Final report

The Persistent and productive pastures package

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Abstract

Pastures cost a lot of money and time to establish and therefore need to be both productive and persistent. To achieve this, they require active management. Southern Farming Systems (SFS) was contracted to develop new products to renew interest in pasture management and assist producers better manage sown pastures. This was done through creation of a pasture assessment method called Pasture Paramedic (PP) and providing support material that was modernised with visual imagery and technical information to assist producers to undertake PP treatment pathways of pasture manipulation or resowing/over-sowing. Producers and advisors were trained in workshops to use the PP rapid assessment method. The result of this has been high interest for the products by both producers and agronomists. The benefits are a legacy of valuable resources to support the renewed interest of producers in pastures, trained agronomists promoting the products and producers who are actively managing their pastures and improving their condition which will ultimately lead to improved red meat production.

Executive summary

Background

Pastures cost a lot of money and time to establish. The last thing producers want to experience is the disappointment of a pasture thinning out after only a few years. Achieving persistent and productive pastures can be a challenge. Meat and Livestock Australia (MLA) contracted Southern Farming Systems (SFS) to develop new products to renew interest in pasture management. The target audience of this project was advisors in the southern feedbase.

Methodology

A pasture assessment method called Pasture Paramedic (PP) containing two decision matrices was developed and road-tested with producers to ensure it worked and to seek improvements. PP informed treatment pathways and factsheets and videos were created to enable producers with the information they needed to undertake pasture manipulation or resowing/oversowing. Producers and advisors were trained in workshops to use the PP rapid assessment method.

Objectives

Objectives of the project were completed by:

- creation of a simple method to rapidly assess existing pasture condition called Pasture Paramedic and support package of technical manual (hard copy and online copy), recording booklet, instructional video and frequently asked questions on use.
- promotion to approximately 550 producers and 170 advisors through expos and media and training of 290 producers and 165 advisors through workshops on how to use PP.
- filling gaps in pasture resources to enable modernised pasture management materials in the PP treatment pathways of manipulation, and resowing by creation of six factsheets, two videos, and 10 producer stories.

Results/key findings

Decision matrices within Pasture Paramedic have worked exceptionally well and allowed the development of an effective but simple process of pasture assessment to inform future management. Producers and advisors have embraced Pasture Paramedic and shown high demand for the tool and the information created to complement it.

Benefits to industry

The benefit from having a new and rapid assessment method of pastures, has been reinvigorated producers who are taking more interest in their pastures. Creation of legacy products that are valued for their objectivity and information that can be used to engage more producers. Trained agronomists promoting the products and producers who are actively managing their pastures. Producers actively managing their pastures and improving their condition, will improve red meat production.

Future research and recommendations

While this project has developed many products for PP treatment pathways, attention is still needed in some areas such as pasture species selection. Further promotion of products and their key components is needed to maximise their value and take advantage of the demand for them by producers and advisors. While some of this could be met within the project, it was limited by Covid and has mainly occurred in southwest Victoria.

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1. Background

Pastures cost a lot of money and time to establish. It's not only the direct cost of the weed control, seed and fertiliser, but also the lost production during the preparation and early establishment phase along with the risk of a poor season after sowing. The last thing producers want to experience is the disappointment of a pasture thinning out after only a few years.

Achieving persistent and productive pastures can be a challenge. They need to be as productive as possible, but also persist. If productive and persistence pastures are wanted, then they need producers to take a keen and ongoing interest in their wellbeing.

Meat and Livestock Australia (MLA) contracted Southern Farming Systems (SFS) to develop new products to renew interest in pasture management. The target audience of this project was advisors in the southern feedbase. Product development was to consider personality (temperament) type and their preferred styles for learning. Specifically, a high proportion of producers are visual learners and so use greater visual imagery in products.

The project has involved first the creation of a unique assessment tool called Pasture Paramedic and second the 'modernising' of existing information to enable greater use of electronic media (video, visual imagery on computers and smart phones, online learning).

Pasture Paramedic enables rapid assessment of a pasture and signposts potential actions or pathways for producers to take. With products in place, training of advisors and producers was to occur to increase their awareness and knowledge of how to use products. The goal being for producers to use these tools and products and agronomists to advocate product use and help train for the purpose of increasing pasture productivity and therefore animal performance.

2. Objectives

The first objective was to provide the knowledge, tools and skills required for producers and advisors to use a simple method of assessing an existing pasture to determine appropriate interventions (decision matrix). This was done through the creation of Pasture Paramedic that utilises two key assessment times and informs decisions, such as maintain, manipulate or resow. It was road tested during development to ensure its functionality and support for by producers. The kit contains a quadrat and is supported by the production of a technical manual (hard copy and online version), recording booklet, pen, instructional video and frequently asked questions.

The objective to produce six factsheets on possible intervention strategies to manage different pasture situations and stresses was completed. The factsheets built on the pathways created by PP and cover green and dry season management, assessment of what might be causing poor pastures, tactical actions such as dry feed removal, seedling recruitment and what grazing to use to recovery pastures from challenging scenarios. In addition, a video was created called How do I rescue pastures. The factsheets contain visual imagery to engage producers and for use in eLearning.

A web based platform (clickable map) objective called "Secrets of Success" with links to champion advisers/consultants/producers was not created. However, 10 Secrets of Success stories were written to be used instead through MLA news and magazines so that other producers could learn from the best and promote key grazing and pasture management messages.

An objective to produce a case study / video on how to pick suitable pasture species using the PTN web tool and "Pasture Picker," was amended. As Pasture Picker was not available due to multiple ownership arrangements, a video instead was created on how to PTN tool which will benefits its planned re-launch by the PTN committee.

The objective to write a feasibility report on creating moisture stress alerts based on access to real time moisture probe data was achieved with recommendations made.

Objectives of running four training workshops with major resellers and advisors and six producer groups to show them how to use and learn from the resources available was completed and the target of workshops exceeded. Data was collected was on use and intended use of products.

Running of two MLA adviser training/expo days to release new products and how to use them was also completed and so to was 6 expo days for producers.

A final objective was the hosting of two regional events where leading pasture managers come together and interact and this was achieved with running both a selective herbicide for control of common weeds and nitrogen use workshop.

A contract variation in September 2019, added extension deliverables and these were also completed including an audit of existing extension resources, printing of additional PP booklets and running additional producer training workshops which were all completed.

3. Methodology

3.1 Pasture Paramedic

A tool and support kit containing two decision matrices was developed and named Pasture Paramedic (PP). This was to reflect, that like a paramedic, there is an initial assessment of condition and decision made on the nature of treatment required. In this case, there was an assessment of whether the pasture needed intervention or not based on indicators and thresholds. The tool was road tested with producers, to ensure it worked and to seek improvements.

3.1.1 Pasture assessment method and decision matrix

The methodology of creating a decision matrix used was based on "A guide to developing a decision matrix" (unpublished) by Cam Nicholson, Nicon Rural.

The pasture assessment criteria used in the decision matrices was identified by literature review and establishing what agronomists look for (indicators) when assessing pasture condition and deciding treatment. Based on this review, and the need for the assessment, to be simple and easy to use, a tool was developed for two different assessment times.

The two assessment times coincided with when most decisions about pasture intervention could be made:

- Winter and early spring – when sown grasses and clovers have established and weeds have germinated.

- Late summer early autumn (before the autumn break)- to check how groundcover and litter had been managed and which perennial grasses have survived summer.

During each time there were three priority factors used in assessment of pasture condition. The winter and early spring assessment was based on the:

- percentage of sown perennial grasses.
- percentage of improved clovers.
- type of dominant weed, (category A, B or C) based on the weed's contribution to the feedbase.

An acceptable pasture was defined in Pasture Paramedic as one that does the job well (provided adequate feed supply) but did not necessarily need to be perfect, meaning that it could contain weeds. Categories of dominant weeds was used as an assessment factor because there were rarely weed thresholds that held true across all farm types. What was a troublesome weed to one enterprise, was valued by another for its feed production. Further information on the creation of the weed assessment is outlined in The Less Weeds Better Pasture Package (L.FAP.1901).

The literature recommended that balanced sheep/beef pastures would ideally contain 40% to 50% perennial grass (Kemp & Dowling 1991, Kemp et al, 1996). This benchmark contributes to the feed supply, while allowing space for legumes to germinate. Further information on sub-clover assessment criteria and methodology is outlined in The More Sub-Clover package (L.FAP.1904).

The late summer and early autumn assessment was based on the:

- percentage of groundcover for protection against soil loss from summer thunderstorms. This benchmark was informed by Lang, 1998.
- amount of dry material covering the ground which influenced hard seed coat breakdown of annual legumes and thus influenced clover germination. Simple experiments were done to verify the effect the amount of litter had on clover germination which reflected those established in literature and these trials were reported by Brogden, 2019.
- number of live sown perennial grasses which had survived summer and could contribute to the pasture. This also based on agronomists' benchmarks for pasture condition which were normally reported per square metre, but were adapted for the 0.1 m^2 assessment quadrat used in PP.

The assessment method developed involved the use of a 0.1m^2 quadrat (equivalent to a square foot). It was recommended to take 10 observations across similar areas within a paddock. This number of observations was based on being able to complete the task rapidly and provide enough data to inform a sensible treatment option.

Each of these assessment criteria had different conditions described and users were asked to identify the condition most applicable to their pastures. These conditions were assigned scores to reflect the condition (Tables 1 and 2). For example, the assessment factor of sown perennial grasses, greater than 50% sown perennial grasses was given a score of 5 and less than 10% sown perennial grasses a score of 0. User's assessments were supported by the collection of visual indicators of each condition.

Table 1. The decision matrix for winter and early spring:

	Score	Condition
Critical Assessment Factor 1 Sown perennial grasses (ryegrass, phalaris, cocksfoot, tall fescue)	5	Greater than 50%
	3	30% - 50%
	2	10% - 30%

	0	Less than 10%
Critical Assessment Factor 2 Improved clover (sub, white, balansa)	4	Greater than 40%
	3	20% - 40%
	1	5% - 20%
	0	Less than 5%
Critical Assessment Factor 3 Dominant weeds	4	No weeds present
	3	Category A weeds - high grazing value, palatable, few animal health effects
	1	Category B weeds - some grazing value, less palatable
	0	Category C weeds - little or no grazing value, major animal health issues

Table 2: The decision matrix for late summer early autumn (before the autumn break)

Critical Assessment Factor 1	**Score**	**Condition**
Groundcover	3	Greater than 70% on flat ground, greater than 90% on slopes
	0	Less than 70% on flat ground, greater than 90% on slopes
Critical Assessment Factor 2 Amount of dry material covering the ground	1	Greater than 2 handfuls of litter
	4	1 - 2 handfuls of litter (1000 – 2000 kg DM/ha)
	0	Less than 1 handful of litter
Critical Assessment Factor 3 Live sown perennial grasses (ryegrass, phalaris, cocksfoot, tall fescue)	7	Greater than 2 phalaris, tall fescue, cocksfoot or 3 ryegrass plants
	4	1 or 2 phalaris, tall fescue, cocksfoot or 1 to 3 ryegrass plants
	0	No live sown perennial grasses

The sum of the three assessment factor scores informed a possible treatment pathway for producers to take (Table 3). These were described as:

- Maintain. No need to treat.
- Manipulation. To be done through grazing, herbicides, soil or pest management.
- Over sowing or resowing. To introduce new species.

Combinations of assessment scores were tested, to make sure that the scores informed sensible treatment options. In the second edition of Pasture Paramedic created in 2020, the no need to treat, was changed to current management suitable but consider improvements. This was partly to keep consistency with other Pasture Paramedic versions being created and feedback, that producers should always be considering pasture improvements.

Table 3. Suggested decisions based on average score for winter/early spring and late summer/early autumn assessments

Winter and early spring score	Suggested decision	Late summer early autumn score
Greater than 10	No need to treat, maintain current management	Greater than 11
6 to 10	Consider pasture manipulation	7 to 11
Less than 6	Consider resowing	Less than 7

These suggested treatments pathways were described in the hard copy manual and are shown below (Figures 1 and 2). These pathways designed to signpost information that producers needed to get right and were used to inform writing of factsheets.

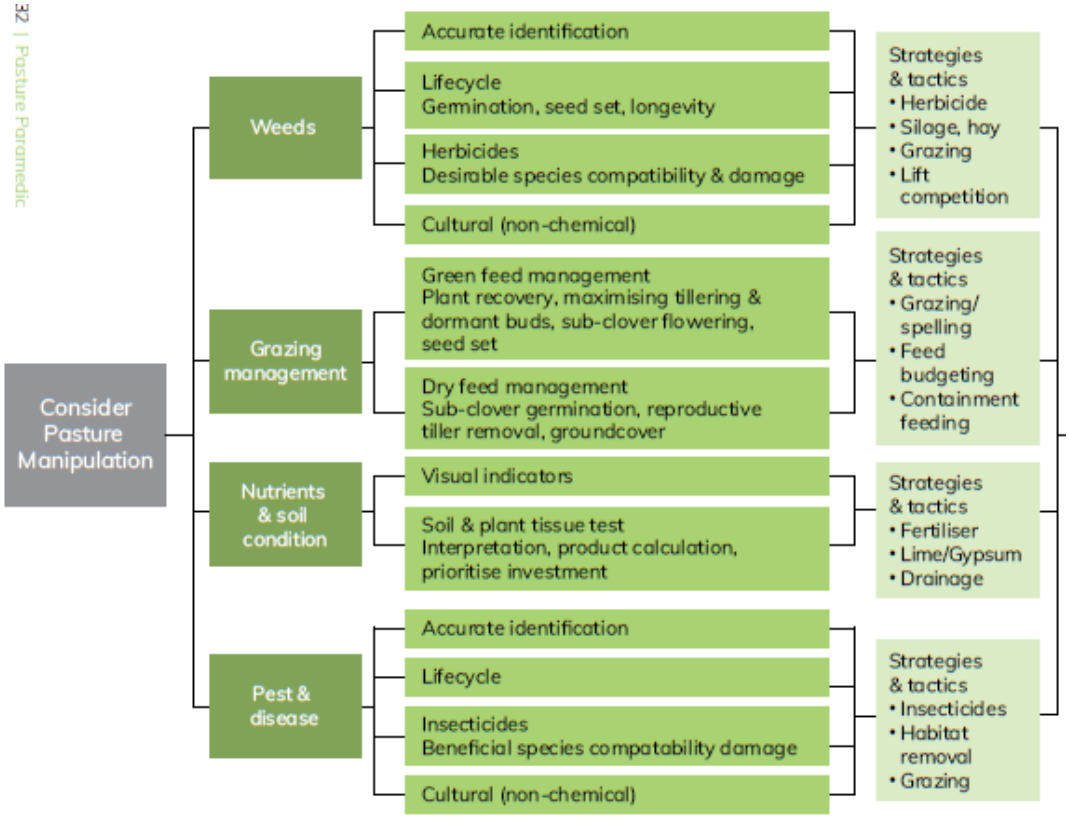

Figure 1. Pathways for pasture manipulation

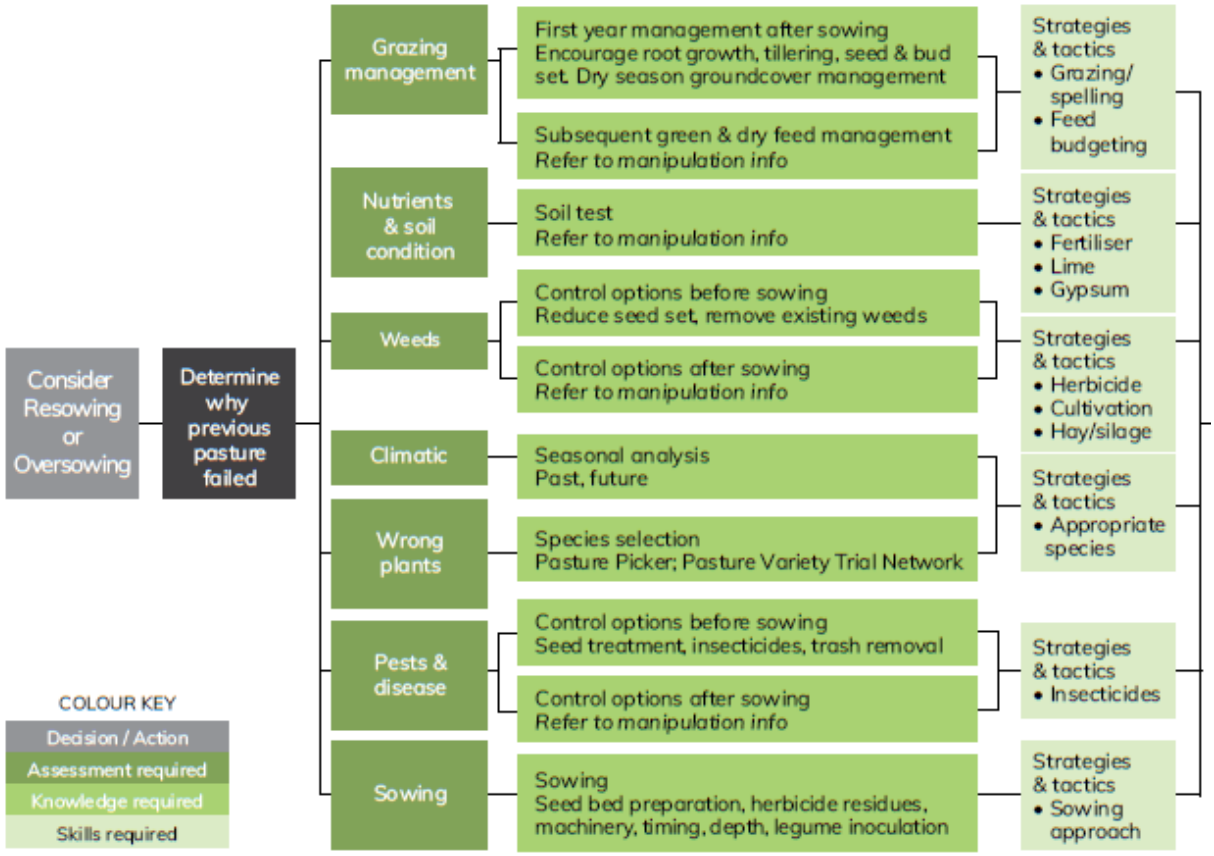

Figure 2. Pathways for over-sowing or resowing

3.1.2 Product testing

Initial product testing of Pasture Paramedic was done to confirm the process and ensure its appeal to different temperament types of producers and improve producer engagement. Temperament is defined as the combination of the mental, physical and emotional traits of a person that influences what they do. Temperament types were originally based on Myers Briggs personality type Indicators and further refinement divided farmers into four main groups of which 80% of farmers were SJ' (Sensing, judging) or 'SP' (Sensing, perceiving) temperament types (Jennings et al, 2011).

