

Boundaries to change: insights into the change process of beef and sheep farmers

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Abstract. Extension programs aim to support farmers in achieving practice change, but often fail to deliver intended adoption outcomes. Understanding why and how farmers make decisions about change helps align extension approaches with farmer values, increasing the likelihood of recommended practice adoption. Interviews with 24 southern Australian sheep and beef farmers explored why and how farmers approach change. 'Boundaries to Change' emerged from a combined deductive and inductive thematic analysis of interviews; providing new insights into adoption based on conceptual Boundaries that constrain farmer decisions around change. The extent of change farmers are willing or able to make is associated with flexibility of Boundaries. Flexibility is influenced by motivating values and information seeking patterns. Farmer segments with particular combinations of Boundaries, values and information seeking patterns emerged, providing guidance for differentiating extension messages. Extension approaches informed by Boundaries to Change identify and respect farmer values, encourage adoption within existing Boundaries and support farmers' moving from firmer to more flexible Boundaries, accommodating practice change.

Keywords: Adoption; Boundaries; Change; Decision making; Extension; Farmer segments

Introduction

Supporting farmers through the complex process of change is challenging for agricultural extension providers. There are many reasons why farmers choose to make on-farm changes and adopt new technologies, and many constraints influencing their decisions not to do so. It is important for extension providers to identify and work with these constraints; recognising the extent of change that farmers are able and willing to make in different areas. Such an understanding is essential for developing and adapting extension programs that both respect farmers' values and maximise adoption outcomes intended by research, development and extension (RD&E) providers. Values are instrumental, social, expressive or intrinsic aspects of farming whose relative ordering influences farmers' decisions (Gasson 1973).

RD&E providers have long grappled with persuading farmers to make changes and adopt recommendations that are based on sound research evidence. From the RD&E provider's perspective, there are generally clear productivity and profit gains that can result from the proposed changes and adoption of a recommended new practice or technology. Widespread adoption within the broader agricultural industry is the logical extension of this goal. Indeed, early diffusion models of technology adoption assumed a continuum along which individual farmers may be early or late adopters; with adoption the final destination of farmers following a rational decision making path (Hooks, Napier & Carter 1983; Rogers 2003). However, for decades RD&E providers have been observing that some farmers adopt one technology early and another late or not at all. In the 1990s scientific institutions addressed this issue by beginning to use participatory extension models and techniques (Hunt et al. 2012). More recent theorising around adoption suggests that change is a process that may be gradual, step-wise and may result in only partial implementation, adaptation or even dis-adoption (Wilkinson 2011).

Another common perception is that 'barriers' stand in the way of farmers adopting new practices. As a concept, barriers to adoption carries the assumption that if the barrier is identified and overcome, adoption will follow. Even recent research tends to assume that the presence of the right tool is all that is needed to overcome adoption barriers (McGregor, de Graaf & Hatcher 2016), while inadequate information has been suggested as the reason medium and small farms are slow to adopt new conservation systems in Europe (Lahmar 2010). The early economic constraint model was based on the assumption that economic barriers prevented a direct link between knowledge of an innovation and its adoption (Griliches 1957). The concept of 'barriers to adoption' offers too simple a view of farmer rationale around decision making and the process of change, particularly when farmers are viewed as a single group with a unified approach to farming (Vanclay 1992), rather than individuals with different values. Changing agricultural policy has resulted in significantly less public funding being available for individual farmer-based extension over the last decade (Hunt et al. 2012). While there has been a rise in private one-on-one extension, it follows that individual farm situations are not usually taken into

account in the design of publicly or industry funded extension programs intended to encourage the adoption of a particular set of recommended practices among a cohort of farmers (Rodriguez et al. 2009).

