

## Tasmanian dairy farmers and the pasture management learning process: Case study findings on the role of coaching in achieving practice change

Lydia Turner & Lesley Irvine

Tasmanian Institute of Agriculture, University of Tasmania, PO Box 3523, Burnie 7325, Tasmania, Australia  
Email: Lydia.Turner@utas.edu.au

**Abstract.** Case studies involving interviews with three Tasmanian dairy farmers and retrospective analysis of their benchmarking data were carried out to evaluate the pasture management learning process that occurred within the 20.12 Pasture Business Project. This paper describes the significant impact of coaching on farmers developing knowledge and skills, improving pasture consumption and cow health, and increasing confidence to further develop their businesses. Key learnings from the subsequent cross-case analysis about how and why the project was effective in promoting practice change were as follows: 1) Farmers were motivated to learn and were in the position to apply new knowledge. 2) Working one-on-one with a coach allowed farmers to incrementally build capacity from their unique starting point, and in relation to their specific farm setting. 3) The length of the project and consistent support allowed new knowledge to be questioned, thoroughly learned and gradually applied over time. 4) The commitment to one-on-one coaching sessions motivated farmers to be disciplined throughout the learning process. 5) The learning process reached completion when farmers could confidently apply pasture management principles and adapt them as their farm business and environmental conditions changed.

**Keywords:** case studies, coaching, extension methodology, farmer learning, pasture management, practice change

### Introduction

Pasture consumption is a key indicator of farm profitability in temperate dairy systems (Chapman et al. 2014) and improving pasture management skills has therefore been a focus of research, development and extension (RD&E) activities within the Tasmanian dairy industry (Mann 2006, Turner et al. 2006a, b; Donaghy et al. 2008, Rawnsley 2013). The 20.12 Pasture Business Project was carried out from April 2005 to December 2006 and was developed in response to industry agreement that management of the feed base was the highest priority for dairy extension in Tasmania (Mann 2006). The project was funded by Dairy Australia, delivered by the Department of Primary Industries, Water and Environment, Dairy Branch, and involved 150 of the 440 farm businesses. Pasture management workshops were held across the state, and 150 farm businesses who attended signed up to be involved in the follow-up one-on-one (around 30 farms) or group sessions (around 120 farms). Each group met 11 times over a 12-18 month period and was facilitated by an industry pasture coach who led sessions focusing on how to measure pasture with a plate meter, how to assess leaf emergence rate, how to calculate cow requirements and intakes, how to allocate pasture, how to use nitrogen effectively, and how to determine irrigation start-up. The one-on-one consultations for the 30 farmers were also held at regular intervals and worked through the same session content, but took place on-farm and each involved one farmer working with one coach. At the completion of the project, an evaluation by Davey and Maynard (2007) concluded that the one-on-one consultations were particularly effective for supporting farmers in learning new knowledge and skills, and subsequently improving their pasture management and consumption. It is now ten years since the completion of the 20.12 Pasture Business Project, and there has been anecdotal evidence that the impact of the project on pasture consumption and farm businesses is ongoing. Case study research methods were therefore used to explore the pasture management learning process that occurred within the 20.12 Pasture Business Project and to gain a deeper understanding of how and why the project was effective in promoting practice change.

### Case study aims and methods

The case studies involved semi-structured interviews with three farmers who participated in the one-on-one coaching of the 20.12 Pasture Business Project in 2005/06 and have also been involved in business benchmarking. The farmers were selected by project team members on the basis of having significantly improved their pasture management and expanded their farm businesses in the years that have followed, and who have identified their participation as being key to their subsequent success. The case study research was approved by the UTAS Social Science Ethics Board (H0015305) and farmers gave consent for their identity and case study information to be shared. One-on-one interviews ranged from 53 to 75 minutes in length, and were recorded for subsequent transcription. Interview questions focused on the pasture management practices that were previously being used and how they have changed over time,

motivations to participate in the project, the practicalities of the one-on-one consultation process and the ongoing impact of the project on the farm business. The exploratory interviews aimed to capture the role of the consultation process in increasing farmers' knowledge and skills in pasture management, and how the new knowledge and skills were applied on-farm to improve pasture consumption and achieve significant on-farm change. Interview transcripts were entered into NVivo10© qualitative data analysis software and coded. Categories or themes were generated from the data, consistent with an inductive analytic approach (Lincoln & Guba 1985; Ryan & Bernard 2000), with categories shaped by the evaluation questions guiding the study. Interview data was supported by a retrospective analysis of the farms' benchmarking data over the last decade. Following within-case analysis, a cross-case analysis was performed to identify key learnings about how and why the project was effective in promoting change.