A short written output report on testing of PP was submitted to MLA in September 2019 and can be found in given Appendix 8.1.

Testing of the process and tool using cardboard protypes occurred with:

- Two producer groups (Best Wool/Best Lamb groups) from across the western district of Victoria that had experience in grazing and mixed farming systems.
- Two classes of agricultural students from Marcus Oldham College and the lecturing staff.

Each participant was also surveyed and assigned a temperament type.

Road testing included two Women on Farm groups at Lake Bolac and Hamilton. They used the tool to assess the pasture condition as part of an "Integrated Weed Management" workshop and used a mock-up recording booklet for the first time.

Two farmer groups at Omeo and Bairnsdale who PP assess pasture condition as part of drought workshops and were used to observe their ease of use.

A summary of the numbers involved in road testing is shown in table 4.

Table 4. Workshop details involved in road testing PP

Training event name	**Presenter**	**Location**	**Date**	**No of producers**	**No of Agron-omists**
Product development with two red meat producer groups in the western district of Victoria	Cam Nicholson & Jess Brogden	Shelford, Inverleigh	Mar 2019	28	2
Road testing with Marcus Oldham College students	Cam Nicholson & Jess Brogden	Geelong	Mar 2019	30	
Road testing with two Women on Farms workshops	Jess Brogden, Lisa Miller	Hamilton & Lake Bolac	Mar 2019	19	5
Totals				77	7

3.1.3 Pasture Paramedic kit and support material

The Pasture Paramedic kit developed contains a:

- Quadrat
- Technical support manual (hard copy and online manual)
- Recording book and pen

Additional support material was the development of an instructional video to show to use the tool.

The quadrat has two faces, where different colours were used to reflect different assessment times (Figure 2). The green side reflects the winter, early spring assessment and yellow (straw coloured) side is to be used in summer and early autumn. Each side of the quadrat contains a critical assessment factor table and the fourth side contains the decision matrix. The quadrat contained press studs, so that it could be conveniently folded into a single length. The green side contained a measurement guide along the decision face, so that the pasture height could also be measured and converted into herbage mass.

Figure 2. The PP kit (quadrat, manual, recording booklet and pen) and the two sides of PP representing different assessment times.

A technical manual was written as a support tool and describes the methodology to use the tool (pages 7 to 15). It also contains other support information such as visual indicators and photographs of plant species to aid in identification (sown grasses, sown clovers and weed species).

A recording booklet was developed to accompany the tool, where scores could be written and provide a record of for future reference. The booklet was designed so it could fit into a shirt pocket. The front cover flaps fold out which contains information to guide scoring. A pen was also provided.

Figure 3. The recording booklet and pen, where scores can be written.

1000 copies of the first edition were printed and released in December 2019 and a second edition was developed with further improvements and made available in October 2020.

An online manual was later developed and made public in May 2021, where producers could access the document by an online search or a downloaded copy saved onto their phone for use when out in the paddock. This was to assist with plant identification.

A QR tracker code was purchased and added to the second edition kit to enable easy access to the online manual. The dynamic QR code enables evaluation data to be collected.

Figure 4. The QR code to access the online manual.

An instructional video was also created on what is and how to use 'Pasture Paramedic.' A link to this video was sent to producers requesting a copy of the kit. The video was uploaded onto the SFS website on May 2020 and on MLA website on September 2020.

Pasture Paramedic frequently asked questions from training events were turned into a resource to help assist producers with its use (See Appendix 8.2).

3.2 Producer and advisor training

Producers and advisors were trained in using PP through PP only focused workshops but also through other topic workshops. Awareness of PP was also made through a number of advisor and producer expo days and media, resulting in requests for training and kits.

3.2.1 Training advisor workshops

The original plan to deliver four training face to face events but because of Covid, training delivery was shifted to mainly online delivery during 2020 and 2021. An online pilot advisor training workshop was developed and tested at a workshop involving Agriculture Victoria's BestWool/Best Lamb Coordinator and an East Gippsland Better Beef facilitator. While normally participants would be expected to use the tool in the field, competency had to be assessed by providing close up photographs of which they then had to assess and score.

The methodology in workshop was successful and feedback was received on what aspects of training were unclear and how it could be improved. For example, it was difficult for participants to identify some annual grasses weed without examining them and therefore the group were told what weeds or sown species were present, if it the images were unclear.

Different methods of testing were used at the workshops to measure competency. At the BWBL workshop, participants completed the testing within the workshop. This involved being shown a square of three different winter/early spring pastures and two summer/early autumn pastures where they scored each critical factor, summed the scores together and identified a treatment option. They filled this out on assessment forms they had been send and then took photos of completed assessment forms and sent them to SFS for evaluation. In the next three reseller workshops, a link to Microsoft form surveys were provided with an assessment. This was designed to make it easy to compile data. However, none of the participants filled out the skills assessment or

online survey form, despite being prompted. This was disappointing because they had all expressed positive feedback during the training.

It was decided that sending advisors surveys to complete assessments was inadequate and that any data needed to be captured in the workshop.

Seven workshops shown in table 5 consisted exclusively of training to use PP and all events were delivered online.

Table 5. Agronomist/advisor workshop details where PP was the main focus.

Training event name	**Presenter**	**Location of agronomists / advisors**	**Date**	**Method**
First pilot with BWBL and BB co-ordinators	Cam Nicholson, Nicon Rural consulting	Benalla and Bairnsdale	August 2020	Delivered online. Assessment method tested.
Gorst Rural agronomists	Cam Nicholson	SW Victoria	September 2020	Delivered online. Post survey assessment.
Nutrien agronomists	Cam Nicholson	SE south Australia, SW and central Victoria	October 2020	Delivered online. Assessed during delivery. Post survey assessment.
AGF Seeds resellers	Cam Nicholson	SW and central Victoria	October 2020	Delivered online. Post survey assessment.
BWBL and BB Facilitators	Cam Nicholson	Throughout Victoria	December 2020	Delivered online. Competency assessed within workshop.
MLA Livestock Consulting Internship (LCI) and alumni consultants	Jess Brogden, SFS	NSW, Vic.	March, 2021	Delivered online. Competency assessed within workshop.
Consultants for bushfire recovery, Coopers, Mt Torrens and DJ Growers, Woodside	Cam Nicholson	Adelaide hills area, SA	October 2021	Delivered online. Organised by for the Adelaide hills and Fleurieu landscapes Board. Competency assessed within workshop.
Total				**7 workshops**

An additional eight workshops shown in table 6 involved PP training, but it was not the focus of the workshops and therefore the evaluation information collected did not either. The workshops were run from June 2021 onwards when Covid restrictions had eased and so the workshops were delivered face to face. In these workshops, there was a quick overview of the product, how to use it and where possible, a demonstration given, or the instructional video shown. The length of the time dedicated to PP depended on how familiar the audience was with using the tool.

Table 6. Agronomist/advisor workshop training details where PP was an additional topic.

Training event name	**Presenter**	**Location of agronomists/ advisors**	**Date**	**Methodology**
More sub-clover focussed workshops X3 agronomy retailers/advisors	Cam Nicholson or Jess Brogden	Mix of locations. Nutrien -SW Victoria and central Victoria Vickery and McDonald Bros – Hamilton and Coleraine, Premium Ag consulting- Inverleigh, Elders – Victoria, SA and southern NSW	June 2021 and September 2021	Face to Face delivery except for Elders which was online. Reported in L.FAP. 1901. Involved hands on practice in paddock except for Elders online workshop.
Less Weed Workshops x4 with agronomy retailers	Cam Nicolson, or Jess Brogden	Open agronomist event- SW Victoria Gorst Rural - Lake Bolac, Elders – Victoria, SA and southern NSW	February 2022	Face to Face delivery except for Elders which was online. Reported in L.FAP.1904.
National Retail Independent (NRI) agronomists overview of MLA products	Lisa Miller, SFS	Agronomists from all over Victoria	March 2022	Face to Face delivery. Feedback sheets collected.
Total				**8 workshops**

At the completion of workshops, advisors were sent links to products and PP Frequently Asked Questions.

In addition, there were agronomists who requested PP kits to carry out producer training and were encouraged to watch the video as a training exercise.

3.2.2 Training of producers to build knowledge and skills

A contract variation in September 2019 saw additional extension activities added to help to build producers knowledge and skills in using Pasture Paramedic and the number of workshops for delivery increased to six.

Details of training with producers that involved PP use only (eight workshops) is shown in table 7.

Table 7. Producer workshop details where PP was the main focus.

Name of event	**Presenter**	**Location**	**Date**	**Methodology**
Marcus Oldham first year Ag students, Geelong	Cam Nicholson	Geelong	February 2020	PP outlined in classroom and then practiced in the paddock in an assessment.
Agrifocus Geelong, Streatham and Hamilton x3 workshops	Jess Brogden	SW Victoria	September 2020	Online training event, assessment was done through entering scores in the chat box and post survey.
Young farmers Beechworth group	Jess Brogden	NE Victoria	March 2021	Online training event, assessment was done through entering scores in the chat box and post survey.
Marcus Oldham Final year Ag students, Geelong	Cam Nicholson	Australia wide	March 2021	Students were shown the PP tool and undertook a late winter assessment of five paddocks as part of an assessable assignment.
Rokewood SFS Branch, Illabarook & Mannibadar x 2 workshops	Cam Nicholson + Jen Clarke, SFS	Woady Yaloak catchment, Vic.	March 2021	Face to Face event. Paddock use formed part of evaluation.
Total				**8 workshops**

There were also numerous workshops that were held over the project period where PP was used as part of another workshop where assessment of pastures was required (9 workshops). Covid disrupted presentations, with many events being delivered online and some cancelled repeatedly (e.g. GSSA Hamilton branch field day was cancelled on Aug 10th, August 26th and October 12th 2021 and will be run in Dunkeld in June 2022.

Part of the reason for the high number of producer workshops was demand but also because it fitted well into other workshops and events involving farm walks.

Table 8. Producer workshop training details where PP was an additional topic.

Name of event	**Presenter**	**Location of producers**	**Date**	**Methodology**
Ground cover and feed crops in dry times x 2 workshops, Omeo, Bengworden	Lisa Miller	East Gippsland	July 2019	PP training and explanation occurred in a paddock. Tool was demonstrated and producers encouraged to try.
Tasmanian NRM North pasture workshop, Longford, Tasmania	Jess Brogden, SFS	Northern Tasmania	February 2020	PP outlined in shed and then demonstrated in paddock
PGS Mixed Farming, Tatyoon	Cam Nicholson	SW Victoria	March 2020	PP overview and paddock demonstration and practice.
PGS PayDirt Session 1 X 4 groups, Mannibadar, Rokewood, Dunkeld, Streatham	Cam Nicholson + Jen Clarke	SW Victoria	April and May 2021	Overview of the product given and demonstration of how to use. Majority of producers had already received training.
Elders' producer event, St Arnaud	Jess Brogden	Wimmera, Victoria	March 2022	PP training was held in store.
Totals				**9 workshops**

3.2.3 Raising awareness via advisor and producer expo days and media

Pasture Paramedic was promoted at three agronomist/advisor major events. Details are shown in table 9.

Table 9. Details of PP promotion at advisor major events.

Event name	**Presenter**	**Location of advisors**	**Date**	**Methodology**
BestWool/Best Lamb and Better Beef Facilitator's meeting, Attwood	Cam Nicholson	Throughout Victoria	February 2020	Face to Face.
SA Livestock advisors conference	Cam Nicholson	Mainly SA advisors/consultants	July 2020	Online delivery
BestWool/Best Lamb and Better Beef Facilitator's meeting, Bendigo	Cam Nicholson	Throughout Victoria	March 2022	Face to Face.

Total				**3 workshops**

Pasture Paramedic was also promoted at four major producer events. There had been a number of invitations to major events that were cancelled due to Covid, such as Sheep Connect, in August 2021 and again in February, 2022 and the PPS conference in 2020 and 2021.

Table 10. Details of PP promotion at producer major events.

Event name	**Presenter**	**Location of producers**	**Date**	**Methodology**
MLA Update: New MLA Feed base Adoption Projects (FAP) coming your way, Stawell	Lisa Miller	Mainly Upper Wimmera producers	April 2019	Face to face delivery
SheepVention	Jess Brogden	SW Vic. producers	August 2019	Promotion at stand
PPS conference: Adopting change; a look to the future, Ararat	Cam Nicholson	Upper Wimmera producers	September 2019	Face to face delivery
SFS Agrifocus 2019, Inverleigh	Jess Brogden	SW Vic. mixed farming producers	October 2019	Face to face delivery
MLA Red Meat and AGM, Tamworth	Jess Brogden	Mainly NSW producers	November 2019	Promotion at stand
MeatUp, Feedbase - what is there? Gawler	Cam Nicholson	SA producers	March 2021	Face to face delivery
Gippsland Field days	Natalie Jenkins	Gippsland farmers	March 2022	Promotion at stand
Total				**7 events**

There was also various media used to promote Pasture Paramedic which is outlined in table 11.

Table 11. Media related to PP promotion and use.

Media description	**Details**
News article	Utilised assessments from Pasture Paramedic. Published 14 February 2019 in MLA Friday Feedback E newsletter. "Are my pastures stuffed?" | Meat & Livestock Australia (mla.com.au)

News article	Published Farming Ahead Kondinin Group magazine, December 2019
Radio interview	ABC radio for Landline, Tasmania - February 2020.
News article	Pasture Paramedic to the rescue – Use this visual guide to identify and assess perennial grasses, clovers and weeds this winter. Published 28 May 2021 in MLA Friday Feedback E newsletter
Making more from Sheep	Pasture Paramedic signposted to in Making more from Sheep module 7 Pastures and module 5 Protect your farm's assets. The 2008 version was updated and changes submitted to AWI at the end of June 2021.
News article	Three ways to capitalise on your natural assets for better grazing. Encourages monitoring of groundcover using Pasture Paramedic. Published Feedback magazine April 2022

3.3 Premium pasture events

The Premium pasture events objective was for hosting two regional events where leading pasture managers come to together and interact. There was difficulty in achieving face to face events with Covid and to ask guest speakers to travel. Therefore, this was achieved using online seminars with numbers of producers restricted to 20 to encourage interaction.

3.3.1 Selective Herbicide Workshop – What can we use in pastures?

The first event was run in February 2021 titled Selective Herbicides – what can we use in pastures?

This topic was chosen because of its complexity and interest to producers. Unfortunately label recommendations for many selective herbicides do not state their impact on other desirable species. Most commonly this is the case when trying to remove grass weeds from perennial grass and legume swards. The label refers to 'legume-based pastures', with limited or no reference to the desirable grass species such as ryegrass, phalaris, tall fescue or cocksfoot. This workshop was to find out what selective herbicides could be safely used.

Cam Nicholson, Nicon Rural facilitated the event with presentations from three main herbicide company (Adama; Nufarm and Sipcam) field researchers on the pasture scenario presented below:

A farmer has an established pasture which was sown with the big four grasses (perennial ryegrass, phalaris, tall fescue, cocksfoot) and sub-clover 8 years ago. It has been limed, rotationally grazed and has a good fertiliser history.

However, some weeds are present and getting worse. The main weeds are barley grass, soft brome, silver grass, capeweed and erodium.

The farmer has tried the more common methods of weed control such as spray-grazing, spray-topping, and winter cleaning (with Simazine) and has been reasonably happy but, has heard in passing about some of the more specific herbicide options. The farmer has never used any of the 'selectives' before and is unsure of the impact in a mixed perennial grass and sub-clover pasture.

Satisfaction was recorded and feedback comments were collected from the zoom chat box.

3.3.2 Nitrogen use in pastures - Can we improve?

This online workshop was run in April 2022. This topic emerged from the "Healthy Soils" regional event as an area of interest and was topical given the high prices of nitrogen fertiliser.

The value proposition for producers was the following:

Nitrogen (N) has high importance in the pasture system for providing additional growth. With current prices, we are unlikely to use bagged N this year, but with N critical to productive pastures, how can we manage to maximise biological N? And when prices fall, where is the place for bagged N?

The topics and speakers were:

Is nitrogen constraining productivity of perennial pastures? – Pasture Consultant

- Pasture nitrogen requirements – how much is needed?
- N cycle – sources of N - The role of clovers and decomposition of plant material.
- When is N supplied & when might pastures be deficient?
- What yield advantage can be gained by supplying more nitrogen to perennial pastures?

