Pasture management and extension on Tasmanian dairy farms – who measures up?

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Abstract. Tasmanian dairy farmers were surveyed to identify the extent of use of pasture management tools and technology and engagement with extension activities. The survey was mailed to the 440 registered dairy farmers with a response rate of 164 (37%). Of the farmers who responded, 65% had previously used a tool such as a rising plate meter, CDAX bike reader or pasture ruler, 48% currently use a tool, and 86% had attended extension activities. Attendance at extension activities, past use of a tool, farm size and education were positively related to the current use of pasture management tools (p <0.05). Farmers who have used a pasture measurement tool in the past and/or currently use a tool, ranked confidence in their pasture management ability higher (p <0.05) than those who have not used a tool. Past use of a tool, herd size and farmer education were positively related to attendance at extension activities (p <0.05).

Keywords: dairy farmers, engagement, extension, pasture management, technology, tools

Introduction

The Tasmanian dairy industry is comprised primarily of pasture-based systems, with pasture typically being the cheapest available feed for dairy cows that meets their nutritional requirements (Chapman et al. 2009; Rawnsley et al. 2012). Dairy farmers are continually faced with the challenges of fluctuations in milk price, rising costs and seasonal conditions, which places a greater emphasis on the importance of improving farm efficiencies. Farina et al. (2013) suggests that increasing the production and utilisation of forages produced on farm will be critical to future growth within the dairy industry. Rawnsley et al. (2012) further emphasises this, stating that in an economic environment where production costs increase faster than commodity prices, there is a need to enhance pasture production and utilisation to maintain efficiencies within the Tasmanian dairy industry.

As a consequence, a key focus of research, development and extension (RD&E) projects in the Tasmanian dairy industry has been on increasing awareness, knowledge and use of best practice pasture management principles and practices to improve the consumption of home grown forages by dairy cows. This includes the use of tools and technologies that have been developed to assist in pasture management. In general, using a tool such as a rising plate meter to measure pasture has been proven to be a quick and effective way of assessing total forage growth and yield, with a greater level of accuracy than visual assessment (Stockdale 1984; Scrivner, Center & Jones 1986). Van Bysterveldt and Christie (2007, as cited in Romera et al. 2013) note that there are clear advantages in regularly measuring pasture, and tools for doing so have been the focus of research and development (Eastwood, Rue & Gray 2017). The use of these tools gives farmers objective information from which they can make decisions on pasture management, give increased control and flexibility around grazing decisions, and can assist in increasing productivity (O'Donovan et al. 2002). Case study research by Turner and Irvine (2017) suggests that farmer confidence increases through the use of pasture measurement tools, partly due to their important role in the pasture management learning process. While farmers learn about the biological principles underlying recommended practices, the use of a pasture measurement tool assists in the training of their eye to visually assess pasture growth more accurately. As new pasture management skills are developed and combined with farmers' experience and existing farm knowledge, the need to continue using the pasture measurement tool may decrease (Turner & Irvine 2017).

Despite focused extension efforts on pasture management practices on-farm pasture consumption is still below potential (Dairy Australia 2015). Farmer engagement with extension activities varies throughout Tasmania, ranging from farmers who have never participated in extension activities to those who are regularly engaged and host events on their farm. Diversity in adoption, integration and engagement leads to a range of outcomes and impacts on farm (Schewe & Stuart 2015). Focus groups conducted within the Tasmanian dairy industry to determine farmer attitudes towards pasture management led to the suggestion that two factors limiting use of pasture measurement tools by dairy farmers were not having the time available, and hesitation to trialling new practices on their own farm (Craigie 2013). Ghadim and Pannell (1999) also identified risk as a major factor in reducing the rate of adoption of an innovation, and given that uncertainty is a normal attribute of innovations before they have been trialled,

risk aversion generally has a negative influence on rapid adoption of innovations and new technologies. However, many of the extension-recommended pasture management tools and technology, and their use on farms, are not new to dairy farmers, and despite many having adopted and demonstrated these practices successfully, anecdotal evidence suggests that the adoption and implementation of some extension-recommended technologies and practices remains low among a significant proportion of the dairy farmer population in Tasmania.