Segmentation is an approach that can help align extension efforts with individual farm situations; seeking to understand what common factors characterise groups of farmers and their behaviour. Some Australian segmentation studies have resulted in farmers being segmented according to their style of farming (Howden et al. 1998; Vanclay, Mesiti & Howden 1998), values (Maybery, Crase & Gullifer 2005), attitudes (Waters, Thomson & Nettle 2009), aspirations and perceived ability to achieve them (Wilkinson, Barr & Hollier 2011), or favoured sources of information or learning patterns (Kilpatrick & Johns 2003). For example, Kilpatrick & Johns (2003) found that farmers who are more open to adopting a new technology or practice are more likely to have sought multiple sources of information and advice before initiating change, with different learning pattern groups having different preferred sources of advice. The implication for extension is that an extension program should be more than a single session injection of information, but could include a follow up session on a farm that has implemented the target change, a piece in a farmer magazine and/or a newsletter with advice from a technical expert.

It has been established that the likelihood of farmers' engagement with learning activities and extent of adoption of recommendations are influenced by their values, motivations and attitude towards risk (Marra, Pannell & Ghadim 2003; Burton 2004; Greiner, Patterson & Miller 2009; Rodriguez et al. 2009). There has also been a focus on how farmers learn about new technologies (Cliffe et al. 2016) and conservation practices (Rodriguez et al. 2009; Lahmar 2010) in recent developed world extension research.

There appears to be merit in combining insights from segmentation approaches, including information seeking behaviour, and consideration of design of extension programs intended to encourage adoption of particular recommended practices among a cohort of farmers who have diverse attitudes and values, and different approaches to farming and learning. A deeper understanding of farmer decision making in relation to change will assist in the design of flexible, effective extension programs that are intended to encourage the adoption of particular practices. Effective programs are those that can respond to individual farmer contexts within the limitations of the current RD&E system. This study seeks a deeper understanding of differences in how and why farmers approach the complex process of adoption-related decision making through exploring why and how beef and sheep farmers approach change.

Materials and Methods

This exploratory study investigated the research question: Why and how do medium-large scale beef and sheep farmers in southern Australia approach change? A qualitative approach gathered in-depth data through semi-structured, in-depth interviews with 24 farm owners or managers in two Australian states, Victoria and Tasmania. The sample was divided equally between the two states (12 for each) and then again between sheep and beef farmers (6 for each enterprise per state). Beef farmers in north-west Tasmania (labelled TB1-6) and south-west Victoria (VB1-6), and sheep farmers in the northern Midlands of Tasmania (TS1-6) and in south-west Victoria (VS1-6) were recruited with the assistance of meat industry extension providers. All farmers who were selected managed medium-to-large scale farms (gross farm income between AUD \$200,000 and \$500,000 per year). In order to achieve variation in approaches to change, the sample was further divided into two sub samples of roughly equal size representing farmers who were identified by extension providers as participants in group extension programs, and farmers who were thought to have not participated in these programs.

The in-depth, semi-structured interviews averaged 40 minutes each and were carried out at the farmers' properties between August and December, 2013. The interviews focused on the process of on-farm change. Interview questions were developed with reference to farmer adoption literature, particularly that relating to social context, the step-by-step nature of adoption and engagement in learning activities (Kilpatrick & Johns 2003; Pannell et al. 2006; Wilkinson 2011). Questions were open-ended with a number of prompts to elicit fuller responses from participants and covered changes made with the goal of improving the farm business, motivations for change, information sources, engagement in learning, benchmarking, limitations to change and future plans. The scope of the study was limited to how farmers approach change and therefore interviews did not explore the impact of the changes made on the farms. Interviews were digitally recorded for subsequent transcription and thematic analysis.

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 research questions guiding the study and by the literature (Huberman & Miles 1994; Ryan & Bernard 2000). During analysis of the data, codes were added to and revised, with new themes emerging from participants' responses to the open-ended interview questions. Data could be searched and retrieved using the NVivo10© software during the iterative process of refining the resulting insights into adoption.

The inductive thematic analysis revealed new insights into how the instrumental, social, expressive and intrinsic aspects of farming, or farmers' values (Gasson 1973) motivated change, and the nature and extent of that change. The deductive aspects of the thematic analysis confirmed previous farmer segmentation work and added some nuances to previous farmer segmentations by farming styles (Howden et al. 1998; Vanclay, Mesiti & Howden 1998), values (Maybery, Crase & Gullifer 2005), attitudes (Waters, Thomson & Nettle 2009), aspirations and perceived ability to achieve them (Wilkinson, Barr & Hollier 2011), and learning and information seeking (Kilpatrick & Johns 2003). The Findings section describes the results of the motivating values and segmentation analyses, and sets out how the two analyses combine to provide new insights into how farmers approach change.