Maximising legume N contribution in mixed pastures- Researcher from NSW DPI

- How much N do we get from clovers and when?
- If relying on legumes in the pasture system to supply the required nitrogen, how can nitrogen fixation be maximised?
- If using both N fertiliser and clover, what rules apply to maximise production & profit?

How to use fertiliser N successfully -Technical advisor, Incitec Pivot Fertilisers

- At what price is there a place for bagged N in pastures (beef/cattle)?
- If additional nitrogen is being supplied as fertiliser – what application rates should be used, how many applications per year, when should these applications occur (timing, growing conditions) and which pastures should be targeted?
- Is there any role for using soil testing to monitor N levels in pastures and, if so, how do we make it accurate?
- What are the environmental implications of increasing nitrogen levels in a perennial pasture system and how to minimise them? N losses, denitrification, leaching.

Producers registered for the event and filled out a baseline survey and were asked to fill out the same questions at the completion of the event. Being an online event, it was harder to get people to provide feedback.

The questions used in the Nitrogen seminar were:

- At what times of the year is soil available nitrogen likely to be insufficient to meet pasture or fodder growth requirements?
- What factors affect plants ability to fix maximum nitrogen levels? That is provide 25 to 28 kg N/ha per tonne of legume dry matter.

- What are common practices that cause environmental loss of fertiliser nitrogen and reduce availability to plants?
- What is your confidence in making nitrogen decisions in pastures for the year ahead?

An additional question was asked post survey.

- On a scale of 1 to 5 how would you rate the value of this workshop in helping you make nitrogen decisions?

3.4 Audit of existing tools / products and recommendations

This output was part of a contract variation. As SFS was contracted to develop new products to renew interest in pastures and pasture management in this project and in Healthy Soils, More Sub-clover and Less Weeds more Feed. (L.FAP.1901- 1904) it was important to identify what information was currently available and useable and what the gaps were.

SFS contracted Cam Nicholson, Nicon Rural to complete the audit. Sixty three 'products' were assessed. Many of these products has multiple components, resulting in close to 300 items being considered.

Items were classified if they supported the manipulation, maintenance or over sowing / resowing pathways. They were also given a 'fit for purpose' rating on a scale of 0 to 10. Additional information on methodology is in appendix 8.3.

3.5 Factsheets

The topics behind the six factsheets were created based mainly on providing different grazing management strategies to support PP decision pathways of maintain, manipulate or resow/over sow. The factsheets were based on a search of current literature support the text written and photographs collected to support text. Throughout the design process producers, agronomists and researchers were involved in making sure the products were suitable and technically correct.

An overview factsheet was created on, "How do I know if my perennial grasses need rescuing?" This was developed to help producers identify what might be causing low perennial grass content in their pastures. It contained a check list to step producers through the main intervention areas needed to get right to improve perennial grass content, grazing green pasture, grazing dry pasture, weeds, pests and environment. Each of these criteria was discussed and producers signposted to other resources for further information.

Two resources were created for advisors. They both went into greater detail about the principles of perennial grass growth and the implications for grazing management. Growth principles would unlikely appeal to producers but understanding how perennial grasses grow and the factors affecting leaf emergence, tiller and root growth enables better management of them. The first of these factsheets was called, "How do I get my pastures to thrive and survive? – a resource for advisors." This covers most of the grazing principles of the growing season. Several pictorials were created to help support learning. The growth principles are envisaged to be used for training purposes and would support eLearning type approaches.

The other advisor resource was “How do I get perennial grasses to thrive and survive in late spring and summer?” This factsheet focused on understanding the common grazing requirements of grasses but also differences in management over late summer and spring which enable production and persistence. It contained tables to easily identify which species are summer active and would therefore require different management over spring and summer compared to winter active grass species. Another feature was that not only it identified the factors common to the plants but individual species requirements. It signposts to the Australian Seed Federation for information on certified seed and seed varieties that are available.

There were two fact sheets developed that were tactical. The first of these was, “How do I optimise seedling recruitment to avoid resowing?” It describes the methodology needed to successfully encourage seedling recruitment and how it can help restore the density of perennial ryegrass and cocksfoot paddocks.

The second tactical fact sheet was, “How do I remove excess mature reproductive pasture?” It describes the importance of removing the dead seed heads to encourage new growth in summer and autumn. It contains strategies for management of mature feed in late spring and tactics for removal of mature feed.

The final fact sheet developed was, “How do I respond to challenges in grazing mixed pastures?” It was written recognising that producers cannot always implement ideal grazing practices and there are common unavoidable challenges that occur in grazing mixed pastures. The fact sheet outlines what actions producers should to take to assist pasture recovery and balance grazing requirements of different plants to restore their productivity and maintain their persistence. It contains a quiz of common challenges where producers can think about how they would respond and then check what is the appropriate response and the reasoning behind it. This activity will lend itself well to eLearning and for learning activities within workshops.

3.6 Secrets of success producer stories

The creation of producer stories was for “champion” producers to share their secrets with pasture management with the objective of getting other producers to adopt similar practices. A list of potential case study topics and the principles related to pasture management that we wanted to convey was compiled. Producers who were recognised for doing these practices well were sought out and approached to help. Producers were interviewed over the phone and their stories written.

It was relatively easy to find “champion producers” that were connected to the network of SFS in southwest Victoria and Gippsland and Tasmania. However, despite six Tasmanian producers being approached, none would commit. There was one story written for Northeast Victoria that was outsourced to another consultant, to cover grazing management challenges in hill country. The producer stories were published through MLA’s Friday Feedback electronic newsletter.

It was initially envisaged that an interactive map could have been created, that producers could visually see where producers were located and click to access stories applicable to them. However, this didn’t proceed for numerous reasons. Firstly, the map would need to be supported by MLA website which was undergoing development and needed the commitment to incorporate it. The producer stories were relevant across many different regional boundaries.

Details of the 10 secret of success stories are given in table 12.

Table 12. Outline of secret of success producer stories

	Story title	Key messages and principles	Location & stock type
1	Mastering the management of tall fescue	Matching species to growing conditions. Maximising growth by irrigation, grazing management and plant nutrition.	SW Victoria, cattle
2	Extending the lifespan of productive pasture	Making pastures pay. Management of highly productive but short term ryegrass to increase its longevity to pay for its establishment costs.	SW Victoria, lamb production
3	Top tips for seedling recruitment	Using seedling recruitment to increase density of a thinned out pasture.	SW Victoria, cattle
4	Secrets to sowing pastures successfully	Keys to successful pasture establishment.	East Gippsland, lamb production
5	Five ways to manage annual weeds	Competitive weeds reduce growth and persistence of desirable sown species.	SW Victoria, lamb production
6	Grazing management throughout the seasons	The challenges of grazing in different seasons and what to focus on achieving.	SW Victoria, lamb production
7	A phalaris cultivar match made in heaven	Selection winter active pasture cultivars to improve growth over winter to match feed demand.	SW Victoria, lamb production
8	Pasture Paramedic shows treatment needed but no hospital case	How using Pasture Paramedic helps with pasture decision making	SW Victoria, sheep stud for lamb production
9	Fertiliser secures feedbase	Promoting pasture growth by using fertiliser and matching it to animal demands.	SW Victoria, cattle, sheep
10	Game changers in hill country	Land classing fencing, nutrient management, species introduction and rotational grazing improve pasture production and groundcover in degraded hill country.	NE Victoria

3.7 How to pick suitable pasture species

When producers were directed towards resowing, then the pasture package needed to support them in selecting suitable species that will persist for the production level required and management. Hence something was needed on how to pick suitable pasture species.

When the project was written, it was envisaged that the highly successful Pasture Picker – pasture selection tool from Pastures Australia could be updated and promoted. Due to multiple ownership issues (AWI, GRDC, MLA, RIRDC and Dairy Australia), this was not feasible. It was last updated in about 2008.

As Pasture Picker was not available, a short video was instead produced on how to use the Pasture Trial Network (PTN) tool that is located on the MLA website. During the video production, the PTN executive officer and board were consulted, and some suggested changes were made.

3.8 Moisture probe feasibility report

A component of this project was to assess the feasibility of establishing a soil moisture stress alert system to forewarn producers of pending reduction in pasture growth. This request was in response to the potential opportunity the proliferation of soil moisture probes on grazing properties and if the benefits described in irrigation and cropping could also be realised in grazing.

The methodology used in assessment of feasibility was to consider the possible value from soil moisture monitoring in pastures and was explored in three parts:

1. New information gained
2. Knowledge created from the information
3. Using the data to inform a decision

Simulations for a perennial pasture site at Penshurst in southwest Victoria using GrassGro® were completed to see if soil moisture probe data measured on August 1, would be useful to inform likely pasture growth to the end of December.

A short report was written by Cam Nicholson, Nicon Rural.

4.1 Pasture Paramedic

The product testing showed the process worked and refinements were made based on feedback (see table 13 and Appendix 8.1). Surveys of producer temperament type showed preferences for learning materials information mainly matched that of the literature and that the PP tool offered something for each of the four groups. It contained enough detail to satisfy the S types (propensity for details, facts and figures) and the N types (big picture learning) understood the concept of assessing pasture condition to inform management.

Table 13. Feedback given by the participants and changes made to tool

Event/Workshop	Feedback received/observed	Changes undertaken
BestWool /BestLamb groups	Suggested order of dry season assessment illogical.	Changed order for assessment
	Wanted a 'where to next' after they had done the assessment.	Created pathways diagrams to include in the instruction booklet
	Logo too gimmicky	Logo picture removed.
	It doesn't need to be perfect, the concept is sound and takes into account the main reasons that are used to make a decision and it will work about 80% of the time.	
Women on Farms groups on the recording booklet	Wanted the assessment booklet to record what the dominant weed was for paddock records & for potential manipulation.	Change was included in the booklet.
	Include a worked example to show how to fill it out.	A worked example wasn't included by an explanation is included in how to use section.

	Apart from date, they wanted the stage or how many weeks past break, so can be compared for monitoring purposes.	Only date included
	Wanted which weeds fitted into which category, example Capeweed, cat 1. Could be a small table at the bottom.	This feature was included in the assessment book and could be later included on the tool in the next print run.
Omeo workshop on using the tool.	Producers struggled to identify plant species. This would be a barrier for them to use the tool. It could be a major reason they currently don't do assessment.	More emphasis put into the weed identification part of the guide.
	Three agronomists present believed the tool was highly relevant and a great learning device.	
SFS SheepVention, Hamilton	Assessment pictures were not clear enough.	As a result, new photos were taken to try and better guide scoring.
	Need to be able to read the wording on each face from the one position rather than moving around the quadrat	The Critical Assessment 3 text on one quadrat face was to be arranged for easier reading.

Of the 2000 copies of the Pasture Paramedic kit for southern high rainfall containing measurement tool, recording booklet, technical manual and pen that were printed, there is approximately, there were 420 remaining in May 2022.

The breakdown on the demand for kits requests has been:

- Advisors: 43% (mainly for training of producers)
- Producers: 44%
- Teachers/Ag colleges requesting kits: 13%

There has also been demand for use related to disasters/droughts.

- Two different bushfire recovery programs. One in NE Victoria and one in Adelaide hills, SA.
- Drought – Gippsland, used to assess pasture condition following drought.

It has also been evident that the PP use can be utilised through many different training topic workshops and paddocks walks.

People who request kits from SFS are instructed to watch the Video: How to use Pasture Paramedic https://www.youtube.com/watch?v=SxUdA8ojkJY&t=5s The video was uploaded in September 2020 onto YouTube and has had 986 views. It was uploaded onto the SFS YouTube channel website in May 2020 and has had an additional 418 views.

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4 | Pasture Paramedic

Figure 5. The PP manual front cover and contents page.

The online version is available from this link [pasture-paramedic.pdf (mla.com.au)](). QR code data metrics showed that there have been 265 views of the online technical manual since August 2020, predominately made from phones and one scan was made from an Ipad. Many views have been in Victoria, which is understandable given the tool relates to the high rainfall southern area.

Views of the MLA PP web page was viewed 2,833 times by 1,770 people. Information on PP is accessible through the Persistent pastures hub which was viewed 4,070 times by 1,789 people. This tends to indicate that a high number (approx. 70%) of visitors to the Persistent pasture's hub, proceeded to the Pasture Paramedic section.

4.2 Producer and advisor training

4.2.1 Training advisor workshops

There was an objective to deliver four training advisor workshops on using Pasture Paramedic. The purpose of the workshops was not only to increase their skill and awareness of the tool but in turn use and promote it with their clients. Seven workshops were held exclusively on PP training (see table 14) but there was another eight that included PP training and introduction to use in the presentation of other topics such as weed, sub-clover or feedbase management.

A summary of these workshops is given in tables 14 and 15 and show collectively 165 advisors were trained.

Table 14. Advisor training outcomes where PP was the main focus.

Training event name & date	No of Advisors	% of participants showing skill increase	Outcomes
AgVic BestWool/Best Lamb Coordinator and an East	2	100%	• BWBL co-ordinator organised training for the facilitators (Dec 2020).

Gippsland Better Beef facilitator. August 2020			• East Gippsland beef facilitator has trained two groups in the use of PP (Oct 2020 for use in PDS monitoring) and trained an additional group in Mar 2022. This training was supported by sending a training PowerPoint. • Training of 5 producers from Oct 2020 indicated ratings were: 3 met and 2 exceeded. The overall accuracy of the group in assessments was 60%. The group had had difficulties in distinguishing different grass species.
BWBL and BB Facilitators December, 2020	18 (10 were AgVic. and 8 private consultants)	100% accuracy using the high rainfall scoring system but less accuracy (86%) in using the medium rainfall assessment. The reason being the addition of scoring in the medium rainfall version was more complicated, as participants made errors with adding up percentages	• 100 kits sent to AgVic for distribution. • Thought to be initially limited as the BWBL/BB groups had not been allowed to meet with their groups because of Covid. Follow up approaches were made from a Beechworth facilitator organised online training for her young farmers group and was supported in delivery for a workshop in March 2022. • PPS facilitator – requested speaking engagement and materials to be available at PPS conference. • Two facilitators planned to use the tool with their producers to assess PDS projects.
Gorst Rural September 2020	10	100% as evident from their scores entered into chat box but did not return post assessment survey	Leader requested a MLA sub-clover workshop
Nutrien October, 2020	6	100% as evident from their scores entered into chat box but did not return post assessment survey	All advisors went on to participate in a MLA pilot sub-clover workshop. They also requested for young advisors and clients to do PayDirt training

AGF Seeds, October 2020	6	100% as evident from their scores entered into chat box but did not return post assessment survey	• Requested SFS to present the products to GSSA Hamilton field day in 2021 (subsequently cancelled). • Requested and hosted training for National Retail Independent agronomists.
MLA LCI (intern and alumni) March 2021	4	• Winter early spring from the showed 100% accuracy. • Summer assessment showed 75% accuracy due to an under estimation of ground litter. • Also going through a worked example during the course, 75% accuracy was achieved in making the right decision from answers submitted in filled out score cards. • 50% rated the event as exceeding expectations and 50% said it met expectations.	Request 40 kits for training producers
Consultants (Coopers, Mt Torrens and DJ Growers, Woodside) for Adelaide Bushfire recovery	2	Consultants were assessed as competent	Initially 100 kits requested and used for training producers. They ran out and another 20 sent.
Total	**48**		**7 workshops**

Table 15. Agronomist/advisor workshop training outcomes where PP was an additional topic.

Training event name & date	**No of Advisors**	**% of participants showing skill increase**	**Outcomes**
4 workshops PP training in More sub-clover workshops	47	Reported in LFAP -1904, Participants observed to use PP in face to face events.	Nutrien advertised use of Pasture Paramedic to clients. All 14 Nutrien agronomists collected kits, indicating their potential intention to use them.
3 workshops PP training in Weed Workshops (Open agro event-Ballarat, Gorst	55	Reported in LFAP 1901. PP not used directly in workshop, as approximately half had prior training.	Elders requested presentation at St Arnaud producer's day.

Rural- Lake Bolac, Elders - online) February 2022			
PP training of Independent agronomists in overview of MLA products at AGF Seeds, Smeeton March 2022	15	PP tool not practiced in paddock as it was between seasonal assessment times. 11 respondent, satisfaction rating 4.9.	Seymour agronomist requested training package to present at Seymour Farming expo. Advisor requested additional 9 kits for training Longerenong Ag college students.
Totals	**117**		**8 workshops**

Qualitative feedback collected from the workshops indicated that the workshops worked well for increasing awareness of the PP tool and other MLA products and that agronomists valued the workshops and the products created. Examples of qualitative data:

- "How much info there is for diagnosing pasture issues," NRI agronomist.
- "The amount of resources and projects available," NRI agronomist.
- "Highlighted decision support tools and literature that are available." Elders.
- "These workshops are great and provide a great bridge between the research side of the industry and commercial," NRI.
- "Was super informative," NRI.
- "Extremely high value," NRI.
- "Simple system approach, easy to understand," NRI.
- "Helps them prioritise paddocks to work on. Creates opportunity for them to do better." AGF seeds.

Agronomists saw value in the PP tool and indicated they valued its objectivity, rather than it being seen to be their opinion. Examples:

- "This will make our jobs easier. Difficult for us to say it's (farmers paddock) bad. It will encourage them to look down and see," Nutrien agronomist.
- "MLA has done it, so it makes the information objective, not us telling them," Nutrien.
- "Rather than selling product, we are seen to be selling good information," Nutrien
- "Decision making matrix to run through with clients – not "opinion" based," Vickeries/McDonald Bros.