The decision-making processes around technology adoption are therefore not as straightforward as simply reducing the risk involved through demonstration, and waiting for natural dissemination of information through farmer-to-farmer communication. For further adoption of pasture management recommendations to occur, RD&E providers need a deeper understanding of why many farmers are not implementing these known and proven practices. Future changes made to extension methods should therefore be based on sound social research findings. This paper reports on a survey that aimed to identify the current pasture management practices in the Tasmanian dairy industry, and potential factors related to use and non-use of tools and technology. These data are essential in informing further social research that will delve deeper into the process of decision making and adoption behind the use, or lack of, pasture management tools and management recommendations.

Methods

Survey

In 2016, a paper based, quantitative survey was mailed to all 440 dairy farmers in Tasmania using their contact details registered with the Tasmanian Institute of Agriculture. Surveys were undertaken on an opt-in basis, with a reply-paid envelope included. The survey was mailed out to each farmer once.

The person responsible for making the pasture management decisions on the farm was asked to complete the survey. The survey collected information on farmer demographics such as age, education, role in business and experience, in addition to farm characteristics such as herd size, land area operated, and location. Responses to the level of formal education respondents have achieved were numerically coded with the median level of formal education received being that of a certificate. For further analysis, the levels of qualifications included in the survey were combined to reflect the current standard levels of education and their equivalents as outlined in the Australian Qualification Framework (AQFC 2013) and Tasmanian Education Act (Tasmanian Education Act Tasmanian Education Act 2016). The six original education options were combined into three groups, Year 10 or below and Certificate, Year 11 and/or 12 and trade/apprenticeship, and Diploma and/or University (see Table 1). The survey inquired about the respondent's involvement in extension activities (including general extension activities and activities specifically focused on pasture management), and past and current ownership and use of pasture management tools. As farmers can choose to use these tools in a variety of ways, such as on a regular basis or intermittently, the survey included a number of options when asking about both past and current tool use. For example, have they tried out or tested a pasture measurement tool on their farm, used a tool consistently for 6 to 12 months or longer, or have they used a tool at particular times of the year. The range of options provided meant that farmers could be categorised into those that have undergone a period of intensive measuring and monitoring using a tool in the past (6 to 12 months, and 12 months or more categories as intensive monitoring), as well as those who currently use a pasture measurement tool on a regular basis or periodically. The survey continued with questions asking about how farmers make decisions about grazing management, including options related to using a pasture measurement tool or measurements taken.

When asked about tool ownership, the survey asked ‘do you own any of the following’, with a selection of pasture management tools listed (including plate meter, CDAX bike reader, pasture probe, and pasture ruler), with farmers selecting one or multiple tools if they owned them, in addition to the option ‘I don’t own any of the above’. The survey asked if the respondent, or anyone else, currently used a tool to measure pasture on their farm, with the selection of pasture measurement tools listed identical to those included in the question about ownership, in addition to ‘never use a tool to measure pasture cover’. If any of the tools were ticked, they were grouped under a ‘yes’ response, and ‘never use a tool’ was grouped as ‘no’. This grouping enabled analysis of Yes/No responses to currently using a tool to measure pasture.

Respondents were asked if they had ever used, tried out or tested a pasture measurement tool on their farm, and given a yes or no option. For those who answered yes, they were asked to identify how they had used the tool in the past, with four options of increasing intensity included. Including a range of responses to choose from enabled groupings of responses into

those who had previously used a tool to measure pasture intensively and those who have used a tool non-intensively.

The survey included a section on grazing and management decisions, where respondents were asked to select from a range of options on how they make decisions about feeding their cows, including allocating pasture and supplement feeding. These responses were then grouped into decisions based on using measurements or data from measuring with a tool, and other (that is, decisions not based on measuring, including visual assessment). Respondents were asked to rank their confidence in their ability to manage pasture on a scale of 1 to 10, with 1 being a very low level of confidence and 10 being a very high level of confidence. When analysing the data, a number of different groupings of confidence were analysed in comparison with demographic variables and pasture management practices. The grouping of 7 or more out of 10, and less than 7 out of 10, have been used when comparing confidence and intensive or non-intensive past use of a tool as this grouping produced a significant result. When confidence was analysed in comparison to current use of a tool, the same grouping was used in addition to 6 or more out of 10, and 5 and less out of 10, as a more representative comparison of confidence ranges.

A number of the questions included in the survey had multiple options to accurately reflect the respondents' situation. Numerical coding of responses was undertaken for questions where responses couldn't be grouped into yes or no responses, enabling further analysis. For example, education responses were coded 1 for Year 10 or below, 2 for Year 11 and/or 12, 3 for certificate, 4 for diploma, 5 for trade or apprenticeship, and 6 for university.