### Case study farmers and within-case findings

Brian Lawrence owns and manages a 1050 cow dairy farm in Meander. At the time of participating in the 20.12 Pasture Business Project, Brian was milking 460 cows.

Nigel Brock owns and manages an 800 cow dairy farm in Montana. At the time of participating in the 20.12 Pasture Business Project, Nigel was milking 280 cows.

Stuart Burr is a 50:50 share farmer in Ringarooma, and milks 450 cows from 190 ha. At the time of participating in the 20.12 Pasture Business Project, Stuart was employed as a farm manager.

Each case study farmer attributes the confidence to expand operations (and in Stuart's case to transition from farm management to share farming) to participating in the 20.12 Pasture Business Project in 2005/6. The case study data for each farmer is presented individually, followed by key learnings from the research that describe the process that helped farmers learn.

#### Brian Lawrence

If you're a dairy farmer, (pasture management) is such a big part of your business that you...owe it to your business to try and learn and do it as well as you can.

*The impact of participating in the 20.12 Pasture Business Project* Brian describes his participation in the 20.12 Pasture Business Project (2005/6) as having the greatest impact on his farm business of any single industry activity. He attributes a 25-30% increase in pasture growth and consumption to this significant consultation process that increased his knowledge, skills and confidence in pasture management. The effect of the 20.12 Pasture Business Project on Brian's improved pasture management has coincided with significant expansion in his farm business. Brian explained that the consultation process, 'broadened out into whole farm management... even though the main focus was pasture'. Brian has since increased his stocking rate and currently milks 1050 cross-bred cows (2015/16 season) from a 260 ha mainly irrigated milking platform. Table 1 presents further Dairy Business of the Year data comparing the farm business in 2007/08 to 2010/11 and 2014/15.

**Table 1. Dairy Business of the Year data for Brian Lawrence's farm from 2007/08 to 2014/15**

	2007/08	2010/11	2014/15
Cows milked (cows)	460	800	930
Milking platform (ha)	250	250	250
Runoff area (ha)	185	185	185
Stocking rate (cows/ha)	1.1	1.8	2.1
Milk production (kg MS/eff ha)	345	756	920
EBIT/ha*	n/a	\$2988	\$3631
Pasture consumption (tDM/ha) from milking area	n/a	11.6	14.3

\* EBIT = Earnings before interest and tax

*Previous situation and motivation for participating* In the years leading up to the 20.12 Pasture Business Program, Brian had been observing the effect of different grazing approaches on the grazing animals and pasture growth in different farm settings. Although he doesn't recall having participated in pasture management training prior to this project, he had noticed differences between the condition of stock grazing really short grass, or long rank grass, compared with stock grazing 'two or three inches of grass, good leafy grass'. He also understood that grass being grazed when it was already very short, took a long time to recover and grow. A visit to New Zealand then exposed Brian to the benefits of rotational grazing systems with higher

stocking rates. Brian enjoys the learning process and has a natural interest in the biology of plants, soil and animals – he had grown up on a farm, studied Agricultural Science at University and continued to learn through working on a few different farms during the following years. In 2005, Brian's responsibility in managing dairy farm operations was increasing and he had started focusing on pasture management in discussion groups. The 20.12 project was 'an opportunity to step up the management of the pastures' and he was in position to put new knowledge and skills into practice. He explains that:

we weren't doing a bad job, but we weren't doing as well as we could have. And what we weren't doing was managing the residuals...consistently; it was getting away from us in the spring. And we were probably making silage too late, letting it grow out too long.

Brian believes there is always more to learn about a topic and 'another opportunity to try and improve what we do'. A desire to continually improve his knowledge and practices is the reason he signed up for the 20.12 Pasture Business Project in 2005, and continues to participate in industry activities today.