There was higher value to junior agronomists or agronomists learning about pastures. Examples:

- "Great session, as a trainee agro this session has been very insightful." Elders.
- "Being a young agronomist in the industry, the products will be used as an education tool," NRI.
- "Being a graduate agronomist, this will help immensely," NRI.
- "I really enjoyed learning about all the resources available coming from being a cropping/agronomist to pasture, it is super helpful to know," NRI.
- "It was all positive form the Agros – good information, more benefits for the junior staff and even the older agro's got something from it," Nutrien.

Agronomists identified their intention to use products and how they would use them. Examples of feedback:

- "Save pasture Paramedic to phone-show and utilise with clients," Open agronomist event.
- “Use fact sheets to back up recommendations to producers,” NRI
- “Will be a handy resource and ute guide when out in the paddock,” NRI.
- “Will use square with growers who aren't really switched on with pasture composition to get them doing it themselves," Open agronomist event.
- “Get some more tools to give out, use examples of data at presentations,” NRI.
- “Email out factsheet links to products. Talk on fact sheets at one of our grower trial sites field days,” NRI.
- “Talk on factsheets at one of our grower trial sites field days,” NRI.
- "Direct clients to this information, use information for consultancy," Open agronomist event.
- "Better advice to producers; spreading the word re-information and tools available," Open agronomist event.

The workshops helped build agronomist confidence to use the tools. Examples:

- "Definitely helped expand my knowledge on pasture assessment as I come from an animal’s science background. I definitely feel more confident now to go out and make some visual assessments for/with my producers,” LCI.
- “For using with my clients to help them and not only give them more knowledge and confidence but myself too,” NRI.

4.2.2 Training of producers to build knowledge and skills

There was an objective of delivering six producer workshops. Seven workshops (table 16) were delivered just with PP training, but it was also incorporated into other nine workshops and field days (table 17) due to demand and applicability of the tool. A total number of 290 producers has occurred through 16 workshops.

Table 16. Producer training outcomes where PP was the main focus.

Name of event	**Number of producers**	**Evaluation data**	**Outcomes**
Training Marcus Oldham First year students February 2020	30	All observed to be competent in use in assessment of paddock and all came to the same decision treatment of manipulation.	Students wanted to know if there were tools available for their locality, as students come from all over Australia.
Agrifocus September, 2020 x3 workshops	23	There was an average of 82% accuracy in using the tool by 18 participants who completed the assessment online. Satisfaction rating 6% met, 61% exceeded and 33% very much exceeded workshop expectations.	Facilitator from WRIST, Hamilton wanted to access training support for students. Kits were dropped off at agricultural stores for pick up by participants.

Young farmers group Beechworth, March 2021	15	• Summer ground cover: 100% correct • Summer number of live plants: 50% correct (There was some difficulty in recognising plants due to online photo). • Winter assessment: 80% correct. • Summer assessment: 100% correct. • “Great tool, thanks Jess, will use" • "Thanks for your time tonight, terrific presentation some terrific info, top stuff"	• Group used tool to take assessments of their PDS. • The group facilitator increased their confidence and skill and subsequently ran a second training event for the group in March 2022. • Information from the producers was collected on actions and producers’ intent to use from the March 2022 event. • From the survey, 58% rated the tool as easy to use but wouldn’t use in again. The remaining 42% intended to use it in future.
Marcus Oldham Final year Ag students March 2021	30	• Students were shown the PP tool and undertook a late winter assessment of five paddocks as part of an assessable assignment. • All showed competency in using the tool (based on scores) and came to the same conclusion about prioritisation of future action.	Students from northern NSW and WA requested copies of the new PP tools being created for these zones as they can see use on their farms when they get home.
Rokewood SFS Branch PP Training Day, March 2021	16	• Skills and knowledge were confirmed by each participant contributing at least one assessment, to score the overall paddock. • They also indicated that they were confident in using the tool. • In subsequent PayDirt sessions, producers, who had completed these Pasture Paramedic training sessions, were asked to get up and explain to the broader group how to use the PP pasture assessment tools and they did that successfully.	As a consequence of the success of Pasture Paramedic, 100% of participants went on to enrol their business in PayDirt PGS training, indicating that they felt that the content delivered was valuable and something that they wanted to build on with the complementary knowledge and skills being offered by the PayDirt series.
Totals	**114**		**7 workshops**

Table 17. Producer workshop training outcomes where PP was an additional topic.

Name of event	Number of producers	Evaluation data	Outcomes
Ground cover and feed crops in dry times workshops x 2 July 2019	44	• Omeo producers used PP in paddock assessment and showed competency. • Struggled with plant identification.	• 50 kits distributed. • Identification that training might be needed on basic plant id. • Not many follow-ups as producers were looking for quick feed and went into a second year of drought.
Tasmanian NRM North Pastures field day February 2020	28	None collected	• Macquarie Franklin advisor who attended requested 100 kits. • 12 follow up requests for kits • ABC radio interview completed
PGS Mixed Farming training March 2020	12	Participants used kits as homework on a test paddock to evaluate pasture condition.	12 kits distributed
Four workshops, PayDirt Session 1 May 2021	38	About 75% had already completed training and the remaining were confident to use.	• 40 kits distributed. Participants used in two paddock assessments to check for fertiliser responsive pastures – no issues reported with use.
Elders, St Arnaud workshop, March 2022	53	High interest. Lots of interaction and questions.	• 40 kits distributed, • Approached by Verbec, to do presentation at Bendigo Elders day. • 4 follow up requests for further kits and fact sheet information
Total numbers	**175**		**9 workshops**

While face to face training events would have been preferred for training than online, mainly for building producer trust, interaction and the added value of application to real life pastures, the online training was still an effective training method. Examples of feedback to support this:

- "I thought the session worked well and even given we couldn't stand in a pasture the use of the photos worked well," Agrifocus
- "Excellent presentation, suits me not to travel this is an idea way to get up to date information," Agrifocus.
- "We have for a long time had the Pasture Paramedic square folding measuring tool but never really been able to put in into practice and today it just clicked, so thank you," Agrifocus.
- "Fantastic webinar, great presentation, incredibly helpful tool," Agrifocus.

It was highlighted from the Beechworth producer's day, that if producers are trained in PP, they still may not adopt and this was not unexpected. As shown with temperament type, different products

appeal to different people and adoption occurs at different times. The Beechworth producers still all took the tool, so may still use it. Producers may also partly adopt the technology. That is not formally score paddocks but still look for key characteristics identified in PP. The criteria for assessment and conditions are relatively simple to remember and if you inspect a paddock you can't necessarily undo that knowledge.

From the Beechworth group feedback, those that indicated that they wouldn't necessarily use PP again had actions that indicated that some would still monitor and that objective management was important. However, many of their actions were around weed management and use of chemical rather than address the cause of weeds which can be related to soil condition. Actions included:

- management of flatweed - need new chemical. (Possible indicator of potassium deficiency)
- winter cleaning for phalaris pastures x2 comments. (Possible indicator of soil acidity)
- Monitor summer weeds.
- Pay more attention to timing for more objective management.

Training of PP treatment pathways and promotion of the now completed products, might help producers better connect pasture condition back to causal reasons, so that they realise better value from PP.

For those that scored in favour of PP their actions were generally more strategic:

- Look closer and be more objective in pasture assessment.
- Pay more attention to timing for more objective management.
- Management of summer weeds- improve this.
- Tactical plan with agro.

Other useful feedback from this group was that they wanted a calendar of events for pasture management.

4.2.3 Raising awareness via advisor and producer expo days and media

The objective was to promote and raise awareness of Pasture Paramedic to advisors at two expo days. Awareness raising occurred at three producer major events to 135 advisors (Table 18) but only in 2019 due to Covid restrictions on participant numbers.

Table 18. Promotion to advisors at major events

Training event name	**No of Participants**	**Outcomes**
BestWool/Best Lamb and Better Beef Facilitator's meeting, February 2020	50	Approached by BW/BL co-ordinator for 100 kits for use in Victoria University Polytechnic agricultural course
SA Livestock advisors conference, July 2020	85	Rural Solutions advisor requested 40 kits
BWBL co-ordinators conference, March 2022	35	Two requests to deliver PP to BWBL groups at Ballarat and Moriac. Request for sub-clover fact sheets for delivery at Gippsland BWBL group.

Totals	**170**	

PP was also promoted at five major producer events to 193 producers (table 19). These were mainly in 2019 and a number of invitations to major events were cancelled due to Covid during 2020 and 2021 (Sheep Connect August 2021 and again in February, 2022 and the PPS conference in 2020 and 2021). There were also four news articles related to Pasture Paramedic and one radio interview that assisted with promotion. It was noted that following promotion, enquiries for kits always increased.

Table 19. Promotion of PP to producers at major events

Training event name	**No of producers**	**Outcomes**
MLA Update: New MLA Feed base Adoption Projects (FAP) coming your way, April 2019	50	Producers and group excited and asked Cam Nicholson to subsequently speak at their conference to give an update on product development.
SheepVention, August 2019	50	50 visits to stand. 35 requests for kits.
PPS conference: Adopting change; a look to the future, September 2019	80	Have since requested to have products on display at their conference but no face to face conferences have occurred in 2020 or 2021.
SFS Agrifocus October 2019	63	50 kits distributed Attendees were shown the tool and how it worked. Due to demand, branch workshops were held to do more training in 2020.
MLA Red Meat and AGM, Tamworth, November 2019	80	120 kits distributed, 32 additional orders made.
MeatUp, Gawler May, 2021	80	20 PP kits distributed. Approached by Adelaide hills and Fleurieu landscapes Board to train two agronomists to use PP in delivery of bushfire recovery.
Gippsland Field days	150	40 kits distributed. 150 visits to stand
Totals	**553**	**7 major events**

4.3 Premium pasture events

The objective of the Premium pasture events was to offer something of value to leading producers and encourage their interaction. In doing this, harvest the information and potentially turn it into a useful product. Covid limited get together opportunities and so both regional events were held online. This had the advantage of saving time in travel for producers and meant they were more likely to attend. Evaluation data and outcomes is shown in Table 20.

A key insight from the Selective herbicide seminar was the identification of gaps in knowledge of selective herbicides efficacy or species tolerance. An opportunity to collect this data could be to partner with herbicide companies and apply herbicide matrices over PTN trial sites at their completion. Additional herbicide tolerance of new species could be collected by overlaying different herbicide applications and creating herbicide matrices. Photos showing pictures of damage at six weeks post application would be quite educational for producers. This would allow a library of new cultivars to be tested. Currently many cultivars that have been tested for herbicide tolerance are no longer commercially available or have been replaced by improved cultivars.

The timing of the Nitrogen use webinar was less than desirable, because many producers would be busy sowing pasture, however, because of the level of interest in the topic, the event was still well attended. Despite it being targeted at producers, there was also interest from advisors. For example, Vickery Bros agronomists planned to have up to 20 agronomists watching it as a training event. This highlights the demand for learning by retailers and agronomy companies.

Table 20 Evaluation data and outcomes from Premium pasture events.

Training event name	**No of Participants**	**Evaluation data**	**Outcomes**
Selective Herbicide Workshop – What can we use in pastures? February 2021	8 producers 9 advisors 4 herbicide company participants Total 23	High satisfaction based on qualitative feedback. Main insights was the realisation that damage to desirables will occur and that there are a number of strategies to minimise this damage.	Much of the information collected was used in development of the fact sheet, "How do I use selective herbicides to safely remove common weeds from sown mixed pastures?''
Nitrogen use in pastures - Can we improve? April 2022	21 plus 9 Longerenong students Total 30	Nitrogen deficiency times; Pre 0%: Post 50% correct Maximising clover N; Pre: 59%: Post 75% correct Losses of N; Pre: 12% Post: 0% correct. Satisfaction: 4.75	The webinar was cut into three speaker sections and placed on SFS Healthy Soils page where it will be promoted and expected to have high numbers of views (> 500 views).

Insights from the nitrogen workshop presented a number of opportunities as outlined below:

- Potential to incorporate nitrogen information collected into a future fact sheet and into the PGS PayDirt course.
- use of soil moisture probes to help in Nitrogen use decisions. A key requirement for using nitrogen is that soils contain at least 50% moisture.
- A gap in producers' knowledge of when nitrogen is deficient in pastures, and what causes environmental losses of nitrogen as identified by surveys.
- Another gap in producer's and advisor's knowledge is their expectation that all cultivars respond equally to nitrogen application, but this is highly dependent on the growing times of

the plants. For example, Australian phalaris shows little response in winter to applications of N because it is genetically not programmed to grow at that time (i.e. semi winter dormant).

- Opportunity to demonstrate nitrogen responses of different species to enforce this learning.
- Further develop a N response/cost tool provided by Incitec Pivot. This tool may not be highly utilised by producers, but would be useful for agronomists and as a teaching aid to show the benefits of applying N.

4.4 Audit of existing tools / products and recommendations

The complete results are outline in appendix 8.2.1. An overview of findings was the identification of some existing products that could be used. These products have subsequently been signposted to in grazing management factsheets.

There were some products that contained relevant content but had some gaps in their explanation or how to apply them. Thirdly there was an absence of information around other topics, some of which have subsequently been addressed as part of this project or other projects. This included:

a. Sub-clover management- addressed in L.FAP.1904
b. Herbicide manipulation – addressed in L.FAP.1901.
c. Climatic influence, growth and suitable species – partly addressed by this project's newly developed factsheets but still requires further attention.
d. Assessment of why a pasture may have failed before resowing- Addressed in factsheet How do I know if my pastures need rescuing?
e. Pest management - partly addressed in in factsheet, How do I know if my pastures need rescuing? Contains signposting to Centre for Environmental Stress and Adaptation Research (CESAR)

The report has suggested opportunities that could be pursued. Some of these opportunities have occurred such as development of new training packages on manipulation and over-sowing and an update the pasture trial network (PTN) so they have more up to date and localised information.

An opportunity that hasn't been addressed was the need to resurrect the pasture picker tool which with the PTN provide valuable components that underpin the proposed PGS resowing package.

4.5 Factsheets

The objective was to create six factsheets. One factsheet was completed in May 2021 and the other five in May 2022. Therefore, there is limited data to evaluate their successfulness. However, based on success and demand of factsheets from the More sub-clover and Less Weeds packages, it is expected the products will have high demand. The factsheets contain good visual information and much of the information is unique and fills an information gap. Key pieces of information that agronomists and producers wanted to know or needed to know has been included in them. It is expected that much of the information will be easily adapted for use in eLearning modules.

The first factsheet completed was, "How do I optimise seedling recruitment to avoid resowing?" This topic was chosen because it is a recognised tactic to ensure persistence of perennial ryegrass and cocksfoot pastures which can thin out over time but there no factsheets had been written on the

topic. The technology had previously been tested in MLA Producer Research Site project (B.FDP.0052) - perennial ryegrass persistence, which produced useful research information and demonstrated a high level of interest by producers. The factsheet contained a useful visual summary of the technique (pictured below) and images that are informative and support text. This allowed it to be easily converted into a MLA eLearning package. The factsheet is available from MLA's pasture hub at [how-do-i-optimise-seedling-recruitment.pdf (mla.com.au)](). Of the 1000 hard copies printed, there is 150 copies remaining.

The factsheets, "How do I get my pastures to thrive and survive'' and ''How do I get perennial grasses to thrive and survive in late spring and summer,'' were initially written as one factsheet but were broken up into two, partly because of length but also because they fitted well into the treatment pathways of PP for manipulation and resowing of green season and dry season management. These factsheets outline principles of growth, and their implications for grazing. Other factsheets tend to provide the grazing management information but without the understanding behind it. The approach used helps to build understanding, so that grazing management can be adapted as different seasonal conditions occur. The factsheet focused on summer management is also relatively unique, as most information often focusses on grazing management during the growing season, and not on summer which can be a major stress and is a critical period for plant persistence in dry environments. There were several infographics created to assist visual learning including:

- How grasses grow and spread.
- Perennial ryegrass growth cycle of tiller development
- Fluctuation in plant reserves under different leaf recovery and re-grazing times.

The factsheet 'How do I respond to challenges in grazing mixed pastures,'' was written in recognition that sometimes best practice management cannot be employed. How producers then respond in managing that pasture will influence its persistence and that there are techniques that can be used to assist in plant recovery. This factsheet was also unique and fills a gap in current extension material.

The grazing principles outlined in "How do I get my pastures to thrive and survive'' and ''How do I get perennial grasses to thrive and survive in late spring and summer,'' have been tested in teaching students at Marcus Oldham Agricultural college. Following this, the students were then given different scenarios presented on cards from the factsheet, ''How do I respond to challenges in

grazing mixed pastures,'' and asked to establish appropriate grazing responses in pairs and report back to the group. The exercise worked well, with students being able to correct others when incorrect grazing responses were given and provide the reasoning why. This teaching method demonstrated how the information could be taught to producers in an engaging and educational way.

The factsheet, "How do I know if my perennial grasses need rescuing'' was written as a resource for when users of Pasture Paramedic scored poorly for desirable grass content. It is similar in its diagnostic approach used in the successful resource developed in the More sub clover project called "How do I determine why my sub-clover is underperforming?" The factsheet contained a check list of what producers need to get right to improve perennial grass content and identify the cause of why desirable grass content might be low. It contains details on the main considerations of what to get right and provides information on pest management with photos of common pests which was identified in the audit as a missing component in MLA resources and importantly signposts to where good pest resources are located. It also links to the resowing aspect of PP by reference to having the right plant in the right location and highlights the main common environmental challenges which affect persistence. This "good management" checklist was used at a workshop on how to increase soil organic carbon from the prospective of improving pasture growth. There was positive response to the factsheet, and it provides a useful summary of what aspects to focus on. It was also shown to National Retail Independent agronomists at their March 2022 workshop, and they expressed desire to have another workshop on the grazing management products developed and have access to these factsheets.