Questions that already had numerical responses, like those for herd size, milking area, and years' experience farming, were left in the original format. Questions that included categorical responses in a range, such as that for age and level of concentrate feeding, were also left in the original categories.

Data Analysis

Data collected from the surveys were analysed using the statistical program Statistical Analysis System (SAS University Edition 5.1.17). Survey results were reported using descriptive and inferential statistics, with summary statistics and correlations produced. The logistic procedure was primarily used to examine which demographic and farm variables were related to past and current use of pasture management tools. The logistic procedure yields odds ratio values that reflect the likelihood of a response in relation to the explanatory variable used. Comparisons were made using chi-square values, with level of significance considered at $p < 0.05$. To examine whether current use of a pasture measurement tool has impacted on farmer confidence in their ability to manage pasture, the Pearson chi-square test was used. In order to gain an insight into the current level of ownership, and then use, of pasture management tools among respondents, the frequency procedure in SAS was used.

Results

Table 1 displays summary statistics for the farmers who returned their survey (37.5% response rate). Out of the returned surveys, 162 were completed and used for analysis. The mean herd size for all respondents was 445 cows, with the mean milking area 186 hectares. The mean value for herd size for respondents of 410 cows is comparable to the estimated average herd size in Tasmania of 412 cows (Australian Bureau of Statistics 2017), which suggests that the survey population is a fair representation in terms of farm size when compared with the broader Tasmanian dairy farm population.

Sixty-four percent of respondents answered yes to owning a pasture management tool, with 65% of respondents having used a tool to measure pasture in the past. However, only 48% of respondents answered that they, or someone else, currently use a tool to measure pasture on their farm. Eighty-six percent of respondents answered that they currently attend extension events (varying from once a year to more than four times a year), with 76% of respondents having attended an activity specifically focused on pasture management.

Table 1. Demographics, farm characteristics and use of pasture measurement tools of survey participants

Variable	Survey Sample
Milking area, hectares*	174 (110)
Herd size, no. of cows*	410 (347)*
Education level % - Year 10 or below, and Certificate	38.5
Education level % - Year 11 and/or 12, and trade/apprenticeship	28.6
Education level % - Diploma and/or University	32.9
Past tool use, % yes	64.8
Intensive (6 months or longer)	43.0
6 to 12 months	13.1
12 months or more	32.7
Non-intensive (less than 6 months)	57.0
Less than 6 months	29.9
Particular times of the year	24.3
Tool ownership, % yes	63.7
Plate meter ownership, % yes	59.4
CDAX ownership, % yes	9.4
Pasture ruler ownership, % yes	14.4
Pasture probe ownership, % yes	0.6
Current tool use, % yes	47.8
Plate meter, % yes	42.2
CDAX, % yes	9.9
Pasture ruler, % yes	3.7
Attend general extension activities, % yes	86.3
Attended an activity specifically focused on pasture, % yes	76.4

n=162, mean values with SD in parentheses
Milking area and number of cows denoted with asterisk have been calculated from 161 respondents, with one respondent who works across multiple farms removed from the initial total of 162 respondents to give a more representative sample.

Factors related to the current use of pasture measurement tools

Four factors were found to have a significant relationship with current use of a tool to measure pasture; past use of a pasture measurement tool, farm size (herd size and land area), level of formal education, and attendance at extension activities (general extension activities and activities specifically focused on pasture management).

The relationship between use of a tool to measure pasture in the past, and current use of a pasture measurement tool was significant ($\chi^2_1 = 30.6$, $p < 0.0001$). The odds ratio value of 10 indicates that respondents who currently use a tool to measure pasture are 10 times more likely to respond that yes, they have used a tool to measure pasture in the past, than no (95% confidence interval of 4 and 23).

When the use of a tool in the past was separated into those who have used a tool intensively and not intensively, the relationship with current use was also significant ($\chi^2_1 = 7.2$, $p < 0.03$). Those who have used a tool to measure pasture intensively in the past are 3.4 times more likely to currently use a tool to measure pasture than those who have not used a tool intensively in the past (95% Wald confidence interval of 1.4 and 8.2). When asked to rate confidence in their ability to manage pasture, respondents who have used a tool to measure pasture intensively in the past were 4.3 times more likely to rate their confidence in their ability to manage pasture at a 7 or more out of 10, than those who haven't measured pasture intensively in the past (95% Wald confidence interval of 1.2 and 16). The relationship between current use of a tool to measure pasture and confidence was also significant. Respondents who answered no to currently using a tool to measure pasture were 2.5 times more likely to give a confidence rating of six or less out of ten ($\chi^2_1 = 5.4$, $p < 0.03$; 95% Wald confidence interval 1.1 and 5.6). When analysis was conducted with confidence groupings of five and less out of ten, and six or more out of ten, respondents that answered no to currently using a tool to measure pasture were 8.6 times more likely to give a confidence rating of five or less out of ten ($\chi^2_1 = 10.4$, $p < 0.003$; 95% Wald confidence interval 1.9 and 39).

