer available to the project
- The Drain sprayed out in March 2022

June 22 to Jan 23

The pasture in the drain paddock had been ungrazed on the date of the field day (13th October), but estimated at 3,000 kg/ha DM, an impressive mix of clovers, cocksfoot, fescue, ryegrass and plantain. The host estimated the cost of pasture establishment, including spraying out old pasture and oat crop phase at $580/ha.

January 2023 to June 2023

The Drain Paddock was assessed on 15th June 2023. The pasture was assessed to be 1000 kg/ha DM, 90% green with 80% ground cover. Major species were Cocksfoot and Fescue with very small amounts of clover present. There was no evidence of the ryegrass or plantain that was planted in the mix.

The paddock has carried 2073 hoggets @ 0.5 DSE for 9 days in Feb and 1,160 ewes @ 1.2 DSE for 14 days in April.

150 kg of single super to be applied in August.

Ag360 estimates rainfall received at Cairnie since 1st June 2022 at 529 mm. The median prediction for rainfall to 30th May 2023 is 325 mm.

Host Site – Te Angie, Wongwibinda

Project Start to June 2022

Control Paddock – East Shearing Shed – Paddock assessment using Rapid Assessment Tool

Date	Sown grasses %	Volunteer grasses %	Native grasses	Grass weeds %	Sown legumes %	Sown herbs %	Broadleaf weeds %	Groundcover %
22nd Oct 2020	0	83	0	0	3	0	14	100
9th December 2020	0	60	14	23	0	2	2	100
28th April 2021	0	90	0	0	5	0	5	100
19th Nov 2021	0	90			5		10	100

- Predominant species in paddock kikuyu, cudweed and rats tail. Kikuyu has been assessed as a volunteer grass, although it may have been originally sown in the paddock
- Estimated pasture biomass on October 22 2020 was 600 kg/ha
- No treatment envisaged
- Paddock is periodically heavily grazed as it is adjacent to the shearing shed
- Grazing since December 2020 – 500 DSE for one day
- Estimated pasture biomass on 28th May 2021 was 1600 kg/ha
- Superphosphate was applied to a strip in the paddock during winter. This application resulted in increased proportion of clover despite the predominance of kikuyu in the paddock. Estimated pasture biomass at 19th November 2021 was 1800 kg/ha. No grazing of the paddock to report for the period.

Treatment paddock – Round – Paddock assessment with Rapid Assessment Tool

Date	Sown grasses %	Volunteer grasses %	Native grasses	Grass weeds %	Sown legumes %	Sown herbs %	Broadleaf weeds %	Groundcover %
22rd October 2020	0	0	71	0	11	0	18	100
9th Dec 2020	100							30
28th April 2021	70	5	0	0	10	0	15	100
19th Nov 2021	50						50	100

- Paddock sprayed out with Roundup (2L), Cutlass and insecticide in October 2020 and sown with millet in late November 2020. At time of first pasture walk millet was just emerging

- Agronomy plan
  i) Millet sown spring 2020. Grazed until March and then sprayed out for weed control
  ii) Bennett's wheat sown autumn 2021. Grazed until October 2021 and then sprayed out for weed control.
  iii) Fallow Oct to December 2021. Weed control December 2021 and January 2022.
  iv) Autumn 2022 sow down permanent pasture.
- Pasture mix – fescue (10kg), cocksfoot (4 kg), prairie grass (2 kg), phalaris (3 kg), red clover (1 kg), white clover (2 kg), arrowleaf clover (1 kg), tonic plantain (0.5 kg), puna chicory (0.5 kg)
- Contract sowing rate - $125/ha. Contract spraying - $90/ha. Fertiliser rates.
- Issues to be further evaluated – cost of seed mix and seeds per ha, fertilizer selection to increase S levels, cost benefit of this program
- General property information
  - Te Angie – 2,834 ha. Other properties total 587 ha.
  - Purchased 7.5 years ago after moving from SA
  - Enterprises – trade cattle to feedlot entry, EU Hereford herd and stud breeding operation, second cross ewe flock
- Owner undertook own pasture improvement trial at purchase. Native unimproved country carried 1 cow/calf to 4 ha. Improved pastures carried 1 cow/calf to 1 ha. Heifer calves sold at heavier weights and for a price premium ($1,400 compared to $1,868 per head). Four fold improvement in productivity.
- Millet grazing with weaner cattle in spring/summer 2020/21
  - 446 weaner cattle. Average weight gains – 0.8 to 1.2 kg/head/day over 3 mobs of heifers and steers
  - Cost of production per kg of liveweight gain - $1.57
- Pasture walk on 28th April – low biomass all millet grazed out and then frosted (estimate 300 kg/ha). Wheat due to be sown
- Host has reduced quantities of seed sown in pasture mix in response to feedback from PDS agronomists – happy with the pasture density in sown areas
- Bennett's Wheat sown in late autumn 2021 – delayed due to wet conditions. The late sowing and wheat winter resulted in sub-optimal growth of the crop. Despite this the paddock carried
  - 60 steers (75 kg LWT gain)
  - 43 steers (71 kg LWT gain)
  - 34 heifers (78 kg LWT gain)
  - 380 crossbred ewes and lambs (6 weeks)
  - 47 calving cows (7 weeks)