*The 20.12 Pasture Business Project consultation process* The consultation process motivated Brian to use a plate meter to measure residuals for the first time, and he would take measurements across the whole farm before the coach visited every month. They would then incorporate the figures into feed budgets that involved calculating pasture and cow production, cow requirements based on stage of lactation, and pasture and supplement allocations. As well as filling the gaps in his knowledge through doing the worksheet calculations in the project manual each month, Brian greatly benefited from the follow up, questions and discussion with the coach. He explains that:

there were a lot of questions and he was there to answer them. And we were there to look and see. So it just, well it just meant everything could be followed up on. I mean it was quite a process to go through to really make it work on farm.

He looks back on the 20.12 Pasture Business Project as an essential contributor to his increasing confidence in managing pasture. During the project he used, 'the plate meter for almost twelve months consistently to get that knowledge to be able to do it by eye.' He also practiced putting up break fences – comparing his eye estimates to plate meter measurements until he could accurately predict where to put them up by eye. The monthly visit from the coach meant that Brian was more disciplined in continuing with plate meter measurements and learning from them throughout the 18 months. He admits that:

if we had just gone to the course it's hard to say whether we would have had the discipline to plate meter and do those work sheets without that follow up. It's hard to know: might of, might not of. But it made sure we did.

*Key learnings and current situation* The 20.12 Pasture Business Project was, 'good timing for good detail' for Brian, and the consultation process led him 'to really understand how grass grows and the changes in quality and quantity, (and) leaf emergence rate through the year.' He explains that, 'Once you've got an understanding of that, and soil fertility and nutrition and are using nitrogen, then yeah you've really got the tools to manage grass...to get your residuals right and consistent.' Brian identifies monitoring and managing residuals as the first key learning from his participation in the 20.12 Pasture Business Project, followed by monitoring and grazing to the 2.5-leaf to 3-leaf stage of regrowth and to canopy closure in the spring. He believes that these are the most important contributors to his increased pasture growth and consumption since the project, and says that 'where we got off those things at different times before, now we try not to.' Today Brian continues to adjust his grazing rotation as leaf emergence rate changes with time of year. Pasture biomass targets of 3000 kg DM/ha for pre-grazing and 1600 kg DM/ha for post-grazing are used. Brian now uses a plate meter a couple of times a year to compare the readings with his visual assessments of pasture cover. While Brian has a sound understanding of the biology and principles underlying pasture management, he is currently participating in the Dairy on PAR Measuring and Monitoring project to help evaluate whether consistent pasture readings with a plate meter can further improve his management decisions and pasture consumption.

### ***Nigel Brock***

I lived on a (dryland) farm where I was on a thirty or twenty-one day round in the middle of January. I know what damage you can do to pasture. Whereas let it rest... you have the confidence then that it's going to do what it wants to do.

*The impact of participating in the 20.12 Pasture Business Project* Nigel Brock decided to participate in the 20.12 Pasture Business Project (2005-6) after attending field days and hearing other farmers discussing their rotation lengths. He realised there was more to pasture

management than he previously thought, and that he needed more knowledge and skills as he stepped into managing and expanding the dairy operation on his family farm. His decision has since reaped enormous benefits, with his increased knowledge, skills and confidence in pasture management leading to far greater expansion than he originally thought possible. When he signed up for the 20.12 Pasture Business Project, he was milking 259 cows in a 20-a-side herringbone dairy. The cows grazed 142 ha dryland pasture, a large proportion of their diet was turnips, and 30 bales of silage were made each year. In the 2015/16 season he milked 800 cows in his 50 stand rotary dairy. Of the 205 ha milking platform, 165 ha is irrigated by three pivots, and 600 bales of silage are made each year. Further Dairy Business of the Year data comparing the farm business in 2005, 2010 and 2014/15 are presented in Table 2.

