Lessons learned in delivering an extension programme for grazing lucerne in Central Otago, New Zealand

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Abstract. On-farm practice change was facilitated in a region where traditional or 'old' lucerne management was entrenched. Central Otago is a region of New Zealand with hot (35°C max) dry (~350 mm annual rainfall) summers and cold (-20°C lowest) winters. Lucerne grows well and is known to farmers, predominantly for making into hay. This case study presents an extension programme that encouraged farmers to shift lucerne from hay making to spring grazing, building from previous research and other extension programmes. To facilitate this practice change required on-farm demonstration; farm walks, field days, physical and financial modeling; leading experts and new practice champions; farmers' experiences and local champions; and a website. Learnings included the importance of understanding the specific farm system; demonstration of the new practice; identifying and solving local problems; recognizing the questions that were limiting uptake of new practice by farmers and identifying and engaging with potential gatekeepers.

Keywords: technology adoption, practice change, farm system, gatekeepers

Introduction

Lucerne (*Medicago sativa*) is the plant that has become the focus of much interest in New Zealand dryland forage systems. Farmers are familiar with lucerne but the innovation for lucerne in a grazed pastoral system has come from new insights around the growth and development of lucerne, particularly with regard to understanding the dynamics of plant root reserves which have allowed greater flexibility for spring grazing management (Moot et al. 2003).

This case study considers an extension programme that investigated the opportunity to change farm practice in Central Otago where traditional management of lucerne was widely practiced by farmers. This region experiences extremes of climate and is recognised as the hottest (maximum temperature +35°C), coldest (minimum temperature -20°C) and driest (300-400 mm annual rainfall) environment in New Zealand (Cossens 1987). Two different farming systems dominate in the region. One consists of semi-intensive valley floor properties (about 500 hectares (ha) running 8-12 stock units/ha) with limited irrigation producing meat and coarse wool. The other is more extensive with properties that range from valley floor to mountain top (approx. 5000 ha running 1-3 stock units/ha). They have no irrigation and produce fine wool with meat as a less important income source (Stevens et al. 2012).

Lucerne has been grown successfully in this environment for many years (Brash & Beecroft 1987, Douglas et al. 1987) since early experiments by the Government Agricultural Department in the early 1900s (Otago Daily Times 1916). It is the ideal high quality plant for dryland farming systems and is traditionally grown on valley floor areas as a cut and carry forage for winter feed. Once winter feed requirements are secure, surplus lucerne is then grazed with lambs or hoggets usually in mid-to-late summer (Kelly 1987).

A Ministry for Primary Industries Sustainable Farming Fund programme called 'Lucerne for Lambs' (2009-2012) was developed as an on-farm deliberative learning and demonstration programme for the Central Otago region. The aim was to assist farmers (and the local agribusiness community) to understand and implement a lucerne spring grazing programme to increase farm productivity and profitability. It was inspired by an earlier project in the Marlborough region (Avery et al. 2008) that was strongly linked to research at Lincoln University (Moot 2014). Outcomes and results of the programme are reported by Stevens et al. (2012) and Stevens & Casey (2014). The programme was designed to have an impact and increase the use of lucerne as a spring grazing option for ewes and lambs by using a range of approaches.

The project used a collaborative approach that focused on knowledge building (Allen & Kilvington 2002; Paine 2005; Thompson & Reeve 2011; Edwards et al. 2013) rather than the more traditional top-down dissemination of information. This approach recognized the complexity of the farming system and also viewed knowledge development and knowledge

sharing as taking place in a complex web of social interaction (Vanclay 2004; Pannell et al. 2006).

The benefits of grazing lucerne are now well documented, (Avery et al. 2008, Stevens et al. 2012, Anderson et al. 2014, Stevens & Casey 2014). This paper examines the extension programme that supported the development of new knowledge, knowledge transfer and practice change in this region.