Findings

Motivating values and information seeking

Farmers discussed changes to farm management practices, investment in infrastructure and land, enterprise mix, and the subsequent impact of these activities on farm labour and debt. The extent of change was typically associated with the farmers' values that motivated change and patterns of information seeking.

Motivations for changes were based on what the farmers valued and included solving problems (e.g. in response to market changes or diseased crops), fulfilling desires related to non-financial principles (e.g. to keep animals content or to maintain optimal organic soil health), achieving production goals (e.g. of one steer per acre or to develop multiple farm operations), gaining greater management efficiencies (e.g. by refining pasture management or monitoring calf weights) and continually improving business profitability (e.g. by changing enterprises or large-scale expansion of herds). There were also a small number of farmers who largely avoided change and highly valued maintaining the status quo; they reported and planned little change to their farming practices. These various values, when combined with particular patterns of information seeking, were observed to shape farmers' approaches to change.

Independent, non-people-based information seeking by farmers in this study ranged from negligible to comprehensive, with different sources of information including scientific textbooks, industry newsletters, farming journals, course manuals, benchmarking reports and websites. There were variations in the extent of interaction between farmers and their engagement with RD&E and other professional services to gain information. Interacting with other farmers was valued by most participants in this study, with the exception of a small number of farmers who either preferred not to socialise or preferred not to share any information about their own farm and practices with others. Interactions with other farmers included informal socialising over a community barbecue, networking at regional RD&E field days and sharing information more formally with likeminded farmers through organised discussion groups.

Introducing the concept of 'Boundaries to Change'

Different approaches to change revealed a number of common 'Boundaries to Change' that constrained farmers' decision making. The term 'Boundaries' was chosen to describe the way management, infrastructure, land, enterprises, labour and debt factors can constrain change rather than acting as an obstacle or barrier to any change taking place. The extent of change, and therefore the flexibility of Boundaries, was influenced both by the farmers' values that motivated change and their pattern of information seeking. The extent of change observed in this study ranged from minimal to extreme, with some farmers resisting change and others continually pursuing it. Some farmers' Boundaries to Change in particular areas were considered to be 'firm' and unlikely to be moved, limiting the change that could take place in that area. Other Boundaries to Change were found to be 'flexible', with the extent of change in that area increasing as the farmer gained confidence to initiate change and confidence that the change would be successful. While each farmer had a unique combination of flexible and firm Boundaries in different areas, the following farmer segments based on particular Boundaries to Change emerged from the data.

Farmer Segments based on Boundaries to Change

Six combinations of Boundaries to Change emerged from the data and are presented in Table 1. Progressing through these segments, Boundaries generally become more flexible and motivations for change develop from predominantly problem-based to strategy-based. The Boundaries to Change farmer segments are described following Table 1.

Table 1. Six proposed farmer segments and observed values that motivated change and information seeking patterns that influence their Boundaries to Change.

Farmer Segment	Values Motivating Change	Information Seeking	Boundaries to Change
Maintenance Farmer	Maintaining static state	Minimal; Avoid interactions with farmers and service providers	Mainly firm Boundaries
Principled Farmer	Fulfilling desires related to non-financial principles	Seek knowledge related to principles	Mainly firm Boundaries, with targeted flexible Boundaries relating to their principles
Reactionary Farmer	Solving problems	Seek knowledge related to problem; Seek direct advice from private consultants and value informal social networks	Mainly firm Boundaries with targeted Boundaries that became flexible when a problem needed solving
Independent Farmer	Achieving production goals	Seek knowledge independently; Do not trust advisors and avoid group activities	Flexible Boundaries relating to production goals
Proactive Manager	Gaining greater management efficiencies	Seek management knowledge from wide range of information sources; Active participation in group activities; Use record keeping to initiate and guide change	Flexible management Boundaries operating within a combination of firm and flexible infrastructure, land, enterprise, labour and debt Boundaries
Benchmarking Farmer	Improving business profitability	Seek knowledge in many areas; Eager to learn broadly; Past or current participation in benchmarking; Skilful in applying new knowledge independently	Mainly flexible Boundaries

Maintenance Farmer Farmers who initiated minimal change, highly valued maintaining the status quo and displayed a low level of information seeking, can be described as having mainly firm Boundaries in place.