The factsheet was also used to produce a video with the same name. This video was uploaded on April 28 2022, and had 116 views by May 1, 2022 despite no advertising. This indicates there is likely to high demand for this topic.

The final factsheet, "How do I remove excess mature reproductive pasture," was written based on producer complaints on just how difficult it is to achieve with recent wet summers and its impact on both pasture production and persistence. It also links to the factsheets, on perennial grass seedling recruitment and optimising sub-clover content where removal of pasture litter by autumn is required. Again, there was previously a gap in resources available on this topic. The factsheet discusses the many downsides of having excessive spring feed and strategies to utilise it and reduce dry pasture carry over, as well as ways to remove it. The factsheet provides good images on the effect excessive mature feed has on reducing new growth and also effects on animal intake and weight gain via Grazfeed generated graphs.

4.6 Secrets of success producer stories

The 10 secrets of success stories have been a successful way to demonstrate the key messages contained in the factsheets. Eight leading producers were used for the stories and these producers were excellent choices for conveying these messages. The stories were informative, interesting and delivered enough detail, that another producer could apply the techniques used. Five of the ten have been published and show high levels of views.

Table 21. Outcomes of the Secrets of success stories.

	Story title	**Notes**

1	Mastering the management of tall fescue	Published in Friday Feedback 30/7/2021 Mastering the management of tall fescue | Meat & Livestock Australia (mla.com.au) Viewed 2,791 times by 1,352 people
2	Extending the lifespan of productive pasture	https://www.mla.com.au/news-and-events/industry-news/extending-the-lifespan-of-productive-pasture/ Published in Friday Feedback 16 December 2021 Viewed 1,416 times by 811 people
3	Top tips for seedling recruitment	https://www.mla.com.au/news-and-events/industry-news/top-tips-for-seedling-recruitment/ Published in Friday Feedback 19 January 2022 Viewed 1,927 times by 965 people
4	Secrets to sowing pastures successfully	Submitted 26 Nov 2021.
5	Grazing management throughout the seasons: Secrets of success	Published in Friday Feedback 25 March 2022 Grazing management through the seasons: secrets of success | Meat & Livestock Australia (mla.com.au) Viewed 1,825 times by 871 people
6	Five ways to manage annual weeds	Published in Friday Feedback 7 April 2022 Five ways to manage annual weeds | Meat & Livestock Australia (mla.com.au) Viewed 1,252 times by 593 people
7	A phalaris cultivar match made in heaven	Submitted 4 March 2022
8	Pasture Paramedic shows treatment needed but no hospital case	Submitted 3 May, 2022
9	Fertiliser secures feedbase	Submitted June, 2022
10	The game changers in managing hill country	Submitted June, 2022

4.7 How to pick suitable pasture species

To help address the resowing pathway, a video was produced called, “How do I use the online Pasture Trial Network (PTN) tool?” This video steps though how you can use the online Pasture Trial Network tool to confidently select pasture cultivars to give you the seasonal production and persistence you are seeking. The video can be accessed at: https://www.youtube.com/watch?v=nFptI0VOYLE

It was only released on March 15th, 2022 but has had 572 views up until May 2022. The PTN executive officer and advisory board were involved in providing comments on the video and helping to produce it.

In hindsight, they could have been brought into discussions at the script writing stage to capture more of their suggestions. Once video production starts, it becomes more difficult to make changes without having to re- record.

This topic of how to pick suitable pasture species still requires attention and would be best approached through an upgrade of the Pasture Picker tool.

4.8 Moisture probe feasibility report

A component of the Feedbase Adoption Plan (L.FAP.1903) was to assess the feasibility of establishing a soil moisture stress alert system to forewarn producers of pending reduction in pasture growth. This request was in response to the potential opportunity the proliferation of soil moisture probes on grazing properties may have and if the benefits described in irrigation and cropping could also be realised in grazing.

The value proposition for MLA establishing such a system is weak, with the challenges far outweighing the likely benefits.

While the benefits include more accurate quantification of plant available water, what the actual soil water is in the soil at any point in time and the extraction of that water by plants over time (rate, depth), these are largely ‘nice to know’ pieces of information that have limited value in decision making for a grazier.

The challenges for MLA to establish a system are greater including:

The greater challenges MLA would need to overcome and to establish a workable system include:

- The need to facilitate a multitude of soil moisture probe data hosts to ‘pool’ and share data (or for MLA to establish a new system themselves).
- Converting the soil moisture data into meaningful pasture growth estimates.
- Recognition that in many years, the moisture status of a soil is not the greatest limitation on pasture growth, but the equipment and platform would need to be functioning every year so it is operational in the years when needed.
- Developing a robust decision making process to accompany the soil moisture data otherwise what value there is in the data may not be fully realised in better decisions.

The full report submitted to MLA in November 2021 and is available in Appendix 8.3.

5.0 Conclusion

The total number of producers trained in the project was 315 (Pasture Paramedic 290 and Premium pasture events 25) and 182 advisors (165 Pasture Paramedic and Premium Pasture events 17).

5.1 Key findings

- Decision matrices within Pasture Paramedic have worked exceptionally well and allowed the development of an effective but simple process of pasture assessment to inform future management.
- Producers and advisors have embraced Pasture Paramedic and shown high demand but unexpectedly there has been demand from agricultural schools and colleges. This highlights its appeal as a teaching aid for pasture management.
- Not all producers and advisors trained with PP will go onto to use the tool, and this would be expected. However, they cannot undo their learning of what the keys things to look for that indicate its condition are, and that there are treatment pathways to manipulate pasture, rather than having costly resowing.
- The collection and creation of good visual imagery to back up concepts of pasture management enabled and will enable many spinoff products (eLearning, video production, use in producer stories and factsheets).
- Through the audit of extension products, it was found that many gaps in pasture treatment pathways have now been filled by this project and from L.FAP.1901, L.FAP.1902 and L.FAP.1904 but there are still some product updates that would be valuable.
- Merchandise retailers/agronomists indicated they are a great resource to extend the reach of MLA projects in addition to advisors, especially as the majority of producers access information from them.
- Agronomists value the factsheets being produced for practical objective information they can pass onto their clients but training in workshops to show how all the products fit together and complement each other is beneficial.
- The value proposition for MLA to consider investing in the development of a soil moisture stress alert system was considered weak. While there are some benefits, the limitations are significant and largely outweigh the benefits.

5.2 Benefits to industry

The benefit from having a new and rapid assessment method of pastures, will be reinvigorated producers and the opportunity to reinvigorate more producer to take more interest in their pastures. Once they objectively identify what is right or wrong with their pastures and are guided to the most suitable treatment pathway, there are now new products (and recommendations on modifications) to others in place to help them manipulate, resow or maintain their pastures. The benefits of these products will provide a legacy for producers for many years.

Having advisors/merchandise resellers trained in using the products and promoting key messages of good pasture management they will extend the reach of this project and increase producer adoption rates. Having producers actively managing their pastures and improving their condition, will improve red meat production.

6.0 Future research and recommendations

While the project and the additional L.FAP 1901, 1902 and 1904 projects have developed many products for treatment pathways attention is still needed in some areas. These information gaps include:

- Pasture species selection as recommended from the audit of extension products. It should be through update of Pasture Picker. This is also supported by the PTN committee.
- Soil conditions is another area, which requires attention. As highlighted in L.FAP.1902 simplifying fertiliser decisions (i.e. Five easy steps to P) and decision making around soil acidity and nitrogen are also required.
- List of monthly or seasonal pasture management actions to act as prompts for the key actions that need to occur. Most of these have been identified in the L.FAP 1901-1904 projects but could be pulled into a useful product. This was identified by producers from the Beechworth young farmers group.

These should take precedent over MLA investing in development of a soil moisture stress alert system, unless there are significantly more benefits identified. There are currently more in depth analysis currently occurring as part of *a National Landcare project entitled "*Building the resilience and profitability of cropping and grazing farmers in the high rainfall zone of Southern Australia". There may be more opportunities that arise from this or current investigation into moisture thresholds for sown species persistence that can help inform stock removal in drought.

While training of PP has occurred, more training of agronomists/advisors to assist with utilisation and understanding of the key information contained in factsheets would be encouraged, given the favourable response they have had in initial training events.

Pasture Paramedic video could be edited to signpost back the MLA feedbase hub and highlight that more regional PP products are available.

7.0 References

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8.0 Appendix

8.1 **Report on Pasture Paramedic testing of the tool.**

Report on Pasture Paramedic testing of the tool

By Lisa Miller and Jess Brogden, SFS

September 2019

Introduction

A new tool called Pasture Paramedic was developed for producers to use to assess pasture condition and help inform decision making on how to treat it. Before finalising its design and content, the product was tested with a wider range of producers and industry representatives.

Different temperament types of producers and people in industry exist who prefer particular kinds of products and delivery strategies. Information on the temperament type Pasture Paramedic appealed to was collected in case the tool could be improved or additional products created that would better appeal to that temperament group.

The objectives of road testing the Pasture Paramedic tool were to capture:

- feedback on the draft pasture paramedic tool (what's good, what could be better, suggested other products)
- temperament details that can be matched to the Pasture Paramedic responses to try and widen its appeal to producers.

Method

<u>Feedback matched to temperament type</u>

Two producer groups (Best Wool/Best Lamb groups) from across the western district of Victoria that had experience in grazing and mixed farming systems as well as two classes of agricultural students from Marcus Oldham College, the lecturing staff and the year 12 agricultural class of Ballarat Grammar were invited to participate in workshops to test the Pasture Paramedic tool. Each workshop went for four hours.

Each participant was surveyed and assigned a temperament type. The statistics of the temperament types for each group are shown in table 1.

Table 1 Temperament types of participants in road testing Pasture Paramedic

		SJ	**SP**	**NF**	**NT**
	TOTAL	Dependables	Doers	Team builders	Pioneers
MOC lecturers	14	43%	7%	43%	7%
MOC 1st yr Agribusiness	35	34%	23%	17%	26%
MOC 1st yr Agricultural business	32	34%	19%	34%	13%
Ballarat Grammar yr 12 Agriculture	14	14%	29%	43%	14%
Producer groups	15	0%	7%	67%	27%
Total	**110**				

Additional groups

Two Women on Farm groups at Lake Bolac and Hamilton used the tool in the field to assess the pasture condition as part of an "Integrated Weed Management" workshop and to provide information back on recording information for the assessment booklet.

Two farmer groups at Omeo and Bairnsdale used the tool in the field to assess pasture condition as part of Drought Workshops and were used to observe their ease of use.

A display was established at the SFS SheepVention area at Hamilton in August 2019 to showcase the tool and obtain feedback on first impressions and interest levels.

Results

Feedback matched to temperament type

Findings from this project found that Marcus Oldham College had the largest preference for detail learning ('S') with 57% and 53% in the student cross section and a 50% preference in the lecturing staff. On the contrary, the greatest preference for big picture learning ('N') at 93% came from two producer groups as shown in the table above. However, the two producer groups might not be expected to be the normal make up of groups as they were considered to contain mainly leading producers.

Preferences and feedback on the design of Pasture Paramedic and associated extension tactics, mostly reflected what was typical of their temperament type characteristics described in the literature. Although feedback suggested this tool had a bit for everyone. There was enough for the detail people (S type) but even the N types could get the concept, i.e. they got that the critical assessment factors was perennial grasses, clovers and weeds.

For people who are more the sensing or detail types would have a stronger preference for information to be delivered in a written form that is clearly explained and supported by the facts and figures. However, a survey of Marcus Oldham students who were sensing or detail types found many students had a farming phone app, but few actually used it. This may be reflective of detail temperament as they are searching for information but the app actually isn't actually delivering what they need. Therefore, investing in a phone app may not be that effective.

Appeal of the product

Comments received consistently from people in other locations was – do you have a version for WA or Queensland or the drier areas? This indicates the PROCESS is sound, just the CONTENT needs adjustment. Feedback from agronomists believed the tool was highly relevant and have expressed interest in training for its delivery. Demand for training has come from Tasmania and producer groups located at Hamilton and Streatham.

Changes made to the tool based on feedback

From testing the product with producers and agronomists, changes were made to the tool. Table 2 shows examples of some of the feedback and the type of changes made.

Table 2 Feedback given by the participants and changes made to tool

Event/Workshop	Feedback received/observed	Changes undertaken
BestWool /BestLamb groups	Suggested order of dry season assessment illogical.	Changed order for assessment
	Wanted a 'where to next' after they had done the assessment.	Created pathways diagrams to include in the instruction booklet
	Logo too gimmicky	Logo picture removed.
	It doesn't need to be perfect, the concept is sound and takes into account the main reason that are used to make a decision and it will work about 80% of the time.	
Women on Farms groups on the recording booklet	Wanted the assessment booklet to record what the dominant weed was for paddock records & for potential manipulation.	Change was included in the booklet.
	Include a worked example to show how to fill it out.	A worked example wasn't included by an explanation is included in how to use section.
	Apart from date, they wanted the stage or how many weeks past break, so can be compared for monitoring purposes.	Only date included
	Wanted which weeds fitted into which category, example Capeweed, cat 1. Could be a small table at the bottom.	This feature was included in the assessment book and could be later included on the tool in the next print run.
Omeo workshops on using the tool.	Producers struggled to identify plant species. This would be a barrier for them to use the tool. It could be a major reason they currently don't do assessment.	More emphasis put into the weed identification part of the guide.
	Three agronomists present believed the tool was highly relevant and a great learning device.	
SFS SheepVention area at Hamilton	Assessment pictures were not clear enough.	As a result, new photos were taken to try and better guide scoring.
	Need to be able to read the wording on each face from the one position rather than moving around the quadrat	The Critical Assessment 3 text on one quadrat face was to be arranged for easier reading.

Discussion

The tool was tested with different groups, and producers and agronomists liked the concept. They found it simple and easy to use and liked that it had clear decision points.

Agronomists welcomed the development of such as tool as they believed that producers currently did very little assessment of pasture condition, but they needed to. They also believed that producers didn't really know if their pasture was any good or not and therefore did not make good decisions in relation to management. They were happy that the tool encompassed the major assessments needed.

Plant identification was something that producers struggled with, especially when weeds were small, and their skills will need to be a focus with training. Based on this observation, more emphasis was put into identification of the different stages of the plant and distinguishing factors from similar looking plants.

Reference

Brogden J (2019). MLA Industry report.

8.2 Pasture Paramedic Use-Frequently Asked Questions

Timing

Can I take measurements in late autumn?

Yes but…. the green assessment is based on a percentage. So if there are bare spaces when the assessment is made or late germination, the observations will be misleading.

Situation

Could I use it in native grasses?

Yes but…the assessment thresholds are slightly different. There is another Pasture Paramedic version being developed for lower rainfall regions which incorporates native grasses.

My rainfall is less than 500mm; can I still use Pasture Paramedic?

Yes but…… pick the right version.

Usage

Why was 10 measurements per paddock selected; shouldn't it be at least 30?

The more the better but it's a balance of number against accuracy. More measurements will refine the scores but overwhelmingly gives the same decision point.

The important bit is to look for distinct differences before you start – so it may involve several observations within a paddock because the areas are different. For example it's common to have strong phalaris in one part of paddock and a poor patch which may occur on a different soil type.

Should I assess all my paddocks or just the ones I'm concerned about?

Up to you. It can be a useful way to understand how multiple paddocks rank against each other because a cheap intervention in one e.g. a spraygraze may be better than a more expensive need e.g. lime and gypsum.

How often should I use Pasture Paramedic?

Up to you. Pastures rarely change dramatically from one year to the next except under unusual circumstances e.g. drought and overgrazing, overgrown pastures from a never ending spring. But most changes are gradual so every three years should be sufficient.

Sub-clover

Isn't 40% sub-clover too much?

No. Sub clover has the dual benefit of nitrogen for grass growth and improved animal performance.

Bloat can potentially be an issue with cattle but this can be managed.

Could I have oestrogenic clovers?

Recent surveys suggest they are common in medium to high rainfall zones due to their high persistence capabilities, having been sown as commercial varieties or come in through seed contamination. Take the rapid oestrogenic likelihood test to check the likelihood you have them.

1. Do you experience unusually low pregnancy rates or lambing rates? (If no, less likely: If yes, more likely)
2. Has the paddock been resown to sub- clover after 1970 and certified seed used? (If yes, less likely: If no, more likely).

If you answered no and yes to these questions, then the likelihood would be low. If you answered questions that indicated more likely then further investigation is worthwhile.

What score do I give my clovers if I find oestrogenic clovers in my assessment?

Score the clover content, but write beside it if it is oestrogenic. Paddocks considered at risk occur when 20% of the total pasture biomass is oestrogenic. Further investigation will need to occur before an informed decision can be made on paddock management. This information is in the MLA fact sheet How do I replace outclassed or troublesome sub-clover cultivars?
https://sfs.org.au/project/more-sub-clover

Is there a laboratory that can test for oestrogens?

Yes there are a few options. Contact Dr Kevin Foster, University of Western Australia (UWA) to arrange for pasture samples to be tested. (Email: kevin.foster@uwa.edu.au). Larry Walker Southern Scientific Services, Hamilton or arrange testing through your local vet.