Background and methods

Programme objectives

The experiences of the Marlborough Starborough Flaxbourne soil conservation project, run from 2006 to 2008 (Avery *et al.* 2008), where lucerne became a key component, had a significant impact on the productivity and profitability of the farm used. This prompted the authors of this paper to pose the question 'why don't more Central Otago farmers graze their lucerne stands?'

The authors considered the following key questions:

- Why weren't the farmers grazing their lucerne as a priority or increasing the area planted?
- Was lucerne a more profitable and easier option than investing in irrigation?

An extension programme was developed to encourage farmers to shift from using lucerne primarily for winter supplement to spring grazing with ewes and lambs. Initial objectives were set to illustrate the significant benefits of grazing lucerne in this environment by demonstrating:

- increased lamb growth rates to weaning,
- increase in the number of lambs sold prime at weaning
- and the increased ewe liveweight and body condition at weaning.

An additional objective was to develop knowledge and skills locally and to enable these to be supported beyond the term of the project.

Initial planning followed by continual evaluation of learnings gained in the programme were as important to its final success as were the increased on-farm productivity gains from grazing lucerne in spring.

Building the team – scientists, farmers and agribusiness

The original project team was expanded to include local farmers and agribusiness professionals, a dryland agronomy scientist, a farm systems scientist and farm consultants. The Central Otago region had become increasingly isolated from research over the previous 20 years due to reduced funding for regional science programmes and a loss of farm consultants so it was critical to include local expertise.

The selection of the demonstration farmers was also important. A range of farmers offered their services to demonstrate the technology. No farmers were rejected and the project team included a wide range of farming skills and types. These included a recently returned son to a very traditional family farm, an older farmer reluctantly farming again, as his son went off farm to support the family business, and a farmer who strongly challenged all the ideas presented. Other farmers associated with the project included those who were familiar with grazing lucerne and those wanting to begin grazing lucerne, owner operators and managers.

The four key demonstration farms were mutually agreed by the farmer and extension team and covered the range of farm types and regional microclimates. The team had identified that there was a risk to the project from choosing farms perceived by others to be in 'better areas' or ideal for lucerne for particular reasons.

The dynamic of the project team, now including farmers, encouraged open questioning of all the ideas and solutions proposed over the three years of the project. It was revealed that there were more challenges to changing to a spring grazing system than were apparent from the initial consideration of these different Central Otago farming systems.

The inclusion of key researchers was important to ensure the project had credibility, both with farmers and funders. It was also recognized that capability building in the local region was a key task of the project because there was little ongoing support from scientists and consultants in the region.

Naming the project

The project quickly became known as Lucerne for Lambs (Luc4Lambs) which was easy to remember and signalled to the wider audience what the project was about. This helped with awareness raising and project recognition in the wider farming community.

Field walks, on-farm demonstration and field days

The initial focus of the programme was to revisit the well-researched fundamentals of lucerne agronomy, management and grazing principles (Moot et al. 2003). This was critical to raise the awareness of the importance of recent lucerne research in a very traditional region.

In the first year of the programme field walks and formal presentations were held on the demonstration farm properties utilising expert advice from a leading researcher in lucerne agronomy. The focus of the field walks included topics such as plant growth, establishment, plant population/density, weed management, paddock selection, irrigation use and regrowth after grazing. This forum, using small groups of invited attendees, was ideal for a question and answer approach that allowed for excellent interaction and increased learning opportunities for all team members to both reinforce and update their knowledge.

Concurrently the project team began the on-farm demonstration trials designed as a collaborative learning process. The aim was to develop a shared understanding between the researchers and the farmers to stimulate new knowledge and new practice. This has been argued as effective practice for Sustainable Farming Fund projects (McEntee 2013).

The objective compared current grazing practices with spring grazing management of lucerne. This included comparing lucerne stands with both dryland pastures and irrigated ryegrass. The demonstration blocks were of significant size, enough to graze 400 ewes and their lambs over spring and provided the opportunity for the farmer to change his spring management of lucerne to a grazed system under the guidance of the project team.