The farmers who avoided change (TB2, VS1) did not keep records or actively seek information to inform their farm practices and tended to avoid group learning activities. A likely consequence of this avoidance of information and learning opportunities was an observed lack of confidence in decision making when it came to implementing change. Fourth generation Farmer TB2 spoke about considering small-scale expansion through buying a neighbouring property and although he had low existing debt he lacked confidence that the additional property would be profitable. While there was some motivation to expand his operation, his disinterest in seeking information and improving his farm management (to potentially make expansion possible) helped shape his perception that the future debt limitation was insurmountable: 'at the moment we're just at a stalemate'. When asked how much bigger he would ideally like his operation to be, if debt wasn't limiting, he replied, 'Oh well I don't know, it just depends what's coming and going I suppose really. We've got most things set up how we want them on the place, and it's really only maintenance a lot of it now'. The changes that

Maintenance Farmers spoke about (including strip feeding during calving and supplementing lambs with straw and pellets in a confined area) involved learning from their independent observations on the farm and the experiences of former generations and neighbours. Farmer VS1 described his enterprise transition from wool to prime lambs 30 years ago as being the result of 'word of mouth and self-observation, and see(ing) what the neighbours are doing'.

Principled Farmer When farmers initiated change and sought new knowledge that centered on upholding personal principles, they generally had firm Boundaries, with targeted flexible Boundaries relating to their principles.

Farmers who used principle-based decision making were not interested in benchmarking or record keeping. A Tasmanian beef farmer had deliberately not participated in these activities because he was not interested in having profit-based comparisons influencing or pressuring his principle-based decision making. While maintaining a profitable business was still important to this producer, the changes he was willing to make were motivated by his values; the principles of optimising organic soil health and related pasture management. He relied on expert advice and textbooks (TB4). Another farmer with goals other than increased farm efficiency and profitability, made changes to her farming system motivated by 'kindness ... to make the animals' life on my farm as happy and as good as I can' (VS3). Changes to the farm design were based on minimising stress to the lambs, changes to feeding were related to easing the delivery of lambs and shelter belts were planted to keep stock warm. While this principled approach can be counter to farm efficiency (e.g. heavy supplementation of stock to maintain a higher than recommended body weight), some targeted changes may align with recommended practices (e.g. use of pregnancy scanning). Unlike farmers who actively seek new knowledge in many areas, these farmers sought new knowledge mostly in areas that related to the principles to which they were committed.

Reactionary Farmer When change was mainly limited to problem solving and information seeking was generally of an informal and social nature, farmers had mainly firm Boundaries with targeted Boundaries that became flexible when a problem needed solving.

Some farmers did not generally seek on-farm change or improvement unless something became unsustainable in their farming system. New information was not actively sought otherwise, with a low priority given to record keeping and engaging in group learning activities. A common explanation for the minimal record keeping was a preference for outdoor activity over office-based work. One farmer explained that, 'If you sit in there (the office) nothing gets done' (TS1). He went on to explain why he does not engage in group learning:

Sometimes you can know too much. Yeah, sometimes there's too much stuff you don't need to know about, that it's just like we don't really care about that, as long as I know what I'm doing is working or not. And you know if it's working or not.

When things were not working, information was mainly sought directly from advisors and discussed with networks of peers, to identify the options available to minimise or solve the problem that had arisen. The benefit of talking to other trusted farmers who were either more experienced or at a similar stage of farming and located in the local area, was emphasised in these situations. Despite making these reactive changes, these farmers were generally more hesitant to initiate future change due to uncertainty about the best course of action or the potential returns on further investment. A Victorian sheep farmer described how his dissatisfaction with wool prices and wool quality led to 'trialing' breeds and 'dabbling' with contracts with different agents (VS5). This trial-and-error process of change was more common among farmers who undertook minimal record keeping and did not engage in group learning activities.