With regards to level of formal education received, the combined levels of Year 10 and below and Certificate represented 39% of respondents; Year 11 and or 12 and the equivalent level of trade and/or apprenticeship represent 29% of respondents; those with a diploma and/or university qualifications made up 33%.

A chi-square test was performed to examine the relation between level of formal education and current use of pasture management tools. The education levels of Year 11 and/or 12 and equivalent (trade and/or apprenticeship), and diploma and/or university were analysed in

comparison to Year 10 or below and certificate. There was a significant relationship between use of tools and level of education for respondents with Year 11 and/or 12 and equivalent compared with Year 10 or below and certificate (χ^2_1 = 9.4, p < 0.003). There was also a significant relationship between use of tools and level of education for respondents with qualifications of diploma and university compared with Year 10 or below and certificate (χ^2_1 = 19.1, p < 0.0001). The odds ratio value for Year 11 and/or 12 and equivalent of 3.6 indicates that farmers with a qualification of Year 11 and/or 12 and equivalent are 3.6 times more likely to respond that yes, they currently use a tool to measure pasture than farmers with qualifications of Year 10 or below and certificate (95% Wald confidence interval of 1.6 and 8.1). For farmers with diploma and/or university qualifications, the odds ratio value of 6.1 indicates that they are 6.1 times more likely to respond that yes, they currently use a tool to measure pasture than farmers with qualifications of Year 10 or below and certificate (95% Wald confidence interval of 2.7 and 13.7).

There was a significant relationship between herd size and the current use of a tool to measure pasture (χ^2_1 = 19.8, p < 0.0001). Further analysis produced an odds ratio of 1.5, indicating that as herd size increases by 100 cows, farms are 1.5 more likely to report that they currently use a tool to measure pasture (95% Wald confidence interval of 1.3 and 1.8). Milking area was also significantly positively related to the current use of a tool to measure pasture (χ^2_1 = 13.3, p < 0.01). The odds ratio of 2.1 indicates that as milking area increases by 100 hectares, farms are 2.1 times more likely to report that they currently use a tool to measure pasture (95% Wald confidence interval of 1.4 and 3.1).

Attendance at general extension activities and attendance at a pasture specific activity both had a significant relationship with current use of a pasture measurement tool. Responses for attending general extension activities were grouped into yes and no categories, with those who chose once a year, two to four times a year, and more than four times a year group as 'yes', and 'never attended' as 'no'. Respondents who said they attend general extension activities were 3.44 times more likely to report that yes, they currently use a tool to measure pasture, than no (χ^2_1 = 5.2, p < 0.03; 95% Wald confidence interval of 1.2 and 9.9).

The relationship between attendance at pasture specific activities and current use of a pasture measurement tool was significant (χ^2_1 = 7.0, p <0.03). Respondents who have attended an activity specifically focused on pasture management are 2.9 times more likely to report that yes, they currently use a tool to measure pasture, than no (95% Wald confidence intervals of 1.3 and 6.4). Forty-eight percent of total survey respondents answered that they currently use a tool to measure pasture. Of those who attend extension activities, 55% answered that they currently use a tool to measure pasture, of the respondents who currently use a tool, 43% have used a tool to measure pasture intensively in the past. Of the total survey population, 28.6 responded that they had been through a process using a tool to intensively measure pasture in the past.