However, visual scoring is still necessary, as a paddock sample sent to the laboratory has no real value unless it's related back to the percentage of oestrogenic clovers in the actual pasture base.

Weeds

What if I have other weeds which aren't mentioned; how do I know what category they are?

Best to think about it under the headings of:

- *Contribute to feed supply (length of vegetative stage)*
- *Do animals readily eat it*
- *Any animal health issues*

Most will fall into category B. The categories for different weeds aren't set in concrete and you can score the dominate weed on how it impacts your enterprise.

Why isn't weed content assessed?

It can be inferred from the remaining % of grasses and clovers. There is provision to record the dominant weeds. More investigation would be required if dominant weeds scores are low meaning it is contributing little to the feed supply.

Insect damage

Why aren't insect pests considered?

Pests are likely to impact on the observed grasses, clovers or weeds meaning their contribution may be lower.

Perennial grasses

Won't perennial ryegrass, phalaris, tall fescue and cocksfoot recruit seedlings that can increase desirable live plant numbers in autumn?

Perennial ryegrass and cocksfoot are more likely to than phalaris or tall fescue but to achieve recruitment you need to do certain things. We consider this a possible manipulation technique if grass content was low.

What if I can't tell the difference between perennial ryegrass and annual grass?

Annual ryegrass has a rolled emerging leaf and perennial ryegrass a folded emerging leaf. Check the manual for additional tips (Page 47). But it probably won't make much difference at the assessment stage. Annual ryegrass is considered a Cat A weed, so if it is the dominate weed it will get a score of 3. If you assess it as perennial ryegrass and greater than 50% it will score 5. So, there is not a big difference. However, it is important to know the difference to make pasture improvements.

Groundcover

Isn't ground cover and amount of dry material covering the ground the same thing?

No. Groundcover refers to proportion of soil covered by dry material. Dry material covering the ground refers to the amount of material. It is possible to have 100% groundcover but only 1000 kg/ha or 100% groundcover with 4,000 kg DM/ha.

Resources

My neighbour wants a kit; where do I get one from?

Kits are currently available via training workshops or from watching the Pasture paramedic video and then requesting a copy through MLA's website. Visit Pasture Paramedic | Meat & Livestock Australia (mla.com.au)

Is there an app for recording pasture paramedic measurements?

Not currently but let us know if this is something you think would be useful.

8.3 Audit of existing MLA tools and products

Audit of existing MLA tools and products

Output for the Persistent and Productive Pastures Package (L.FAP.1903)

Aug 2020

Contents

1. Background to the audit

Meat and Livestock Australia (MLA) have contracted Southern Farming Systems (SFS) to develop new products to renew interest in pastures and pasture management (L.FAP.1901- 1904). Development has involved (i) the creation of a new assessment tool and (ii) the 'modernising' of existing information to enable greater use of electronic media (video, visual imagery on computers and smart phones, on line learning etc).

The assessment tool is called *Pasture Paramedic.* It is designed to enable rapid assessment of a pasture and signpost possible actions or pathways for producers to take. The pathways are described as:

- **Manipulation** through grazing, herbicides and soil management
- **Oversowing** and **resowing** to introduce new species
- **Maintaining and optimising** current management.

The 'modernising' of information is intended to support the various pathways described in *Pasture Paramedic*. Topics areas include soils, perennial grass management, weed control and sub-clover. However these four topic areas will not completely cover all information required within each pathway. Additional information is required which may be available from other sources.

Meat and Livestock Australia have a significant amount of information related to these pathways. Products MLA have ownership to use can be found at:

- www.mla.com.au/extension-training-and-tools/creative-commons-licenses/
- www.mla.com.au/research-and-development/Grazing-pasture-management/

Meat and Livestock Australia have partnered and co-owned many other 'products' that may have relevance to the pathways described in *Pasture Paramedic*. These materials require permission from other co-owners before they can be modified which makes them more problematic to use.

It would be unwise to assume the products that currently exist are 'fit for purpose' for use with *Pasture Paramedic*. By 'fit for purpose' this means content is *directly* relevant to the curiosity generated through *Pasture Paramedic*, is the appropriate length, is engaging and if a tool, that the data requirements and outputs readily inform a decision.

An audit is required to examine the alignment of existing MLA products with the direction of *Pasture Paramedic* pathways (figures 1 & 2) and recommend modifications that would make them 'more fit for purpose'.

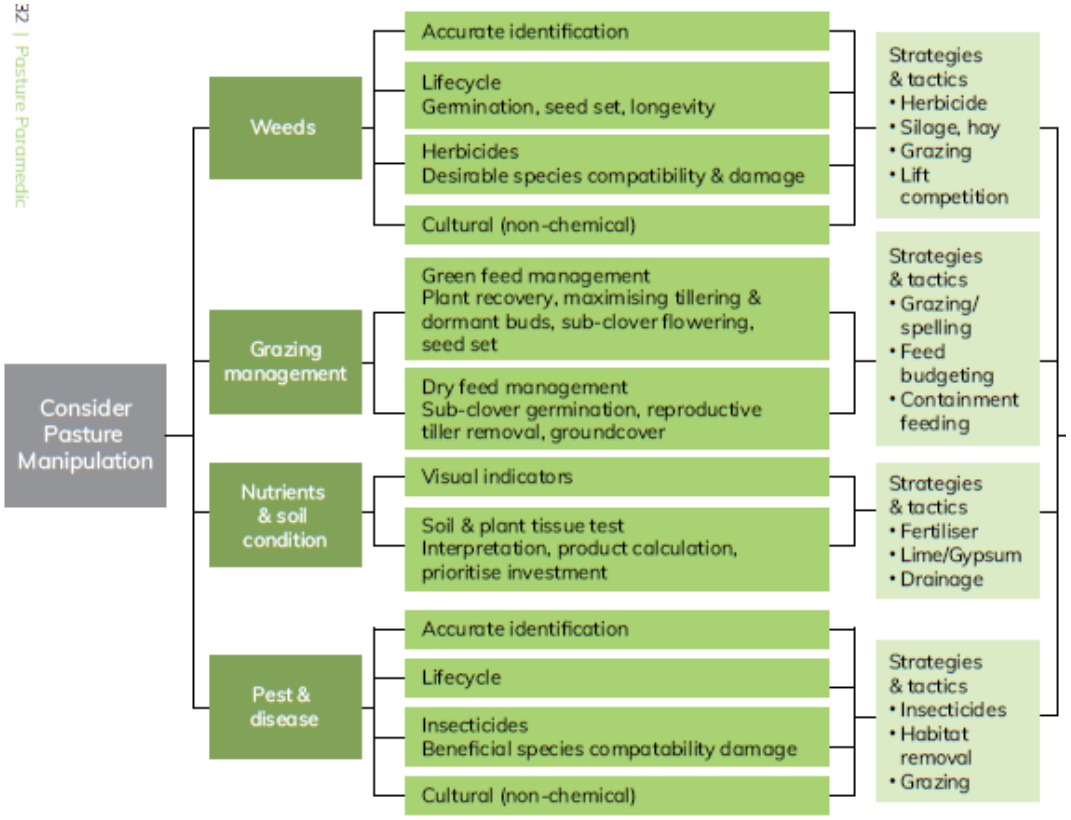


Figure 1: Pathways for pasture manipulation

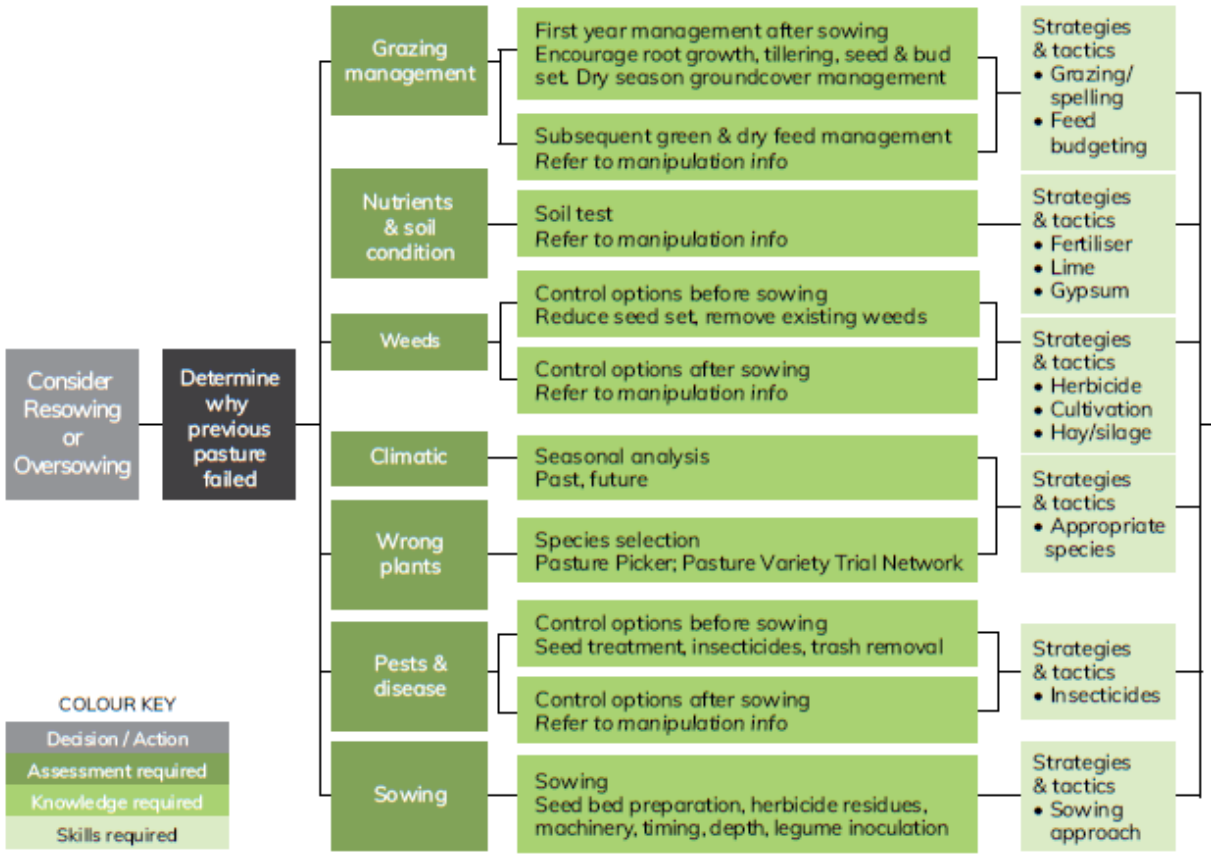


Figure 2: Pathways for oversowing or resowing

2. Audit of 'products' relevant to *Pasture Paramedic* pathways

Sixty three 'products' were assessed. Many of these products has multiple components, resulting is close to 300 items being considered.

Items were classified if they supported the manipulation, maintenance or oversowing / resowing pathways. They were also given a 'fit for purpose' rating on a scale of 0 to 10. The complete assessment is in appendix 1.

The audit results confirm:

2. There are some existing products that could be used 'off the shelf'. However, they are concentrated around:
    a. Grazing principles and approaches for mixed pasture management.
    b. Information on specific perennial grasses and their management.
    c. Tools for feed budgeting.

3. There are some products that contain relevant content but have some gaps in their explanation or how to apply them. i.e. less well explained. This includes:
    a. Soil conditions. Relevant information is available on nutrient cycling and soil biology. Benchmarks are provided to compare against soil test results but not how to calculate requirements or prioritise investment.
    b. Pasture resowing. The cost benefit calculators are relevant but establishment information is dated and variety selection is out of date.

4. There is an absence of information around:
    a. Sub-clover management, with most information on more 'niche' species e.g. lucerne, chicory etc.
    b. Herbicide manipulation, either common herbicide techniques e.g. spraygrazing, wintercleaning, spraytopping or selective herbicides.
    c. Climatic influence, growth and suitable species. There is a Northern Australia example (see sustainable grazing section 2) but is high level and uses averages.
    d. Assessment of why a pasture may have failed before resowing.
    e. Pest management, with this being referred to other sources, often with broken links or out of date information. Information from The Centre for Environmental Stress and Adaptation Research (CESAR) has arguably the most up to date and relevant information to meet this need and should be utilised to fill this gap.

Other observations from the audit include;

1. The materials are extremely wordy. Given most people are visual learners the current materials will only appeal to a few people who have inclination, time and capacity to read and process a massive amount of content.
2. Hyperlinks are overused, to an extent that it is easy to get lost following pathways that are less and less relevant to the original search.
3. Many hyperlinks are broken, especially to those that refer to outside organisations. This is an extremely frustrating process as you feel to have wasted your time pursuing something that can't be accessed.

4. The information is repetitive. While it is understandable different organisations want to create their own products, searching but finding the same or similar information on multiple occasions feels like a waste of time.
5. The search function is incomplete. Relevant information was often found by chance, not by the search function.
6. Considerable effort will be required to turn the existing information into e-learning type products. Much of the content is applicable, but the current form does not encourage learning. This is partly because of a lack of engaging imagery but also the current information 'tells' rather than prompts questioning and a reaction.

3. Suggested actions

Suggested actions have been clustered under two headings:

- Materials that are in the pipeline
- Opportunities that should be pursued

3.1 Materials in the pipeline

Existing materials and projects already under contract with SFS will adequately supply information on several topics identified as deficient in section 2. These will complement existing fit for purpose information.

Activities already under contract under SFS are:

- The development of sub clover information (technical notes, diagnostic guide and video) as part of L.FAP.1904.
- The development of weed control information (technical notes, weed characteristics, intervention guide) as part of L.FAP.1901.
- The development of visual indicators (poster, video, images) as part of the soils package (L.FAP.1902).

3.2 Opportunities that should be pursued

There is considerable opportunity to develop two new PGS training packages to provide continuity from *Pasture Paramedic* to knowledge and skills development.

These training packages would cover:

- **Manipulation,** where the principles of grazing management, soil improvement and herbicide management could be discussed and implemented.
- **Oversowing, resowing**, which would include many of the manipulation principles but also include diagnosis of why the previous pasture failed, species selection and sowing methods.

There is an urgent need to resurrect the **pasture picker tool** and update the **pasture trial network** so they have more up to date and localised information. Both are valuable components to underpin the proposed PGS resowing package.

Appendix 8.2.1 Audit of MLA owner and co-owned products

No	Product name	Short description	Owner	Type	PP intervention			Fit for purpose (0-10)	Comments
					Maintain	Manipulate	Resow		
1	Pasture improvement calculator	Interactive tool to calculate break even and return on investment from pasture resowing.	MLA (EverGraze)	Tools / video			x	10	Useful tool but sensitive to livestock GM and change in stocking rate. Valuable in resowing / manipulation comparisons and understanding the true cost of resowing - Is it worth it?
2	Tips&tools	Making perennial ryegrass-based pastures productive and persistent	MLA	Written	X	X		10	Good information with seasonal tactics and benchmarks
3	Tips&tools	Making phalaris-based pastures productive and persistent	MLA	Written	X	X		10	Good information with seasonal tactics and benchmarks
4	Tips&tools	Maximising production from kikuyu-based pastures	MLA	Written	X	X		10	Good information with seasonal tactics and benchmarks
5	Tips&tools	Get the best out of set stocking	MLA	Written	X	X		10	Good information with seasonal tactics and benchmarks
6	Tips&tools	Intensive rotational grazing	MLA	Written	X	X		10	Good information with seasonal tactics and benchmarks
7	Feed budget and rotational planner	Allows 10 different feed & animal based calculations to be made. Some of questionable value	MLA (EverGraze)	Tools	X	X	X	9	Requires fair bit of data and drop down menu selections. **LINK BROKEN** 1. Pasture growth (2/10). 2. How much feed left after grazing (8/10). 3. How many stock (same as MLA stocking rate calculator) (2/10), 4. Grazing rotational planner (4/10 - overcomplicated), 5. Develop a feed ration (0/10), 6. How long will feed last (8/10), 7. How much feed is required at start of grazing period (3/10), 8. Summer feed budget (9/10), 9. Winter feed budget (6/10), 10. How many hectares (2/10).

No	Product name	Short description	Owner	Type	PP intervention			Fit for purpose (0-10)	Comments
					Maintain	Manipulate	Resow		
8	Tips&tools	Increasing earthworms in pasture	MLA	Written	X	X		9	Useful methods of monitoring, benchmarks and tips for improvement.
9	More Beef from Pastures - Module 3	Pasture utilisation: Details methods to increase stocking rates and adopt a plant growth-based approach to grazing management.	Commons	Written	x	x	x	8	37 pages (wordy) but useful methods on utilisation and discussion on tactical grazing (calculating stocking rate, quantities to start and stop grazing, typical regional average pasture growth rates). Consistent with other info around but need modification for teaching.
10	Making more from sheep - Module 7	Grow more pasture	MLA/AWI	Written	X	X		8	Information on only some of the grazing principles. Benchmarks to assess an existing pasture consistent with Pasture Paramedic but slightly different method. Grazing tactics at the species level but all written. Consistent messages to More Beef from Pastures. Generic info on pasture establishment, with further links to useful but generic NSW docs.
11	Tips&tools	Taking the most of phosphorus fertiliser applied to the soil	MLA	Written	X	X	X	8	Good background info on P cycle and useful tips of management practices
12	Tips&tools	Managing soils to keep them healthy and productive	MLA	Written	X	X		8	Good background material on biological activity and OM
13	More Beef from Pastures - Webinar	Pasture economics 101 for Beef producers *Is pasture improvement making me or breaking me?*	Commons	Video			X	7	Holmes Sackett (John Francis). Focus on return on investment calculation of pasture improvement. Uses a different tool to EverGraze tool but same principles. Steps through the assumptions. Useful intro to the EverGraze tool. Could be used to evaluate possible investment plan.