Tools

Farmers involved in the on-farm demonstrations needed tools to assist with the grazing management of their lucerne area. A rotation calculator was developed (Stevens & Casey 2014) to assist the farmer to develop a lucerne grazing plan. The initial stocking rate on the lucerne was determined by calculating the approximate lucerne growth rate based on historic records of soil moisture and air temperature at nearby climate recording stations, associated with soil depth and water holding capacity information. Temperature relationships were based on Moot et al. (2003) while the soil wateruse efficiency relationships of Brown, Moot & Mackenzie (2005) and Brown, Moot & Pollock (2005) were used. A minimum of six paddocks was used within the lucerne rotations, with a calculated regrowth period of at least 35 days between grazing events.

This calculator was designed to remove some of the uncertainty for the farmer over how the grazing management would work and how long the lucerne area would last. The area sown in lucerne, and its planned use, differed between each property (Stevens et al. 2012).

Results and discussion

Communication

'If research can't be found, or is not easily understood by target audiences it simply does not travel, falling at the first hurdle in the process of trying to bring about change' (Research to Action 2015). The project team identified that making the information as accessible as possible was a priority for this project. The communication plan was part of the initial project design and included email, newsletters, media articles, milestone reports to funders, research publications and a website (Table 1). Each aspect of communication had a purpose and this changed as the project progressed.

The outcomes of the demonstration farms were presented to the wider farming audience at annual field days attended by between 80-120 people per event. Similar to the field walks these days always had a component of lucerne agronomy as it applied locally and to the spring grazed system.

Key influencers

The project team recognized the potential negative influence of 'gatekeepers' very early in the programme. These gatekeepers could have a detrimental effect on project outcomes in this traditional farming area. To try and limit the impact of this group in a small farming community they were identified at the outset and invited to attend the field walks. This group was predominantly from the rural agribusiness sector (seed company representatives and veterinarians) and included some influential farmers.

Table 1. Communication strategy that developed for the Lucerne for Lambs Sustainable Farming Fund project

Style	Format	Purpose
Informal	Emails and newsletters	Informal communication between the project team and the wider audience.
Formal 4-monthly	Reporting to funders	Milestone reporting provided the summary of the progress and key messages and has proved a valuable resource.
Ongoing	Website www.farmingsheep.co.nz	The key tool for hosting the ongoing outcomes of the project including handouts, factsheets, field day presentations and the final publication from the project (www.farmingsheep.co.nz). The website is critical to enabling the information and knowledge gained to remain available beyond the life of the project.
	Printed resources ('Recipe for Success' FAQ booklet and also as a pdf document http://farmingsheep.co.nz/?p=51)	A project summary was produced using the key learnings from the project in a frequently asked questions format. This ensured the information was presented in a way farmers could easily relate to, in a common language and related back to all the questions the project team had been asked during the project.
	'Lucerne summary papers for establishing and managing lucerne'	Beef + Lamb NZ publication
Formal and permanent	Research publications	These are important for the credibility of the work and for reaching the wider research and extension audience. This project has produced farm systems modelling, lucerne grazing management and extension papers.

This inclusion of the likely 'gatekeepers' in the project at an early stage had three main outcomes; significant retraining of the main sources of technical knowledge for lucerne in the area (seed company representatives); reduced risk of project failure if the 'gatekeepers' had continued to promote the traditional management model and undermine the project message; and finally increased interest in the project by farmers that were outside of this group at an early stage. The gatekeepers were encouraged into the programme by their awareness of the earlier successful Marlborough programme, and the inclusion of the two project champions from that work.

Monitoring and evaluation – recognizing the farmers' questions

The key issues for farmers implementing grazing of lucerne in the Central Otago region were defined through an ongoing yet informal evaluation process over the 3 years of the project. The project had to be able to accurately answer the following two questions:

- "how much lucerne do I need?" and
- "how do I feed my stock over winter?"