  Over winter and spring before being spayed out in November. The net return from the winter wheat phase of weed control was a small loss of $2,500 or $16/ha.

  The paddock was due to be sprayed for weeds again in December in preparation for permanent pasture planting in February 2022. Estimated pasture biomass on 19th November 2022 was 100 kg/ha.
- A key change for this property is a shift from summer backgrounding of steers and heifers to finishing of prime lambs. In this case $150,000 would have purchased 83 weaners (666 DSE), vs 1000 store lambs or 600 DSE. It is expected that returns will be much higher per DSE for the finished lambs.

Jan 2022 to June 2022

The pasture at Te-Angie was sown in January 2022. In May 2022, the pasture was estimated at 1500 kg DM/ha and was already being grazed at an estimated stocking rate of 15.5 dse/ha. See case study for more details.

June 2022 to Jan 2023

Te-Angie Round Paddock assessed on 22nd December 2022 at 1500 kg/ha DM. Conditions were dry with limited rainfall in November and December and pasture was showing signs of some moisture stress.

The Round paddock (120 ha) carried 2,100 DSE for 223 days from 1st May to 8th December 2022 (600 x 50 kg lambs and 120 x 450 kg heifers) and 1,440 DSE since 8th December (300 x 35 kg lambs and 120 450 kg heifers).

Whilst pasture productivity has been excellent, Richard recognized the need to subdivide the paddock and commence rotation grazing rather than set stocking.

Pasture improvement is commencing in another paddock in January 2023. The paddock (Tindal Flat 57 ha) was soil sampled in December 2022 before lime application. The soil is described as grey clay. This paddock will be the subject of the third case study and cost benefit analysis.

Ag360 estimates rainfall received at Te-Angie since 1st June 2022 at 483mm. The median prediction for rainfall to 30th May 2023 is 278 mm.

The monitored pasture at Te-Angie (Round Paddock) maintained an impressive stocking rate of 17.5 DSE/ha for 223 days from May to December 2022. Conditions continued to be wet throughout this period. The season has now dried up significantly with soil moisture and pasture growth declining. Stocking rates were adjusted to 12 DSE/ha on December 8th. It will be interesting to see if this stocking rate can be maintained throughout the summer, particularly if the dry conditions continue. Successful pasture improvement at Te-Angie results in new requirements for capital to effectively fence and rotationally graze the pastures to ensure productivity and longevity. This is in direct contrast to the start of the project where set stocking was preferred.

January 2023 to June 2023

Te-Angie Round Paddock was assessed on 28th June 2023 at 1600 kg/ha DM, 80% green and 95% ground cover. The major species present were Fescue, Cocksfoot, Phalaris and 15-20% clover.

The paddock has been set stocked with 600 lambs (52-65 kg) and 100 heifers (350-400 kg) for the past 6 months. The stocking rate for the period is estimated at 18 DSE/ha. It will be rested at the end of July. A trial of 50% Gibberellic Acid will be trialled on half of paddock to increase pasture growth.