No	Product name	Short description	Owner	Type	PP intervention			Fit for purpose (0-10)	Comments
					Maintain	Manipulate	Resow		
14	More Beef from Pastures - Module 2	Pasture growth: Helps producers develop expertise in soil, pasture and grazing management to boost productivity and profitability.	Commons	Written	x	x	x	6	50 pages (very wordy). Procedure 3 (Build and maintain soil nutrients to improve soil fertility …) and procedure 4 (Manipulate pasture species composition….) are directly relevant and have useful background information on principles and some numbers. Consistent with other info around but need modification for teaching.
15	Feed demand calculator	Interactive tool to graphically represent feed supply and animal demand	Commons	Tool		X		6	Useful tool to understand utilisation, deficiencies and excess in feed supply, so could be useful in deciding should I bother (i.e. if never short of feed, why improve pasture?). Uses drop down selections to regionalise pasture growth and make easy selections. Requires accurate animal inventory. Biggest limitation is use of average values so no understanding of volatility in feed supply (no understanding of risk).
16	Making more from sheep - Module 6	Healthy soils	MLA/AWI	Written	X	X	X	6	Information on groundcover and soil test values for macronutrients (P,K,S), pH, EC which is consistent with Pasture Paramedic and other soil test data (based on 95% potential yield). Good simple facts on soil biology and impact of herbicides.
17	Sustainable grazing - section 3	Healthy fertile soils	MLA (Farm 300)	Written	X	X		5	Useful text in this section: (1) Maintaining groundcover -good pics and facts (2) Soil texturing (how to) (3) Tactical grazing management, (4) Weed management protecting the pasture investment (5) common fertiliser questions. Has a link to a research report (Kahn, 2014) that contains useful information on results from alternative fertilisers and products. Many **sub links broken** which may contain possibly useful information.

No	Product name	Short description	Owner	Type	PP intervention			Fit for purpose (0-10)	Comments
					Maintain	Manipulate	Resow		
18	Sustainable grazing - section 4	Productive, persistent and profitable pastures	MLA (Farm 300)	Written	X	X		4	Useful generic information with benchmarks that are consistent with *Pasture Paramedic*. Some **sub links broken.**
19	Making more from sheep - Module 8	Turn pasture into product	MLA/AWI	Written		X	X	4	Identifies climate analysis to understand pasture growth but **links to tools broken**. Main focus on feed supply and demand using MLA tool. Useful estimates of regional PGR and change in average pasture growth rates for NSW in better and poorer than average years. Feed budgets as per other tools.
20	More Beef from Pastures - Module 1	Setting directions: Helps producers set clear business objectives and the strategic direction of the beef enterprise.	Commons	Written	x			3	33 pages. Planning and analysis approaches. Most at the whole farm level, so difficult to apply to an individual paddock decision.
21	Sustainable grazing - section 5	Grazing management	MLA (Farm 300)	Written	X	X		3	Generic info not overly useful. Does have grazing definitions (grazing lingo). Some links to incorrect information or **links broken**.
22	More Beef from Pastures - Video	A producer experience from Western Australia	Commons	Video	x			2	Reference to rotational grazing but just in a general sense.
23	Stocking rate calculator	Interactive tool to calculate number of animals in a paddock for a set period of time.	MLA	Tool				2	Limited use if encouraging tactical or rotational grazing, where other calculations (e.g. days feed will last and feed left after grazing) are more useful.

No	Product name	Short description	Owner	Type	PP intervention			Fit for purpose (0-10)	Comments
					Maintain	Manipulate	Resow		
24	Phosphorus tool (P tool) - 5 easy steps	Interactive tool to calculate phosphorus requirements, internal rate of return (IRR) and time to positive cashflow.	MLA	Tool	X	X	X	2	Limited value. Assumes P most limiting nutrient until critical level (95% yield optimum) is reached. Overcomplicated (requires 26 data entries) with the most sensitive information highly variable so assumptions used make large differences in the result (See: *Discussion on possible ways to simplify the 5 easy steps (P tool) - Output for the Healthy soils package* (L.FAP.1902) Nov 2019
25	Sustainable grazing - section 2	Climate variability; using water wisely	MLA (Farm 300)	Written			X	2	General discussion, but possible useful information e.g. seasonal rainfall patterns links broken.
26	Making more from sheep - Module 1	Plan for success - Focus on planning, benchmarks (and calculators to conduct analysis).	MLA/AWI	Written	X	X		2	Limited application
27	Sustainable grazing - section 1	Running a sustainable grazing business:	MLA (Farm 300)	Written				1	Planning and analysis approaches at the whole farm level, so difficult to apply to an individual paddock decision.
28	Making more from sheep - Module 5	Protect your farm's natural assets	MLA/AWI	Written		X		1	Small section on how to consider weed control but main emphasis on noxious weeds rather than pasture weeds. Recommend monitoring via photopoint method. Tactics from weed CRC, generic and focus on native grasses.
29	More Beef from Pastures - Module 4	Cattle genetics: Provides information to help producers lift productivity and profitability through	Commons	Written				0	Not relevant

No	Product name	Short description	Owner	Type	PP intervention			Fit for purpose (0-10)	Comments
					Maintain	Manipulate	Resow		
		ongoing genetic improvement.							
30	More Beef from Pastures - Module 5	Weaner throughput: Outlines practices to determine how and when to wean calves early in order to maximise production and profitability.	Commons	Written				0	Not relevant
31	More Beef from Pastures - Module 6	Herd health and welfare: Outlines procedures required to manage a healthy, productive and profitable cattle herd.	Commons	Written				0	Not relevant
32	More Beef from Pastures - Module 7	Meeting market specifications: Helps producers to increase financial returns by better meeting target market specifications, exploiting market opportunities and managing the risks.	Commons	Written				0	Not relevant
33	More Beef from Pastures - Video	A producer experience from South Australia	Commons	Video				0	Focus on genetics and repro performance not pastures

No	Product name	Short description	Owner	Type	PP intervention			Fit for purpose (0-10)	Comments
					Maintain	Manipulate	Resow		
34	Rainfall to Pasture Growth Outlook tool	Predictive tool of future pasture growth based on climatic conditions	N/A	Tool				0	Tool missing, **Link broken**
35	Cost of production tool	Interactive tool to calculate COP for sheep or cattle	Commons	Tool				0	Well set out and has minimal data input (so useful) but not relevant to pastures perse.
36	Health cost benefit calculator	Interactive tool to calculate benefit and MRR from different animal health treatments	Commons	Tool				0	Not relevant
37	Calving histogram calculator	Interactive tool to calculate calving pattern compared to theoretical	Commons	Tool				0	Not relevant
38	Making more from sheep - Module 2	Market focussed wool production	MLA/AWI	Written				0	Not relevant
39	Making more from sheep - Module 3	Market focussed lamb and sheepmeat production	MLA/AWI	Written				0	Not relevant
40	Making more from sheep - Module 4	Capable and confident producers	MLA/AWI	Written				0	Not relevant
41	Making more from sheep - Module 9	Gain from genetics	MLA/AWI	Written				0	Not relevant
42	Making more from sheep - Module 10	Wean more lambs	MLA/AWI	Written				0	Not relevant
43	Making more from sheep - Module 11	Healthy and contented sheep	MLA/AWI	Written				0	Not relevant

No	Product name	Short description	Owner	Type	PP intervention			Fit for purpose (0-10)	Comments
					Maintain	Manipulate	Resow		
44	Making more from sheep - Module 12	Efficient pastoral production	MLA/AWI	Written				0	Not relevant
45	Making more from sheep - Module 13	Hot topics	MLA/AWI	Written				0	Not relevant
46	Tips&tools	Increasing earthworms in pastures	MLA/AWI	Written				0	Not relevant
47	Tips&tools	Grazing management for a mixed perennial based pasture						0	**Link broken**
48	Tips&tools	Grazing management for productive native pastures						0	**Link broken**
MLA co-owned products									
49	EverGraze - On farm options	Feedbase and pasture species - selecting pastures for place and purpose.	MLA/AWI/ AgVic	Written			X	10	EverGraze principles are sound 1. Right perennial plant, right place, right purpose, right management, 2. right combination of perennials across the farm and 3. Needs to be combined with highly productive livestock and optimum tactical management. Also has a good section on pros and cons of resowing or rejuvenation which is consistent with the Pasture Paramedic flowchart and new MLA products being produced.
50	EverGraze - On farm options	Grazing management	MLA/AWI/ AgVic	Written	X	X	X	10	Cover the main grazing principles which are consistent with new work. Forms the basis for any teaching guide but are similar to the Making More from Sheep and More Beef from Pastures information. Rotational grazing planner is too complex.

No	Product name	Short description	Owner	Type	PP intervention			Fit for purpose (0-10)	Comments
					Maintain	Manipulate	Resow		
51	EverGraze tools	Tools in the EverGraze stable	MLA/AWI/ AgVic	Written			X	10	Only one tool relevant - Investing in pastures which is the pasture improvement calculator
52	EverGraze Actions	Topic specific fact sheets	MLA/AWI/ AgVic	Written	X	X		10	Highly relevant topics: 1.Phalaris 2. Perennial ryegrass 3. Tall fescue x2, 4. Cocksfoot (NSW DPI), 5. legumes (but little on sub-clover and **all links broken**) 5. Native grasses.
53	EverGraze library	Topic specific fact sheets, often from other organisations	AgVic	Written			X	8	Relevant topics: 1. Pasture establishment (Vic DPI) - dated.
54	EverGraze - On farm options	Livestock systems	MLA/AWI/ AgVic	Written				5	Limited value, except for a detailed explanation on how to set up and interpret the MLA feed demand calculator.
55	EverGraze - Demonstration and case studies	50 local case studies and demonstrations	MLA/AWI/ AgVic	Written	X	X	X	4	Some useful and more localised examples that could be used to support regionally specific activities.
56	EverGraze - On farm options	Making decisions	MLA/AWI/ AgVic	Written				4	Identifies aspects to consider but is at the whole farm level (strategic). The process for decision making weighs each aspect equally and runs the risk of users being overwhelmed by considerations. Would be surprised if many would use it based on its complexity.
57	EverGraze - On farm options	Soil and fertility management	MLA/AWI/ AgVic	Written	X	X	X	4	Limited direct information - referral to State based interpretation (**most links broken**). Does have an EverGraze quick guide for interpreting soil tests for south eastern Australia, based on similar optimum levels of other programs.
58	EverGraze - Pasture monitoring tools	A manual on various pasture monitoring techniques	MLA/AWI/ AgVic	Written	X	X	X	4	Well set out and explained but too detailed for most producers.

No	Product name	Short description	Owner	Type	PP intervention			Fit for purpose (0-10)	Comments
					Maintain	Manipulate	Resow		
59	EverGraze - Regional information	Description of regional 'proof sites' with links to relevant information for that location	MLA/AWI/ AgVic	Written			X	3	Limited number of sites. May be useful in determining why a pasture may have failed or for understanding a regional location.
60	Stocktake plus app	Free phone app to record pasture and livestock data	QDAF/MLA	APP	X	X		2	Designed for Northern Australia but some of the applications are useful for recording.
61	EverGraze - On farm options	Feed budgeting and tactical management	MLA/AWI/ AgVic	Written / video				2	Limited value. It is about matching feed supply and animal demand. Video of limited value.
62	EverGraze - Training and events	Training and events on offer	MLA/AWI/ AgVic	Written				2	Limited value. Provides link and re-directs to partner sites where events have not been updated. Offers 1 or 2 day EverGraze courses that cover the main principles 1 day = Feed budgeting, pasture assessment, supp feeding. 2 day = Farm mapping and whole farm considerations.
63	EverGraze - Research	Results and rationale behind different farming systems components being tested	MLA/AWI/ AgVic	Written				1	Limited value, as they look more at a systems profitability approach.

8.4 Moisture probe feasibility report

Feasibility of Meat and Livestock Australia establishing a soil moisture stress alert system to help farm decision making

Output for the Persistent and Productive Pastures Package (L.FAP.1903)

October 2021

By Cam Nicholson, Nicon Rural, on behalf of Southern Farming Systems

Executive summary

A component of the Feedbase Adoption Plan (L.FAP.1903) was to assess the feasibility of establishing a soil moisture stress alert system to forewarn producers of pending reduction in pasture growth. This request was in response to the potential opportunity the proliferation of soil moisture probes on grazing properties may have and if the benefits described in irrigation and cropping could also be realised in grazing.

The value proposition for MLA establishing such a system is weak, with the challenges far outweighing the likely benefits.

While the benefits include more accurate quantification of plant available water, what the actual soil water is in the soil at any point in time and the extraction of that water by plants over time (rate, depth), these are largely 'nice to know' pieces of information that have limited value in decision making for a grazier.

The challenges for MLA to establish a system are greater including:

The greater challenges MLA would need to overcome and to establish a workable system include:

- The need to facilitate a multitude of soil moisture probe data hosts to 'pool' and share data (or for MLA to establish a new system themselves).
- Converting the soil moisture data into meaningful pasture growth estimates.
- Recognition that in many years, the moisture status of a soil is not the greatest limitation on pasture growth, but the equipment and platform would need to be functioning every year so it is operational in the years when needed.
- Developing a robust decision making process to accompany the soil moisture data otherwise what value there is in the data may not be fully realised in better decisions.

Contents

1. Background

Soil moisture probes have become more common on farms in Southern Australia. While soil moisture monitoring using tensiometers was available in irrigation areas in the 1980's, significant growth in the number of soil moisture probes has occurred with the technological advances of remote and near real time capture of information. Often these probes are combined with other sensors such as soil temperature and weather information (rainfall, temperature, humidity, windspeed).

The proliferation of soil moisture sensors has also led to a growth in suppliers of equipment and monitoring platforms. There are multiple companies providing a range of monitoring services to individual farmers (e.g. Wildeye, Adcon), along with farming groups (e.g. https://sfs.org.au/farm-data/probe-trax) and State Agencies (e.g. https://extensionaus.com.au/soilmoisturemonitoring/). In addition, the most popular farm management software packages also includes climatic and soil moisture monitoring capacity (e.g. https://ag360.com.au). This not only allows current moisture conditions to be shown, but enables comparisons with other historic time periods. Predictive models of future pasture growth are increasingly being offered, using soil moisture as an essential input.

With the proliferation of soil moisture probes, Meat and Livestock Australia (MLA) wished to appreciate the potential benefits of investing resources to create a soil moisture stress alert system to forewarn producers of pending reduction in pasture growth. Southern Farming Systems were requested, as part of the Feedbase Adoption Plan (FAP), to conduct a small exploratory study to examine the value proposition (if any) for future MLA investment in this area.

While the study makes conclusions about the value of a soil moisture stress alert system, other potential benefits of understanding soil moisture are also considered. This is to identify other positives that may add value when considering the core question.

2. Why the interest in soil moisture?

Soil moisture is a key driver of plant growth. Along with soil temperature, soil moisture is critical in driving leaf emergence. Periods of adequate soil moisture, combined with favourable soil temperature[1] results in more rapid emergence of new leaves than periods with limited moisture and/or unfavourable temperatures. As moisture declines, given adequate soil temperature, then pasture growth will also decline. On the face of it, it makes sense to want to know available soil moisture, because combined with soil temperature, these two measures should enable estimates of pasture growth to be made[2].

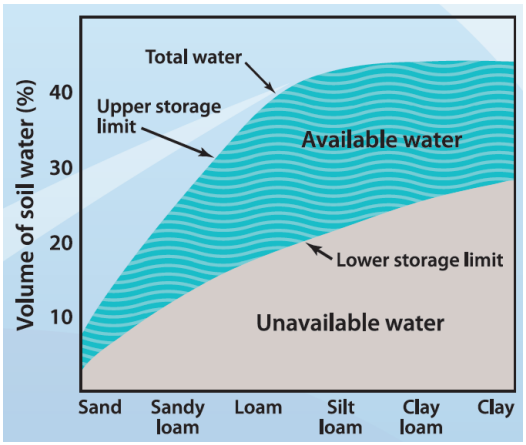
Most new moisture probes also have soil temperature sensors. This makes the calculation of leaf emergence (and pasture growth) using a simple approach such as growing degree days (GDD – appendix 1) or through more sophisticated computer models possible.

Understanding the volume of water a soil can store is also of interest. Colloquially referred to as the 'soil water bucket', the capacity of a soil to store water will influence the moisture available for plant growth. A soil with a larger 'soil water bucket' in theory will have a greater volume of plant available water (PAW) and therefore a longer growing season (if full), compared to a soil with a lesser water holding capacity.

[1] The ideal temperature range varies for temperate and tropical plants.

[2] Pasture growth will also be affected by soil conditions (fertility, pH, structure etc) and grazing management.

In the absence of direct soil analysis (pressure plate measurement), soil texture has been used to estimate the upper limit (field capacity) and lower limit (wilting point) of plant available water. The difference between the two enables the plant available water (PAW) to be estimated[3] (figure 1).



Source: soilquality.org.au

Figure 1: Soil water capacity for different soil textures

Soil moisture probes, over time enable the upper and lower limits of a soil to be more accurately determined than the estimate derived from soil texture (figure 2).