**Table 2. Dairy Business of the Year data for Nigel Brock's farm from 2005 to 2014/15**

	<b>2005</b>	<b>2010</b>	<b>2014/15</b>
Cows milked (cows)	259	550	700
Milking platform (ha)	142	200	205
Runoff area (ha)	100	200	183
Stocking rate (cows/ha)	1.1	1.4	1.8
Milk production (kg MS/ef ha)	455	629	1036
EBIT/ha*	\$1419	\$1480	\$2743
Pasture consumption (tDM/ha) from milking area	6.1	7.0	13.3

\* EBIT = Earnings before interest and tax

*Previous situation and motivation for participating* Nigel explains that before the 20.12 Project, he would not have planned such a large expansion, 'because I didn't have the confidence, grass growing wise.' He had a 20-30 day rotation length throughout the year and pre-grazing residuals were consistently too low. This management:

...damaged pastures; it...thin(ned) pastures out, allowed no feed through winter, no feed through calving... The cows were (sent to) the gravel pit in winter and fed hay. They were in a skinny condition because they've been on turnips and silage and grain, and really no grass involved in their diet much apart from spring... We used to have calves to pull all the time. The cows were weak. It was just ridiculous – but you just couldn't get out of the rut.

A contributing factor to being stuck in the 'rut' was lack of time and energy to learn how to implement new practices. Nigel had previously attended pasture management training sessions and recalled two courses that did not lead to on-farm change. The manuals from both courses went straight to the bookshelf, because the new concepts were too complex to put into practice immediately and he was working too many hours to study the manuals and figure out how the concepts could be applied. Another contributing factor was that Nigel was working under his father's management and had limited independence with time and resource management. The timing of the 20.12 Project coincided with the opportunity for increased management responsibility for Nigel. When he heard other farmers discussing their rotation lengths at field days, he realised that his rotation length was vastly different to theirs, and was motivated to participate in further pasture management training.

*The 20.12 Pasture Business Project consultation process* After attending the initial pasture management workshop, Nigel signed up for one-on-one sessions with a coach that consisted of monthly visits to his farm over a 12-month period. He explains that he opted to participate in the consultation because there are:

Totally different farms, totally different systems, totally different constraints. So I said, "Right, I'm going to do it individually. Because it's got to be specific to this farm."

Each month Nigel and the coach would discuss new information and calculation templates from the 20.12 Project manual. The process helped Nigel learn how to calculate pasture management basics including how much feed cows need, how to calculate supplement requirements, and how to calculate leaf emergence rate. In between the coach visits, Nigel practiced applying his new knowledge – whether it was calculating average pasture cover or measuring residuals using a plate meter, or counting perennial ryegrass leaves to calculate leaf emergence rate. Using a plate meter to measure pasture every week throughout the project gave Nigel the experience needed to more accurately assess pasture cover and residuals by eye. Nigel took the initiative to transfer some of the templates to Excel so it was possible to:

just go to the computer, (enter) your LER (leaf emergence rate) which it would automatically calculate your area. And multiply it by average pasture cover on those paddocks or individual paddocks if you wanted to, and it'd spit out down the bottom how much silage (or hay) you need to feed.

***Key learnings and current situation*** The consultation process also provided the 18-month timeline and ongoing support needed to make on-the-ground changes associated with basing his rotation length on leaf stage. It was a step by step process that started with splitting paddocks to allow the pastures late in the rotation to rest and regrow. Improvements were gradual, as this still required going into the first paddocks in the rotation when they had low pre-grazing residuals. Nigel describes the regrowth requirement of perennial ryegrass, and the seasonal variance in its growing time, as the key learning of his experience with pasture training. He explains that if pasture 'needs forty-five days (to recover) it should have forty-five days; if it needed sixty it should have sixty.' Learning about pre- and post-grazing targets to maximise pasture persistence was also key to improving his pasture management practices. By applying his new pasture management knowledge and skills, pasture consumption on the farm rapidly increased along with Nigel's confidence to expand the business. Shortly after the pasture training sessions with the coach had finished, when he and wife Rachael saw 'that with the new 20.12 results we were starting to have a farm full of grass...we thought we could go to five hundred cows easily'. They sat down with their coach at their first post-project meeting and discussed:

where we want to go ultimately... I reckoned four to the hectare on two hundred hectares. It was a little bit pushy for out here, but that was my ultimate aim. I thought the farm could run it, it could run all the livestock.

They have achieved their ultimate aim, with 800 cows currently allocated pasture using the principles learned through the 20.12 Pasture Business Project. Nigel is now teaching his staff to determine the leaf stage of ryegrass to calculate leaf emergence rate as well as estimate individual paddock pasture cover.

#### **Stuart Burr**

I did everything differently... I'm pretty sure there's a big (group) of farmers that were in that 'chase your tail' situation, without the right knowledge. And I was one of them. So it (20.12 Pasture Business Project) did impact everything, and it has a big impact on the whole farm.