Independent Farmer Farmers who initiated strategic change to achieve production goals and sought new knowledge in a highly independent manner had flexible Boundaries that related to their goals.

Some farmers minimised engagement with industry and extension providers, and independently sought knowledge to support strategy-based change. This independent approach to change involved farmers setting clear production goals that motivated extensive change in the areas of management, infrastructure, land, enterprise, labour and debt in order to achieve the production goals. These production goals included a system in equilibrium with one steer per acre (TB6), and increased herd sizes per property (TB1). A Tasmanian beef farmer commented that he would,

go stale if we didn't have new projects ... if you do the same thing all the time you need to be stirred up occasionally. We're improving things here flat out. I think it's really important to have these goals (TB1).

The small number of highly independent farmers in this study were confident in moving towards goals without engaging with other farmers, relying on advisors or engaging in group learning activities or formal benchmarking. The confidence was based on knowledge they had gained through tertiary education, further reading, targeted internet searching and observing the effect of farm practices. Reasons given against participation in benchmarking and group learning activities included not wanting to share financial information or the successful farm practices currently being implemented.

Proactive Manager Management change and new knowledge were strategically pursued to improve farm efficiencies by such farmers who can be described as having flexible management Boundaries operating within a combination of firm and flexible infrastructure, land, enterprise, labour and debt Boundaries.

Some farmers participating in past or current benchmarking activities used the data to improve management decisions and gain greater efficiencies, but valued improving farm efficiencies more than maximising profits. They were therefore less likely to make major changes to their infrastructure, land, enterprise, labour or debt structures (TS3, TS6, VB1, VB2, VS4, VS6). A Tasmanian sheep farmer resisted the change from mainly wool production to prime lamb production, despite market conditions that have favoured the latter (TS6). He remained focused on wool production, likening it to a 'slow boat', and his approach was to 'pick a course and follow it. I mean you can deviate a little bit, but you have to become good at what you do and then just keep doing it. And work out ways to manage risks along the way'. However, he made consistent and significant management changes within fixed factors of infrastructure, land, enterprise, debt and labour, and was guided in his decision making by record keeping, active participation in group learning activities and involvement in benchmarking activities.

The important role of record keeping in decision making was evident, with farmers with this approach to change saying that 'it's a great unknown if you don't measure it (TS6)' and 'you can't manage what you don't measure (TS3)'. Examples of changes motivated by the value of maximising farm efficiency included basing drenching activities on faecal egg counts and carrying out feed budgets for animals that included the expected live weight gain; management that 'saves a lot of money and a lot of time' (VS4). After improving many aspects of his pasture, disease and breeding management, VB1 was monitoring his calf weights to improve the process of buying cattle. The ability to maximise farm efficiency by basing decisions on measurements was developed for some farmers through previous participation in formal benchmarking.

Benchmarking farmer Farmers with a dynamic approach to change that was supported by benchmarking, record keeping and active knowledge seeking, and valued continually improving farm efficiency and profitability, can be described as having highly flexible Boundaries.

Farmers who highly value continually improving business profitability displayed a proactive, dynamic approach to change, tended to seek new knowledge in many areas and prioritise benchmarking in their farm management. For some farmers in this study, formal benchmarking was carried out between farms and was an intensive process of recording many aspects of the farm business. In this benchmarking system, a producer shares these measures with others in a group who have similar enterprises – allowing for comparisons and open discussion around opportunities to change or improve practices with the aim of further increasing profitability. Another systematic but less formal benchmarking approach described by farmers involved maintaining records to review their own farm performance on a yearly basis, allowing reflection on whether decisions have been successful.

Some farmers in this study who participated in benchmarking activities (TB5, TS4, TS5, VB4, VB5) were open to extensive change in the areas of management, infrastructure, land, enterprise, labour and debt because they based change decisions on evidence. New knowledge was actively sought from a wide range of sources, including through participation in group learning activities. Past or present involvement in benchmarking activities provided the evidence and ultimately confidence to implement change. For these farmers, the record keeping skills and subsequent data gained through benchmarking both directly informed the direction and extent of change. One Tasmanian sheep farmer explained that it was when he commenced benchmarking activities that 'a lot of changes started to happen' (TS5), and another agreed that benchmarking 'changed the way we were thinking' (TS4). For these two farmers, benchmarking then guided the process of change from wool production to lamb production. Benchmarking also showed them what could be gained from changing other crop and animal enterprises, and investing in irrigation infrastructure, by:

putting in black and white what's profitable and what's not ... you've got it all in black and white in front of you what's making the money and what's not, so it's pretty easy to put a line through (TS5).