Table 2. Explaining the current use of pasture measurement tools

Variable	Description	χ^2 (P)	Odds Ratio	95% Wald Confidence Interval
Age	Years	4.9 (0.295)		
Herd size	No. milking cows	19.8 (<0.0001)	1.5	1.3, 1.8
Milking area	Hectares	13.3 (0.003)	2.1	1.4, 3.1
Education	Year 11 and/or 12 and equivalent compared to Year 10 or below and Certificate	9.4 (0.002)	3.6	1.6, 8.1
Education	Diploma/university compared to Year 10 or below and Certificate	19.1 (<0.0001)	6.1	2.6, 13.7
Extension attendance	Yes or no	5.2 (0.022)	3.4	1.2, 9.9
Pasture specific activity	Yes or no	7.0 (0.008)	2.9	1.3, 6.4
Past tool use	Yes or no	30.6 (<0.0001)	10.1	4.4, 22.8
Past tool use	Intensive use or non-intensive use	7.2 (0.008)	3.4	1.4, 8.2

Discussion

In the past, farmers have readily adopted new technologies that have offered opportunities to increase production and income, for example biological innovations such as new seed varieties, chemical innovations including fertilisers and pesticides, animal innovations such as breeding and artificial insemination, and mechanical technology including tractors and harvesters (O'Neill 2010). Tools that have been developed to assist in measuring and managing pasture have generally not seen the same rate of adoption, with use of pasture measurement tools continuing to be limited (King et al. 2010; Eastwood, Rue & Gray 2017). With the extent of information and technology available to farmers, it is plausible that technology is unlikely to be adopted of its own accord and merit, and it is important to recognise that different types of technology require more work and understanding in order to be adopted and used effectively, as they may be more complex or more knowledge intensive than other practices (Ingram 2008). There is an important role for extension and other support and information services, improved and better designed tools, in assisting in this process.

A major priority of extension in the Tasmanian dairy industry has been to promote and increase the knowledge, awareness and understanding of pasture management practices, with the aim of assisting farmers in increasing their skills and ability in pasture management and achieving a higher level of pasture consumption (Mann 2006; Irvine 2013). Various tools and technology and their application on farms have been developed with the aim of assisting farmers to improve their pasture management and pasture consumption. The use of pasture measurement tools as an important component of developing pasture management knowledge and skills has been encouraged through extension activities that include farmer discussion groups, field days, 2-day training sessions and longer-term projects involving facilitated incremental learning. The high level of engagement of Tasmanian dairy farmers in extension activities (86% in general activities and 76% in activities specifically focused on pasture management) reflects the consistent emphasis of publicly funded extension efforts on management of the pasture feedbase.

Results from this survey have found that participation in extension activities, both general extension activities and those focused specifically on pasture management, was associated with a greater likelihood of using tools to measure pasture. Fifty-one percent of farmers who had attended extension activities currently use a pasture measurement tool, compared with 23% of the farmers who have not attended extension activities. This supports findings of Rhoades and Booth (1982) who found farmer participation in extension practices such as discussion groups and on-farm trials strengthen the relevance and acceptance of research findings and their application at farm level.

Farmers who reported they had used a pasture measurement tool intensively in the past (for a period of 6 months or more) were six times more likely to have attended extension activities than to have not engaged. The relationship with past use and current use of a tool was also significant, and there was also a significant number of farmers who have used a tool intensively in the past and no longer do. A study by Turner and Irvine (2017) found that Tasmanian farmers who had been through a prior pasture management learning process, including an intensive period of measuring and monitoring pasture using a tool, developed their knowledge and skills to accurately assess pasture visually, thus reducing their reliance on the use of a tool (Turner & Irvine 2017). Eastwood and Kenny (2009) and Parker (1999) also noted this, with the use of tools by New Zealand farmers diminishing over time as farmers learn to calibrate visual assessments and outcomes with those derived from using a tool. The results of the current survey have informed farmer interviews that are exploring why some farmers have continued to use pasture measurement tools and others have not. Further study is also necessary to understand in greater depth how farmers use pasture management tools, what has facilitated the use of tools, and how these learnings and practices could be adapted and applied to others.

Despite the significant relationship observed between attending extension activities and current use of pasture measurement tools, some farmers have only 'tried them out' temporarily. While a high number of Tasmanian farmers have been motivated to buy plate meters (59%), 30% were found to use them for only a short period (6 months or less) and then discontinued use. It is important to gain a greater understanding about why some farmers intend to use a pasture management tool, often following participating in an extension activity, but do not continue using it past an initial trial. Survey results suggest that using pasture management tools more consistently (even if this has been in the past) is associated with increased confidence in decision-making (self-reported), and that the measurements assist in associated management practices like assessing pasture residuals and allocated supplements. Possible explanations for discontinued use of a tool, as proposed by Pannell (2006), include challenges in applying

information or data from measurements to an individual farmers' circumstances and decision making, and uncertainty about the benefits. Creighton et al. (2011) found that while farmers may be aware of research and its proposed benefits, such as the benefits of those practices promoted through extension, this does not necessarily lead to adoption on farm. Farmers who displayed an interest in learning more about pasture management through engaging in some extension activities and purchasing or trying out a pasture measurement tool, but quickly discontinued using it, are of particular interest for further research. While it is possible that some farmers will have developed accurate visual assessments quickly, anecdotal evidence suggests that further supported learning may be required to assist farmers in gaining the full benefits of using measurement tools as well as understanding the associated biological principles underlying recommended pasture management practices. Different modes of extension delivery may well be needed to provide this supported learning, but their development must be based on sound social research that explores the how's and why's of the observed farmer behaviour.