***The impact of participating in the 20.12 Pasture Business Project*** Stuart Burr explains that participating in the 20.12 Pasture Business Project changed, 'pretty much the whole way we farmed'. Previously he relied on allocating cows 'enough little block each time to keep them going round and they give what they give' compared with 'actually feeding them what they needed'. The benefits of learning what, when and how cows should be grazing led not only to greater pasture consumption, but healthier cows with improved fertility and milk production. Stuart's new knowledge and skills in managing pastures gave him the confidence to transition from a farm manager to a 50:50 share farming position in 2008. Since entering a share farming arrangement, Stuart has been building his herd up to 450 cows that were milked from 190 ha of irrigated pasture in Ringarooma in the 2015/16 season. There is risk associated with these transitions and business expansions, and Stuart stated that he would not have 'gone share farming if I hadn't done that program'. However, once 'you've got the knowledge and the capabilities, well it's not that big a risk'. Table 3 presents Dairy Business of the Year data from 2011/12 and 2014/15 that demonstrates the effect of improving pasture management on the whole farm business.

**Table 3. Dairy Business of the Year data for Stuart Burr's farm from 2005 to 2014/15**

	<b>2005</b>	<b>2011/12</b>	<b>2014/15</b>
Cows milked (cows)	n/a	411	430
Milking platform (ha)	n/a	150	140
Runoff area (ha)	n/a	90	120
Stocking rate (cows/ha)	n/a	1.7	1.7
Milk production (kg MS/ef ha)	n/a	774	852
EBIT/ha*	n/a	\$1720	\$2040
Pasture consumption (tDM/ha) from milking area	n/a	9.1	13.0

\* EBIT = Earnings before interest and tax

***Previous situation and motivation for participating*** Stuart started working on a dairy farm at the end of high school and although his apprenticeship involved some pasture management

training, his 'mindset was probably in the wrong place to learn'. He then drove a milk tanker for four years and when he returned to dairy farming as a farm manager Stuart says that he, 'struggled at allocation and...knowing what the cows should have and where they're going'. He found it difficult to break out of the cycle of fast grazing rotations and feed shortages. Looking back at this struggle, he can see that 'Feed grows feed. If you haven't got any feed it's hard to grow feed. So yeah you always end up chasing your tail'. Stuart was now responsible for making management decisions on the farm and was particularly frustrated by feed shortages that held his cows back when they should have been peaking in their milk production. He was motivated to improve his knowledge and the feed availability on the farm and started participating in discussion groups before signing up for the 20.12 Pasture Business Project. He explains that the timing of the project was right for him, because:

When you get in the position that you get interested about something and you want to learn, you can learn so much better. If you haven't got that interest and you're not really focused on learning you don't take anything in.

*The 20.12 Pasture Business Project consultation process* Stuart chose to receive one-on-one consultation through the 20.12 Pasture Business Project and found the ongoing sessions with his coach helped him stay engaged in the learning process. The early monthly sessions covered learning how to measure pasture with a plate meter and learning how to assess leaf emergence rate. Using the data from this monitoring learning, he learnt how to set the rotation length to match leaf emergence rate and calculate supplements to meet cow feed requirements. Stuart describes the learning process as 'gradual...we'd slowly improve what we knew'. Plate meter measurements and leaf emergence rates provided Stuart with new pasture management tools he had never used before, and he emphasised the contrast from previously having 'no idea and guessing... (and)...nothing to work with' in his pasture management. The sessions progressed to feed budgeting and the potential for using fodder crops and fertiliser to further improve feed availability. Stuart believes that the step-by-step training process over an 18-month period was 'critical to hav(ing) that full understanding' of the pasture management principles, and to work through the finer details of their on-farm application.

*Key learnings and current situation* Participating in the 20.12 Pasture Business Project gave Stuart the knowledge and tools to allocate pasture and adjust grazing rotation length throughout the year. It also initiated Stuart's use of a spring rotation planner to address the problem of feed shortages when cows are peaking in their milk production. He explains that:

We'd had a problem with having grass on our second round, and that's what the spring rotation planner fixes. Once you've got all your cows in and you want them to peak you need to have some food, and if you don't have food they don't go too good. Well that's the key to setting your season... the goal from the start of calving was to have feed in the second round. And yeah it's still as important as ever.