These farmers were willing to take risks to test the upper limits of farm efficiency and profitability. A Tasmanian beef farmer described this approach as:

pushing the limits to see where the boundary is. You think, oh, okay, the boundary's going to be there, and you push, push, push – no, it goes out to there. Push, push, push – it goes out to there (TB5).

For this farmer the changes were motivated by a goal to improve his benchmarking performance (to reach the top quartile) and guided by the data this activity provided. Attention to detail with record keeping and comparing farm data provided the confidence to implement change, which for this farmer had involved large-scale expansion of his herds and property to additional locations and changes to calving patterns.

Discussion

RD&E providers often approach extension with the objective that farmers should adopt best practice recommendations and when adoption does not proceed they may assume that there is a 'barrier' to adoption that if identified and resolved will lead to comprehensive implementation of the recommended practices (Vanclay 1992; McGregor, de Graaf & Hatcher 2016); or they may assume that given enough time or information, adoption will eventually result once successful uptake by others is observed (Hooks, Napier & Carter 1983; Lahmar 2010). This study has revealed there are Boundaries around the nature and extent of change each farmer is willing or able to make. These Boundaries to Change can be firm or flexible and farmers have unique combinations of Boundaries in the areas of management, infrastructure, land, enterprise, location, labour and debt that characterise their approach to change.

Change was either a reactive or a proactive process for the farmers in this study depending on their values, with proactive change stemming from a strategic desire to continually improve farm efficiencies or profitability, or to achieve a particular goal. Our findings suggest that the extent of change is likely to be greater and Boundaries to Change are likely to become more flexible, when farmers make strategic decisions to implement change based on new knowledge they have sought or evidence they have gathered through recordkeeping and benchmarking activities. In contrast, when change is initiated in reaction to a problem that needs solving, the farmer is likely to use existing knowledge or seek targeted information to identify a specific solution.

Particular combinations of Boundaries, values motivating change and information seeking patterns were observed for six farmer segments that emerged in the current study: Maintenance Farmers, Principled Farmers, Reactive Farmers, Independent Farmers, Proactive Managers and Benchmarking Farmers. Mainly firm Boundaries were associated with non-engagement with other farmers and group learning activities, hesitant decision making and resistance to seeking new knowledge (Maintenance Farmers). These characteristics align with those of Non-adopters, who are described by Rogers (2003) as being highly sceptical about change and unwilling to trial new practices. At the other end of the spectrum, mainly flexible Boundaries were associated with continual improvements to farming systems and management, with confident decision making based on science and recorded data (Benchmarking Farmers). Benchmarking Farmers in the study displayed the strong economic and business orientation of the Progressive farming style identified by Howden et al. (1998). Some of them also fitted the description of the Innovators categorised by Rogers (2003) and Howden et al. (1998): farmers who are at the forefront of change and enjoy the process of trialling new practices.

Most of the Proactive Managers in this study, like Benchmarking Farmers, displayed the traits of a Progressive farming style (Howden et al. 1998) and are Early Adopters (Rogers 2003), who implement new practices successfully and are viewed with respect by their industry peers. The potential to encourage farmers outside the Benchmarking Farmers and Proactive Managers segments to benchmark their farm performance has emerged from this research as a means to guide decision making and increase confidence around change. Those undertaking minimal record keeping were more likely to have either not engaged in the process of change or have approached it in a more cautious manner consistent with their firm Boundaries. This study suggests that increased skills and confidence in measuring and monitoring would increase the flexibility of farmers' Boundaries and therefore the likelihood of on-farm change. The findings of Kilpatrick (2000), which revealed a strong relationship between level of education and extent of practice change, suggest that Benchmarking Farmers are likely to have a high level of education and be comfortable with data analysis and technical change. There is an opportunity for RD&E providers to create a wider range of simplified record keeping options for farmers with different values and experience with data collection, to increase the number of farmers making confident decisions around change based on evidence.