Pasture improvement has taken place on a second paddock (Tindal Flat 57 ha). The paddock was soil sampled in December 2022 before liming. The soil is described as grey clay. The paddock was sown in January 2023 and is currently carrying 30 bulls (600 kg), estimated to be 8 DSE/ha. Pasture was assessed on 28th June 2023 at 2100 kg DM/ha, 70% green. Major species were Fescue, Cocksfoot, Brome and 10-15% clover.

Ag360 estimates rainfall received at Te-Angie since 1st Jan 2023 at 396 mm. The median prediction for rainfall to 30th December 2023 is 340 mm.

The Round paddock at Te-Angie has maintained an impressive stocking rate of 18 DSE/ha from January to June 2023. Richard has recognized the need to rest the paddock and is currently split the paddock in two and is planning further subdivision. which is needed for rotational grazing and improved pasture management in the future.

June 2023 to Jan 2024

Te-Angie Round Paddock (120 ha) was assessed on 2nd August and 23rd October. The paddock was heavily grazed on both occasions as conditions were very dry. The estimated pasture biomass on both occasions was below 1,000 kg/ha with very little green or legume component. The Round paddock was subdivided early in the year with heifers (125) and lambs (300) rotated between the two paddocks on a 6-weekly basis for the period July 2023 to January 2024. On a DSE basis the two subdivided paddocks have carried 11 DSE/ha over the 6- month period.

Pasture improvement has taken place on a second paddock (Tindal Flat 57 ha). The paddock was soil sampled in December 2022 before liming (5t/ha). The soil is described as grey clay. The paddock was sown in January 2023 with rye grass and leaf turnip. Over the past 6 months the paddock carried

145 heifers (320 kg) for a period of 8 weeks. This equates to a stocking rate of 23 DSE/ha for the grazing period. The paddock has subsequently been sprayed out and cultivated in preparation for sowing to permanent pasture in late January 2024.

Ag360 estimates rainfall received at Te-Angie between 1st July 2023 to 12th January 2024 to be 312 mm with the bulk of the rainfall in November and December. The rainfall for the previous 6 months been in the lowest quartile of records. Predictions for the coming 6 months are for 420 mm of rain, which also represents below average rainfall for that location.

Host Site 3 – Bridgewater, Dundee

Start of Project

Treatment Paddock - Lucerne

- Degraded Lucerne paddock with needle grass, volunteer grasses, broadleaf weeds and couch
- Paddock will be grazed with lambs until April/May 2020. After autumn rain, spray with sub lethal dose of Paraquat and direct drill fescue/cocksfoot and lucerne to improve pasture composition. Possible broadleaf control in summer with Thistrol Gold or Broadstrike.
  Love Grass – control and treatment paddock

African Love Grass

- Paddock of pure Love Grass. Large amounts of biomass (8-10,000 kg/ha). Low digestibility and protein content.
- Sections of the paddock will be treated differently to compare results
- Treatments – autumn/winter 2021
    - Nil control
    - Mulch and direct drill oats
    - Burn and direct drill oats
    - Apply herbicide and direct drill oats

Project Start to June 2021

Lucerne paddock

- Sown in 2016 with lucerne and brassica mix. Brassica initially choked out lucerne, but insect infestation knocked the brassica and good lucerne remained
- Has gradually degraded due to drought and grazing management
- Sprayed with Broadstrike in December 2020 (50g = Oil in 100 l/ha) targeting Amaranth, Fat Hen, thistles, and other broadleaf weeds
- Was planning to re-sow to lucerne but found more Chilean Needle Grass, so now returning to a cropping phase for fodder preservation (silage) and weed control
- Will sow to corn in spring 2021 followed by annual ryegrass and then perennial ryegrass
- Permanent pasture sowing will depend on how well the needle grass is controlled
- Lucerne paddock assessed in January (2,500 kg/ha) and May (2,000 kg/ha). Grazing during that period was;
    - Jan 1 – Feb 26 – 250 XB lambs
    - April 23 – May 14 – 875 merino weaners

African Love Grass Paddock

- Granite soils with rocks
- January 2020 pure love grass ~ 5-6000 kg/ha
- 13th Jan – Roundup Ultra Max 3.5 l/ha, plus wetter
- Direct drilled on Australia Day with Nile oats (70kg/ha plus 125 kg/ha Starter). Should have sown later or grazed earlier as some oats went to head quickly. Heavy disc drill required to get through the African Love Grass trash
- Direct drilling is best when material is green or very dry. If half dried then trash can hairpin into the slot. Can spray close to drilling or directly afterwards or allow enough time for material to die and dry out