The planner focuses on adjusting rotation length, allocations and silage making plans to ensure feed availability continues through spring into summer. Stuart discusses the difficulties of managing pastures in spring and further opportunity to increase consumption (and therefore business efficiency) by capturing more surplus and decreasing wastage. He continues to assess pasture cover and leaf emergence rates to guide his pasture management, and combines these learned principles with his own experience of his individual farm and environmental conditions.

### **Across-case findings**

Case study research involving three dairy farmers confirmed that improving pasture management and consumption had a positive impact on many aspects of their farm businesses. Each farmer described the significant impact of participating in the project on their knowledge, skills, pasture consumption, cow health and confidence to further develop their businesses.

This farm used to have two hundred hectares, two hundred and eighty cows, and we used to only ever cut thirty bales of silage off it. Now with eight hundred cows we're cutting six hundred bales off the same dairy block (Nigel Brock).

I went from not knowing... (to) learning when to graze and how to graze, and how to look after grass. So we changed everything... pretty much the whole way we farmed (Stuart Burr).

Its impact on the business and how important it is, you drop our pasture utilisation and growth by 25, 30 percent and the effect it has on your business - yeah it would easily be the most significant course we've done (Brian Lawrence)

An important aim of the case study research was to gain a deeper understanding of why and how the 20.12 Pasture Business Project was successful in leading to on-farm change for these businesses. The observed roles of the farmer and coach in the learning process are represented

in Table 4, which shows farmer confidence increasing over time, and the decreasing requirement for coach input.

**Table 4. The roles of the farmer and coach in the observed pasture management learning process**

Role of Farmer	Farmer confidence increased over time	Coach input decreased over time	Role of Coach
Motivated to learn/change and has the capacity to implement new practices			Aware of the relationship between increasing motivation to learn and increasing responsibility for pasture management
Has the opportunity to share about existing knowledge/skills/resources/ practices			Focused on identifying individual farmer/farm needs as the starting point to providing support
Willing to learn about the scientific and mathematical principles underlying pasture management calculations and decision making			Facilitated the introduction of new knowledge in a simple format and being available to answer questions and discuss content over a significant period of time
Committed to a process of learning how to apply new knowledge and skills on-farm and training the 'eye' to accurately assess pasture growth			Present on-farm at regular intervals to support farmers through the gradual process of trialling new practices
Adapted new knowledge and practices by combining principles with own experience and individual farm setting			Maintained contact as farmer pursued farm business development and expansion

The key learnings associated with the pasture management learning process, are further described below.

***The three farmers were motivated to learn and were in the position to apply new knowledge in their pasture management.***

The timing of the 20.12 Pasture Business Project aligned with the opportunity for the case study farmers to manage pastures independently and experience the repercussions of sub-optimal management, which motivated them to improve their pasture management practices and consumption. An important constraint to change prior to participating in the project was the role of these farmers before they were given full responsibility for dairy farm management. When they were not fully responsible for pasture management they lacked the interest to learn, and/or the full capacity to apply new knowledge.

When you get in the position that you get interested about something and you want to learn, you can learn so much better. If you haven't got that interest and you're not really focused on learning you don't take anything in (Stuart Burr).

The requirement to meet in a group of farmers with different farm settings, the short length of other training activities, and the lack of individual follow up, were further factors limiting change for the case study farmers prior to participating the 20.12 Pasture Business Project.

***Working one-on-one with a coach allowed farmers to incrementally build capacity from their unique starting point, and in relation to their specific farm setting.***

In group settings by necessity there is the need to focus on a common approach that may not be directly relevant or applicable for the farmers (who have different levels of knowledge and experience) and the farm settings (which have different physical and environmental opportunities and limitations even when in the same region). The impact of group extension activities can therefore be constrained by dilution of content relevance with increasing number of participants, and the requirement for farmers to return to their property and figure out how to apply the training materials. The one-on-one consultation process allowed farmers to focus on their existing knowledge, skills and practices, which provided the ideal starting point for building capacity over time. New knowledge and skills could be directly related to the individual farm setting, which removed a significant barrier to adoption.