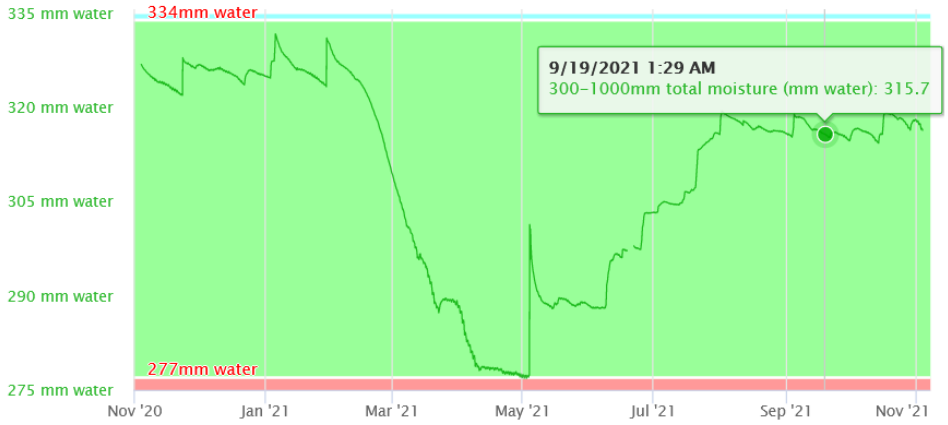
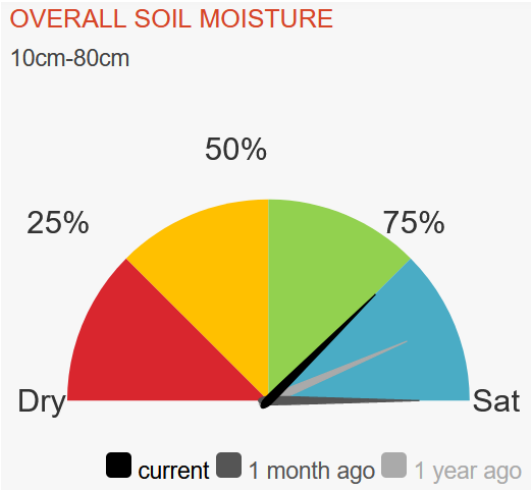


Figure 2: Example upper and lower limit of a soil (334 mm and 277 mm) for the 30 cm to 100 cm soil depth.

Long term monitoring can also provide a relative understanding of current conditions against previous periods (figure 3).

[3] Available soil moisture cannot be equally extracted by plants, with the first 50% of the total water capacity easily depleted and the remaining 50% increasingly harder to deplete.



Source: Agriculture Victoria

Figure 3: Example comparative soil moisture information.

3. Identifying the value from soil moisture monitoring in pasture

The value of soil moisture monitoring is obvious for irrigators who can add water when soil moisture begins to limit plant growth. Avoiding moisture stress is essential to maximising productivity. The value is also more evident in cropping, where obtaining a return on seasonal inputs such as nitrogen and fungicides are heavily reliant on the crop having enough water to finish. However, in rainfed pasture systems, that often only have one input made early in the season, the benefits of knowing the soil moisture status during the growing season is less clear. The benefits in knowing soil moisture are primarily in appreciating the impact on pasture growth, especially at times when water is the most limiting constraint.

Further consideration of the possible value from soil moisture monitoring in pastures is discussed in three parts:

4. New information gained
5. Knowledge created from the information
6. Using the data to inform a decision

3.1. New information

Useful information can be gleaned from soil moisture monitoring in pasture. A soil moisture probe provides near real time data on the amount of water in the soil profile. If an upper and lower limit can be established (as discussed above), then how full the bucket is, both in terms of the quantity and percentage of water, can be determined.

Other useful information can be gleaned such as where soil moisture is being extracted from in the profile (indicating possible rooting depth of pasture plants), the rate at which soil moisture is being used (daily water use) and how rainfall events refill the profile and to what depth. However, users need to be mindful of the likely spatial variability of PAW commonly occurring between and even within paddocks. The probe, while accurate in the immediate area, may not be representative of the wider landscape.

3.2. Making sense of the information (knowledge creation)

Information often remains 'nice to know' unless some meaning or understanding can be attached to it. For example, soil temperature data is useful to compare the germination thresholds of various pasture species to inform sowing decisions (Lonati *et al* 2009, Charlton 1986).

The soil moisture information needs to have a similar meaning attached to it. This can be relatively simple, such as comparing historic and current pasture conditions at the same time last year (although this does rely on accurate recall of historic conditions). Knowing the soil is wetter or drier than a previous period, and recalling a past outcome, may be useful as a prediction of the future (however anecdotally some producers have suggested they intuitively know if the soil is wetter or drier and don't need a moisture probe to add extra precision to this future prediction).

Existing soil moisture probes have also been used to calibrate predictive soil moisture models e.g. HowLeaky, DairyMod (Thayalakumaran *et al*, 2018) and to evaluate satellite soil moisture monitoring (McCaskill *et al*, 2014). The soil moisture probes were useful to refine the models to a high level of accuracy, enabling the models to then estimate pasture growth. However, they became redundant once the models were calibrated, negating the need for ongoing readings.

More insights about the impact of PAW on pasture production can be extracted through other modelling approaches. For example, the frequency of different amounts of PAW are derived from historic soil moisture data and then used to construct a range of future outcomes. This enables the value of knowing the starting soil moisture to be assessed against the final outcome i.e. was the known soil moisture level important in predicting the final pasture production outcome?

An analysis conducted by Southern Farming Systems for a perennial pasture site at Penshurst in south west Victoria, concluded that soil moisture probe data measured on August 1, would be useful to inform likely pasture growth to the end of December in only the drier 30% of years (Appendix 2). For the other 70% of years, knowledge on the soil moisture status, which could be provided by a moisture probe, was irrelevant to the final pasture outcome. In addition, it is likely farmers could already tell that the soil was drier than average (the 30% of drier years), making the need for the accuracy provided by the probe questionable.

While results at sites of lower rainfall and smaller soil water holding capacity may be helpful in more years, the results highlight the need to understand the frequency of knowing when the soil moisture status is of value.

There may be other benefits from knowing the exact soil moisture status e.g. is there adequate moisture before sowing a fodder crop? But these instances are infrequent compared to ongoing permanent pasture scenarios that the moisture stress alert would focus on.

It should also be recognised the data derived from a moisture probe require some expertise to maintain and display. Virtually all probes are hosted by a service provider, often on bespoke platforms and at a cost.

3.3 Informing a decision

Soil moisture probes, like a lot of recent technology, is promoted because it will help farmers make better decisions. There is a belief that more, or more precise information will lead to better decisions. This is a dangerous assumption to make.

Complex decision making is a challenging process. Many decisions in farming are informed not only by 'data', but also the intuition and experience of the decision maker, along with their preferences and values (Nicholson *et al*, 2016). The 'head, heart and gut' of decision making is also influenced by

the personality of the individual, the level of risk they wish to take on, and the other considerations that need to be weighed up. In other words, knowing the soil moisture status is only one piece of information in a complex puzzle.

It would be surprising if producers did not a have a rudimentary sense of the moisture status of their soil, albeit, in a very fundamental way e.g. it's dry, or it's wet. As the analysis by Manson showed (appendix 2), being more precise was of very limited value and only in the few drier years (when producers would be likely anticipating poorer growth anyway). Where is the value in making this assessment more precise?

Even if producers had soil moisture information and understood the implications of reduced feed supply and were considering selling stock, then there are a multitude of other considerations that would need to be included in the final decision. This includes things like current and future livestock prices, amount of supplementary feed on hand, condition of livestock, ability / desire to supplementary feed etc. Just because the soil moisture data indicated a dry profile (and therefore no further growth), these other considerations may, on balance, override the low but precise PAW result. In this case a general estimate 'it's dry' would probably suffice, rather than having the expense of a soil moisture probe.

There are also alternative ways of attaining a relative measure of soil moisture to inform such a decision. This could be through direct examination, push rods, satellite or calibrated computer models. In other words when there are 'competing' sources of information, what is being proposed (real time soil moisture monitoring) needs to be significantly better[4] than what is on offer to be attractive.

It is important to recognise that if other pieces of information related to the decision are missing, or there is no rigorous decision making process to accompany the increased information, then the value of that individual piece of data is greatly diminished, even to the point of information overload. It is critical any investment in technology to improve soil moisture data that MLA may consider, is accompanied by support to enhance the decision making process around that additional data.

Other potential benefits from accessing moisture probe data (described in 3.1 and 3.2) also needs to be associated with the ability to act on the information. A better understanding of water holding capacity or plant rooting depth may be interesting to know, but what practically can be done about it? Removing subsoil constraints in a pasture situation or aiming to increase soil water holding capacity is a difficult or possibly an impossible task. Where is the value in knowing this information if it cannot be acted upon?

Despite these reservations, there still is an attraction to soil moisture probe technology. A very small study by Agriculture Victoria at Hamilton (5 progressive producers who like technology), all preferred the on-property data provided by a soil moisture probe and were less trusting of other property, modelled or satellite data (McCaskill, *pers comm*). They wanted this information to be extrapolated into pasture predictions, which McCaskill provided. When asked about how this would inform decisions, only three responded. Two suggested it may help in late season nitrogen fertiliser decisions (which is not common practice on pasture for most producers) and one say it may be useful in considering selling excess stock.

[4] Better may relate to convenience, ease of use, cost, time etc

4. Conclusion

The value proposition for MLA to consider investing in the development of a soil moisture stress alert system is weak. While there are some benefits, the limitations are significant and largely outweigh the benefits.

Possible benefits

- Accurate understanding and quantification of what soil water remains in the bucket.
- After time, multiple comparisons can be made so producers can compare year on year.
- Provides insights into soil water and plant root growth and how the soil is behaving.

Possible downsides

- A multitude of soil moisture probe providers exist, some as commercial businesses. Facilitating this group to 'pool' data may be problematic, especially given the ongoing operational costs and data sharing agreement each has. For MLA to establish their own network, if sharing arrangements were not agreed to, would be costly ($5,000 per probe, ~$300/yr ongoing operation).
- Much of the current information obtained from soil moisture probes in pasture e.g. root depth, soil moisture extraction rates by plants etc is 'interesting to know' but has limited value in decision making.
- The soil moisture information *per se* is of limited value unless it is linked to other outcomes e.g. predicted pasture growth. This requires modelling that a small subset of farmers that were surveyed said they would have limited trust in anyway.
- For some years (possibly average and definitely good years), knowledge of soil moisture is not useful in decision making. This means the system only has value in drier years (which is when the alert system was intended to help). Unfortunately, the costs associated with maintenance of the equipment and platform would need to be continued in most years so it is operational in the years when needed.
- A robust decision making process is required to accompany the soil moisture data otherwise what value there is may not be fully realised.

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Appendix 1: Estimating the rate of leaf emergence during the vegetative stage of growth.

Key points:

- Plants require heat as well as light from the sun for photosynthesis.
- The accumulation of heat by a plant is called degree days or thermal units.
- 100 degree days are required to grow a new leaf.
- Plants require a minimum temperature before growth begins. This is called the base temperature. Below the base temperature plants cease to grow.
- Plants also have an optimum temperature for growth. Temperate plants (C3) are between 18^0C to 24^0C. Tropical (C4) plants are 25^0C to 30^0C.
- Base temperature varies between pasture types.

Pasture type	Base temp (^{0}C)
Temperate species e.g. perennial ryegrass, phalaris, sub clover	~5
Temperate 'winter active' species, annual ryegrass	~3.5
Tropical species e.g. Mitchell grass, kikuyu	~12

Calculating growing degree days (GDD)

The growing degree days can be calculated by averaging the maximum and minimum daily temperature (in ^{0}C) less the base temperature.

Growing degree day (GDD) = (daily maximum temp + daily minimum temp)/2 – Base temp

- Each GDD is added to the previous day until 100 degrees days are reached. It is then reset at zero for the next leaf
- If the GDD is negative this is recorded as zero.

Refer to example on next page.

Implications for grazing management

Leaf emergence is regulated by both soil temperature and soil moisture. In general terms the main period of growth occurs when both temperature and moisture are at their optimum (highlighted in green).

Zone	Driver	Season			
		Summer	Autumn	Winter	Spring
Temperate	Moisture	X	√[5]	√	√√
	Temperature	√	√	X	√√
Subtropical	Moisture	√√	√	√	√√
	Temperature	√√	√	X	√
Tropical	Moisture	√√	√	X	√[1]
	Temperature	√√	√	X	X

[5] Depending on the opening rains or break

Appendix 2: Summary of later winter to end of spring pasture growth at Penshurst (SW Vic) using GrassGro®.

James Manson

Southern Farming Systems

Simulations were conducted with a self-replacing merino system, on a Penshurst soil with Penshurst weather data. The soil has a PAWC of 236mm. The system was initialised from 1 January 1950 to the day before the prediction date, then a tactical analysis was run from the prediction date to December 31 using weather data from 1950 to 2019.

Three variables were examined to understand the interactions from August 1 to the end of growing season. These were:

- Future rainfall
- Starting feed on offer (FOO)
- Plant available water (PAW)

The outputs were aggregated by tercile of rainfall from the prediction date to December 31. Deciles 1 to 3 are "Dry", Deciles 4 to 7 are "Average" and Deciles 8-10 are "Wet". This follows the system used by the long-term forecasts of BOM.

The results were examined individually, in pairs and then as a three way interaction (figure 1).

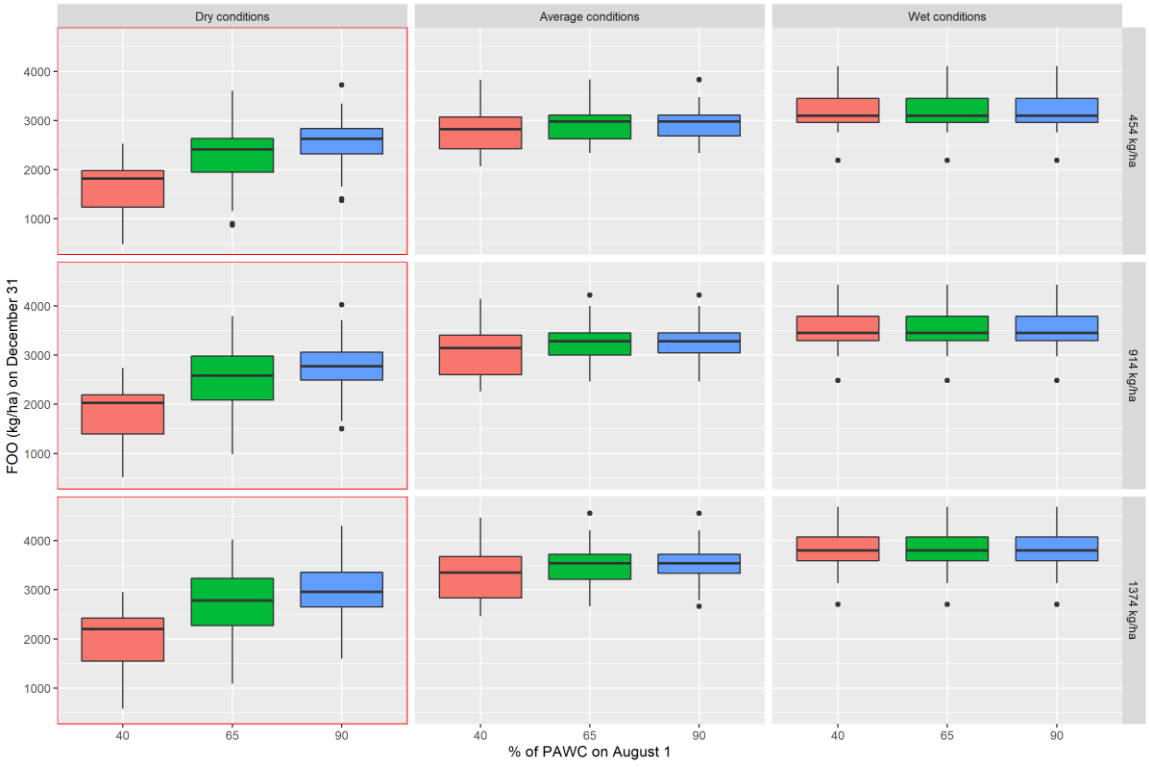

Figure 1: Range in Feed On Offer (FOO) at December 31, for a 40% (dry), 65% (average) and 90% (wet) August 1 PAWC and three different starting FOO on August 1 (454 kg/ha, 914 kg/ha, 1374 kg/ha).

The simple, but highly insightful findings for a location like Penshurst were:

- Rain drives the feed grown. Irrespective of the starting FOO, the more rainfall the greater spring growth.
- Initial FOO is the foundation for final spring production. The more starting FOO on August 1, the better the final production outcome.
- The initial PAW, which is what a soil moisture probe can inform, should be considered an 'insurance'. It is only valuable (and 'called upon') in a poor spring. In average and wet springs, the PAW plays no part in the final production outcome
- There is considerable symmetry between the box and whisker graphs, especially in the average and wet years indicating a similar chances of similar outcomes.

Therefore, the conclusion to be extrapolated in knowing the soil moisture status by having a moisture probe is:

- useful for a dry spring
- useless for a wet spring
- helps fine-tuning predicted outcomes in an average spring

So, on August 1

- if there is a dry forecast, the PAW (soil moisture probe) will be useful to know which outcome
- if there is an average or wet forecast, the FOO at August 1 will give the best indication of the December 31 FOO outcome.

*NB: This is a heavily abridged version of a report being prepared for a National Landcare project entitled "*Building the resilience and profitability of cropping and grazing farmers in the high rainfall zone of Southern Australia – 4-99UNW35." *Other location analysis is available on request.*