- Can also mulch or burn love grass. Mulching can also cause hair pinning
- Long term wants to be able to direct drill with smaller Duncan drill rather than expensive contractor machine
- Will continue to direct drill in crop and control emerging love grass
- Biomass in April 22nd 2020 4,500 kg/ha ungrazed
- Biomass on May 20th – 3,000 kg/ha of oats with sheep grazing
- Lambs introduced to paddock on Sunday 16th May – 875 X 32 kg weaner lambs (7 days in larger paddock and 3 days in smaller paddock)
- Rust
    - can be leaf or crown rust, but most likely leaf
    - some varieties bred with rust resistance
    - need to stop the green bridge over summer from self-sown and wild oats
    - graze and open the canopy
    - cattle would have opened this up if grazed earlier
    - foliar treatments are unlikely to be economic in pasture situations

June 2021 to January 2022

Lucerne paddock

Lucerne paddock was sprayed out in spring 2021 and sown to corn on 17th November 2021. The corn will be harvested for silage in the autumn. Based on the weather forecast, Ag360 predicts that biomass will peak around 10th March 2022. The biomass predictions are 8,000 kg DM/ha (75th percentile), 6,800 kg DM/ha (50th percentile) and 3,800 kg DM/ha (25th percentile).

African Love Grass Paddock

Remaining oats to be sprayed out in January 2022 and sown to annual ryegrass at the end of January. Based on the weather forecast, Ag360 predicts that biomass at the end of May will be 6,000 kg DM/ha (75th percentile), 5,500 kg DM/ha (50th percentile) and 2960 kg DM/ha (25th percentile).

January 2022 to June 2022

The corn silage at Dundee yielded 39t/ha wet. The total cost per tonne in the silage pit was $67 wet or $133 on a dry matter basis. See case study for more details.

The African Love Grass paddock at Dundee was grazed out with 900 Merino lambs, sprayed and sown down to annual ryegrass, turnip, brassica and white clover in mid-February 2022. Results have been disappointing, due to wet conditions hampering the timing of weed control and the sown pasture being outcompeted by Vulpia (Rat's tail fescue).

June 2022 to January 2023

Since the harvesting of the corn silage in April 2022, nothing has been sown in the paddock. There were plans to direct drill oats immediately after harvest, but conditions became too wet.

The African Love Grass paddock was inspected in October 2022 and had recently been sprayed with roundup and sown with annual ryegrass and sub clover

Ag360 estimates rainfall received at Devon Court since 1st June 2022 at 460 mm. The median prediction for rainfall to 30th May 2023 is 268 mm.

January 2023 to June 2023

The two paddocks at Bridgewater were inspected on 10th May 2023. After a long period with no intervention due to wet conditions. The paddocks had been sprayed out with Roundup and sown with ryegrass and brassica in March. The plants had emerged and the biomass was estimated at 300-400 kg/ha DM with ground cover quite low at around 50%.

The paddocks have not yet been grazed, but this is anticipated in the next month.

Ag360 estimates rainfall received at Devon Court since 1st January 2023 at 354 mm. The median prediction for rainfall to 30th December 2023 is 390 mm.

June 2023 to January 2024

The pasture improved paddock at Bridgewater was inspected on 17th October 2023. The ryegrass, clover and brassica pasture was estimated to be 3,000 kg/ha. It had been subdivided with temporary fencing and was being grazed with cattle. The 22ha paddock carried 95 400kg heifers for 6 weeks and 77 cows and calves for 10 weeks during the previous 6 months, giving an average stocking rate over the 12-month period of 13.3 DSE/ha.

During the winter/spring of 2023 approximately 600 tonnes of the 900 tonnes of corn silage had been fed out across the property.

Ag360 estimates rainfall received at Bridewater between 1st July 2023 to 12th January 2024 to be 300 mm with the bulk of the rainfall in November and December. The rainfall for the previous 6 months been in the lowest quartile of records. Predictions for the coming 6 months are for 350 mm of rain, which also represents below average rainfall for that location.