I'm sick of going to groups and they tell you what you should do when it's not suited to your particular farm. You know it might be... five different farms there. Totally different farms, totally different systems, totally different constraints. So I said, 'Right, I'm going to do it individually.' Because it's got to be specific to this farm (Nigel Brock)

***The length of the project and consistent support allowed new knowledge to be questioned, thoroughly learned and gradually applied over time.***

Unlike many pasture management training activities that are held over the course of 1, 2 or 5 days, the length of this project allowed time for the process of on-farm change and adoption of new technologies and tools to be carried out. Adoption is not a single event, but a continuous and step-by-step process (Wilkinson 2011) that the one-on-one consultation sessions supported over a 12-18 month period. Consistent support through regular on-farm sessions with the coach provided the opportunity for farmers to question, clarify and discuss information and for repetition of the session content and grazing management principles. Early sessions focused on practicing how to measure pasture, assess leaf emergence rate, and calculate average feed cover, feed and supplement requirements, and feed allocations. Sessions progressively focused on the use of this knowledge and skills in changing grazing management practices, and then introduced more complex management principles.

Oh yeah it was gradual. We'd slowly improve what we knew. But yeah well we started off by measuring and knowing what was there, and then being able to set allocations (Stuart Burr)

There were a lot of questions and he was there to answer them. And we were there to look and see. So it just, well it just meant everything could be followed up on. I mean it was quite a process to go through to really make it work on farm (Brian Lawrence)

***The commitment to one-on-one coach sessions motivated the farmers to be disciplined throughout the learning process.***

Changing practices takes more energy and effort than keeping the same practices, and the regular visits from the coach helped the case study farmers to continue learning and applying new knowledge and skills. Each farmer described how they were introduced to measuring pasture with a plate meter through the 20.12 Pasture Business Project, and how important using the plate meter over an extended timeframe was in training their eye to accurately assess pre- and post-grazing pasture cover. The sessions with the coach aligned this activity with learning biological and mathematical principles so that the farmers understood how to apply plate meter measurements in their grazing management calculations and decision making. If the farmers had not committed to the ongoing one-on-one consultations, they admitted that they probably would not have maintained the discipline to continue using and learning from the plate meter measurements, and would therefore not have developed the deep understanding needed to apply and adapt pasture management principles independently.

At that stage I was out with the plate meter and I was walking the farm. And I'd be drawing up lists of each paddock and doing the whole scenario. Or if it was calculating LER (leaf emergence rate) I'd be going out counting leaves, I'd be down in the paddock looking at leaves all the time... it's just practice (Nigel Brock).

To consistently plate meter – I think initially it was every month or two – so to consistently do that the repetition to get it in your head I think that follow up made sure it was done. Whereas if we had just gone to the course it's hard to say whether we would have had the discipline to plate meter and do those work sheets without that follow up (Brian Lawrence)

***The case study farmers now confidently apply pasture management principles and adapt them as their farm business and environmental conditions change.***

Farming that focuses on increasing pasture consumption requires an understanding of the biological principles underlying pasture growth and rotation length, and the mathematical calculations that guide feed allocations. However, this learned knowledge is most confidently applied when combined with farmers' experience and observations of their own farms. Over time the case study farmers have generally lessened their use of the formal pasture management tools and resources they were introduced to during the 20.12 Pasture Business Project (e.g. the plate meter and worksheets) but continue to rely on what these tools and resources have taught them. The biological and mathematical principles continue to guide their grazing management decisions, with each farmer adapting them to suit his individual farm setting, the challenging seasonal conditions and his unique approach to dairy farming.

It's not exact science. Some days are warmer, cows eat less or more; and some days they're filled up on a pasture that you might have guessed slightly under or over. It's not an exact thing... even with a pasture meter it's not exact... And that's where farming comes in (Nigel Brock).

**Discussion**

The exploratory case study research suggests that for the case study farmers, the one-on-one coaching sessions within the 20.12 Pasture Business Project supported them in progressing through stages of a pasture management learning process. The key learnings about how and



why the project was effective in promoting practice change are as follows: 1) The farmers were motivated to learn and were in the position to apply new knowledge in their pasture management. 2) Working one-on-one with a coach allowed farmers to incrementally build capacity from their unique starting point, and in relation to their specific farm setting. 3) The length of the project and consistent support allowed new knowledge to be questioned, thoroughly learned and gradually applied over time. 4) The commitment to one-on-one coaching sessions motivated the farmers to be disciplined in trialing new practices throughout the learning process. 5) The learning process reached completion when farmers could confidently apply pasture management principles and adapt them as their farm business and environmental conditions changed. As farmer confidence increased over time, the requirement for coaching input decreased.