The significant relationship identified in this survey between attending extension activities and current use of a tool suggests that farmers may have identified extension as a source of information in order to improve or enhance farm practices, such as using a tool to measure pasture to assist in improving pasture management and performance. One of the important aims of extension in the Tasmanian dairy industry has been to facilitate group learning and developing awareness, knowledge and implementation of practices. Kilpatrick and Johns (2003) reported that the social interaction such as that which occurs through group based extension and learning can assist in changing the attitudes and values of farmers, which can then present an opportunity for achieving behavioural change through targeting of information and programs (Wollni & Andersson 2014), and thus adoption. A study by Hansen (2015) found that the ability to understand and apply new knowledge and skills depends on the amount of existing related knowledge, with farmers who have received a higher level of education being more familiar with the concept and process of learning and applying that knowledge in practice. This supports the findings of this survey in that farmers with a higher level of education are more likely to attend extension activities, and were more likely to currently use a tool to measure pasture.

Level of education has been linked with knowledge seeking behaviour, with farmers who have received a higher level of education being more likely to seek out and participate in further learning opportunities than farmers who have received lower levels of education (Kilpatrick 1996; Kilpatrick 1999; Fulton et al. 2003). The significant relationship found in this survey between level of education and participation in extension activities supports these findings, suggesting that farmers with a higher level of education are more likely to seek further knowledge and development around pasture management, with extension providing an option for further learning. Education and training has been shown to assist farmers in making changes to their farming practice (Kilpatrick 1996). Several studies have demonstrated a relationship between farmer education and adoption, such as adoption of technology in the beef industry (Quinn, 1999, as cited in Fulton et al. 2003), and the increased likelihood of adoption of sustainable farming practices with increased education (Reeve & Black 1998). The significant relationship found in the current study, between the level of farmer education and participation in extension activities, and also the current use of tools to measure pasture, align with these findings. Further research is necessary, however, to explore whether there are gaps in current content and delivery of extension programs, and whether additional resources may be needed to meet the needs of farmers with a broader range of education levels and to address any possible future implications for extension such as policy and environment compliance.

Limitations

It is possible that those who completed and returned their surveys are more likely to have a positive view of TIA RD&E and represent more of the farming population that have participated in extension activities than is representative of actual engagement. This introduces a source of potential bias in the survey population, given that engagement in extension has been shown to be associated with a greater use of pasture management tools.

Conclusion

The challenge for extension providers is how to engage more farmers, and adapt extension content to a wider demographic, including those who are not currently engaged in extension. As noted by (Vanclay 2004), farmers are not homogenous, and there exists a challenge for extension in not only catering for a wider demographic, but to do so in a way that caters for the application of principles to individual farmers' specific situation and needs (Wood et al. 2014; Rodriguez et al. 2009). The use of pasture measurement tools is viewed as an important component in the pasture management learning process by those in Tasmanian feedbase RD&E.

This survey has identified the current and past use of pasture measurement tools, the extent of engagement of Tasmanian dairy farmers in extension activities and the farm and farmer-related factors associated with these behaviours. Further research is now being carried out to gain a greater understanding of the decision making underlying adoption and adaption of pasture management tools in the pasture management learning process; recognising that the consistent use of tools may not be necessary after farmers have gained new knowledge and skills that include accurate visual assessment of pasture. Farmers who have not engaged in extension activities, and those who have 'tried out' pasture measurement tools are of particular interest, and their stories may shed light on how the content and delivery of future extension efforts may be developed to better engage them in the pasture management learning process. As concluded by (Kilpatrick 1996), there is no single way of best delivering education and training, but a variety of delivery methods and programs is required to meet different farmer needs and stages of learning. A deeper understanding of farmer attitudes towards both extension and technology, and the adoption and the decision-making processes will help inform the continued development of extension programs with the aim of achieving on farm change.

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