There were a few Independent Farmers in this study, who limited their knowledge-seeking to non-social sources, but confidently made changes that helped them achieve their goals. For other farmers, a strategic approach to farming was more likely to involve engagement with group learning activities. Proactive Managers and to a greater extent Benchmarking Farmers displayed the Extensive Networking learning style identified by Kilpatrick & Johns (2003). The positive relationship between openness to change and degree of contact with researchers, experts and group learning activities has been observed in other farmer segment research (Emtage 1995; Howden et al. 1998; Kilpatrick & Johns 2003). The interaction between participants in group learning activities allows information to be gathered from both experts and other farmers. Group learning activities also present the opportunity for farmers to compare their own practices and values with those of others and Kilpatrick (2000) reports that these collective experiences increase the likelihood of farmers successfully implementing practice change.

In this study the Benchmarking Farmers and Proactive Managers were eager to learn broadly, while for Reactive Farmers and Principled Farmers information seeking and change were more reactive and limited to specific areas. There is limited flexibility of the Boundaries involved in the changes for these two segments and the Boundaries are likely to become firm following the implementation of the solution or when their relevant values have been addressed. This approach to change is associated with the medium to low level of risk that Middle of the road farmers (Howden et al. 1998) adopt; farmers that are viewed by their peers as being practical. Farmers with strong principles may even adopt what others perceive as strange management and any influence of extension providers may need to occur through relatively limited contact (Howden et al. 1998). Social network research carried out by Wood et al. (2014), confirmed that many farmers prefer to learn about practices that can be directly applied to their individual farm and are less interested in engaging in knowledge exchange about generalised best practices. The Boundaries to Change concept provides additional guidance around recognising non-financial motivating values (Sattler & Nagel 2008; Rodriguez et al. 2009) and limited areas where Boundaries are flexible, so that programs can include a focus on these motivators in their design where possible.

Boundaries to Change farmer segments provide those working in RD&E with an enhanced understanding of the adoption process that could be drawn upon when designing activities and communication with farmers. The segments identified here cannot represent every farmer (Emtage, Herbohn & Harrison 2006), but they can assist in designing RD&E programs that target a greater proportion of farmers. While the six farmer segments need to be further tested for representability across a larger number of farmers and across more agricultural industries, they provide a starting point to apply Boundaries to Change in agricultural extension program design.

Conclusion

This paper extends understanding of how farmers go about adopting new practices by introducing the concept of Boundaries to Change. Instead of viewing a farmer's reasons for resisting adoption as a barrier that must be overcome, the Boundaries to Change approach suggests that farmers are likely to have Boundaries of varying degrees of flexibility around the factors of management, infrastructure, land, enterprises, labour and debt. The flexibility of a farmer's Boundaries to Change is associated with the values that motivate change, participation in group learning activities, proactivity or otherwise in information seeking and extent of use of benchmarking data in decision making for change. Boundaries to Change provides those working in RD&E with an effective approach to facilitating farmer change through an enhanced understanding of the adoption process and exposition of new farmer segments that can inform extension practice. The farmer segments set out in this paper will assist those working in extension to identify farmer values that may be motivating change and the likely status of an individual farmer's Boundaries to Change and are integral to applying the concept in extension.

The findings of this study suggest that RD&E providers should ask the following questions to identify into which segment a farmer falls and which Boundaries are likely to be firm and flexible:

- Why have farmers implemented past and current change?
- How has the change process been influenced by knowledge seeking?
- What are the characteristics of current boundaries to change?

Boundaries to Change advocates differentiation of the extension message through identifying and respecting farmers' values, encouraging change within existing Boundaries, taking

advantage of any temporary flexibilities in Boundaries and supporting farmers to move from firm to more flexible Boundaries.

Acknowledgements

The authors thank the Victorian and Tasmanian farmers who participated in this study, and Mary Graham and Mya Gaby for their assistance in conducting farmer interviews in Victoria.

Funding: This work was supported by Meat and Livestock Australia under Grant [number B.COM.0346]

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