The importance of the coach identifying individual farmer/farm needs as the starting point to providing support was evident across the case studies, as was the step-by-step introduction of new knowledge that built on the farmers' existing knowledge. The step-by-step introduction of new knowledge supported the learning process, because 'learning depends on what people already know' (Hansen 2014, p. 86). Weick (1979, 1995) discusses the need for new knowledge to build on existing knowledge, so that farmers can make sense of it, and connect it into an existing frame of reference. In this situation, new knowledge was incrementally built, and aligned with developing farmers' skills as they trialed new practices. According to Sewell et al. (2014) the opportunity for farmers to make these connections between evidence-based ideas and their own farming systems is one of the keys to supporting farmer learning and encouraging adoption of management recommendations.

Wilkinson (2011) discusses the non-linear nature of adoption; often a complex process that can involve multiple steps, trialling, adaption and dis-adoption. From the perspective of RD&E providers, there are clear benefits for farmers adopting best practice recommendations. However, there are many competing factors influencing farmers' attitudes towards the recommendations, and their ability to adopt new practices. Szulanski (1996) identifies 'motivational barriers' and 'knowledge barriers' as two broad categories that influence farmer learning and practice change. Turner et al. (2017) link these influences, suggesting that farmers who are motivated by the desire to improve efficiency or maximise profitability, are more likely to proactively seek out knowledge and exhibit 'flexible boundaries' (i.e. they are more open) to change. It can be more difficult to engage farmers in extension activities who are reactive in their motivations (i.e. motivated by the need to solve problems), as these farmers can have 'firmer boundaries' to change (Turner et al. 2017). For these farmers, it is especially important to address motivational barriers by emphasising the broader benefits of improving pasture management practices, and the wider farm business problems that can be solved by doing so.

Addressing motivational barriers must be accompanied by the delivery of extension activities in a way that allows knowledge barriers to be identified and worked through, as occurred through coaching in the 20.12 Pasture Business Project. Adoption of knowledge-intensive practices like pasture management is not an event, but a process, as it aligns with the farmer learning process. True learning cannot occur as a result of a single training session, but requires support and interaction with knowledge sources over time as farmers adapt knowledge and trial applying it on-farm. The level of support and interaction that is needed by farmers through the learning process varies with their existing knowledge (Weick 1979, 1995) and approach to change (Turner et al. 2017), but delivering extension using an approach that is flexible enough to identify and respond to these influences, boundaries and barriers, will maximise the likelihood of adoption.

The facilitative process in the 20.12 Pasture Business Project involved the coach working together with the farmer over time; being available to answer questions, discuss content and support the ongoing trialling of practices. Although the coach was viewed as a source of knowledge, the collaborative nature of the relationship encouraged joint problem solving and a learning environment of exchange and interaction. Monthly visits by the coach over an 18-month period helped to build the credibility and trust known to underpin effective learning relationships (Bryk and Schneider 2003). Ingram (2008) discusses the effectiveness of this facilitative approach to advising when knowledge-intensive agricultural practices are being introduced, as it empowers farmers to learn about and adapt technologies. In these case studies, the farmers progressed through stages of the pasture management learning process until they understood the intricacies and implications associated with the new knowledge. Ko et al. (2005) suggest that this level of understanding is an indication of true learning taking place, to an extent that practice change occurs through application of the knowledge to best suit their own farming systems.

## Conclusion

Due to the changing nature of extension in Australia, opportunities for one-on-one advising through publicly funded D&E can be limited. This case study research has highlighted the importance of incremental farmer learning over time, with ongoing access to support within a facilitative context. While it is more challenging to provide this support outside a one-on-one advisor relationship, these key learnings can guide the design of extension group content and delivery, as well as more collaborative approaches between public extension and private consultative services. When it comes to pasture management practices, and other knowledge-intensive agricultural practices, it is essential that farmers are supported through a learning process, until they can confidently adapt new knowledge and practices by combining learned principles with their own experiences and individual farm settings.

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