Ensuring that a project team 'hear' these questions is a difficult task. It is essential that there is at least one team member whose role is to listen and act as an interpreter. Teams are often composed of similar types of people who like to be leading the discussion or answering the questions. Often the same questions keep recurring during a project over time, at field days or on farm, and it becomes obvious that the answers are not satisfying the audience, as with the two questions above. Interestingly, with all the expertise involved in the project, these were not simple questions to answer and needed further research.

Answering questions to create farm systems change

It was perceived by farmers that grazing the lucerne in spring instead of hay-making impacted on their winter feed resource. The impacts on winter feed were not apparent from earlier agronomic research and the following guidelines were the outcome of local understanding of the complex farm systems and observation of the outcome of the on farm demonstrations.

The production results from the programme (Table 2) provided a basis to answer farmers questions about how to mitigate against the potential impacts on their winter feed supply when shifting to spring grazing of lucerne. These answers provided learnings for the entire project team, the farmers, researchers and extension agents.

Table 2. Answers to the question 'How do I feed my stock in winter?' using the production results to identify outcomes created when shifting to spring grazing of the lucerne

Answers	Outcome
Plant more lucerne for grazing	This allows the farmer to retain the original lucerne area needed for winter feed conservation.
Irrigate winter crops	Use any irrigation to water winter feed crops (e.g. swedes or turnips) to secure a constant yield.
Plant lucerne on deep soils	Many farmers were using lucerne on soils with the lowest rather than the highest water holding capacity. Their understanding of the benefits of lucerne as a dryland plant had previously limited its use to low water holding capacity soils. Greater understanding of the advantage of the water use of lucerne and its deep rooting nature meant the real advantage of the lucerne was on high water holding capacity soils.
Plant more lucerne area	Once there is enough lucerne area planted on a farm it provides much of the winter feed resource due to late autumn and early winter clean-up grazing. This effectively shortens the winter deficit period but is not immediately obvious to farmers in the transition phase for cutting to grazing lucerne.
Lucerne planted on warmer north facing slopes	These areas will start to grow earlier in spring because it is responding to air temperatures. This brings forward the first possible grazing, and is counter intuitive to farmers who have traditionally planted lucerne on the flatter valley floor to ensure ease of mechanical harvest.
Lucerne and traditional pasture both grew the same amount of feed in early spring.	This fact was initially disputed by the local farmers but local on-farm data collection enabled proof of concept (Kearney, Moot & Pollock 2010).

How much lucerne do I need? – modelling the answer

This proved one of the more difficult questions to answer as there are distinct farm types in Central Otago, as described above, and the answer was different for each. One of the most common problems was the under-use of lucerne. A single paddock led to a hay-making outcome. Thus the first step was to ensure that extra lucerne was planted to achieve significant areas for grazing. At least 6 paddocks were required, and an area large enough to support a cohort of livestock for a single purpose (e.g. twin-bearing ewes).

Extensive systems modelling (Stevens et al. 2012) looked at how much lucerne should be planted, as well as the expected costs and returns for two farm types (extensive and intensive). Development on scale is a significant financial investment and this was highlighted in the paper even though the potential returns were significant.

For many farmers it was easier to use smaller steps and develop areas of lucerne that are large enough for a specific purpose – i.e. grazing the twin ewe mobs in spring using the grazing plan. A minimum recommended area of 20 ha was encouraged because this was considered sufficient for farmers to see differences in the mob assigned to the lucerne grazing programme.

Effective outcomes

The learnings by the project team (Table 3) highlight the depth of thinking that a programme like this needs to be successful. While the project team did not use a formal methodology to develop the programme, the programme activities all played a role in three of the four successive levels of change as described by Crisp (2010).

- Change in awareness - naming the project, field days, targeting individuals/gatekeepers.
- Change in knowledge, understanding and skills at a generic level - field walks, field days.
- Change in practice or behaviour - retraining gatekeepers, on farm demonstration.

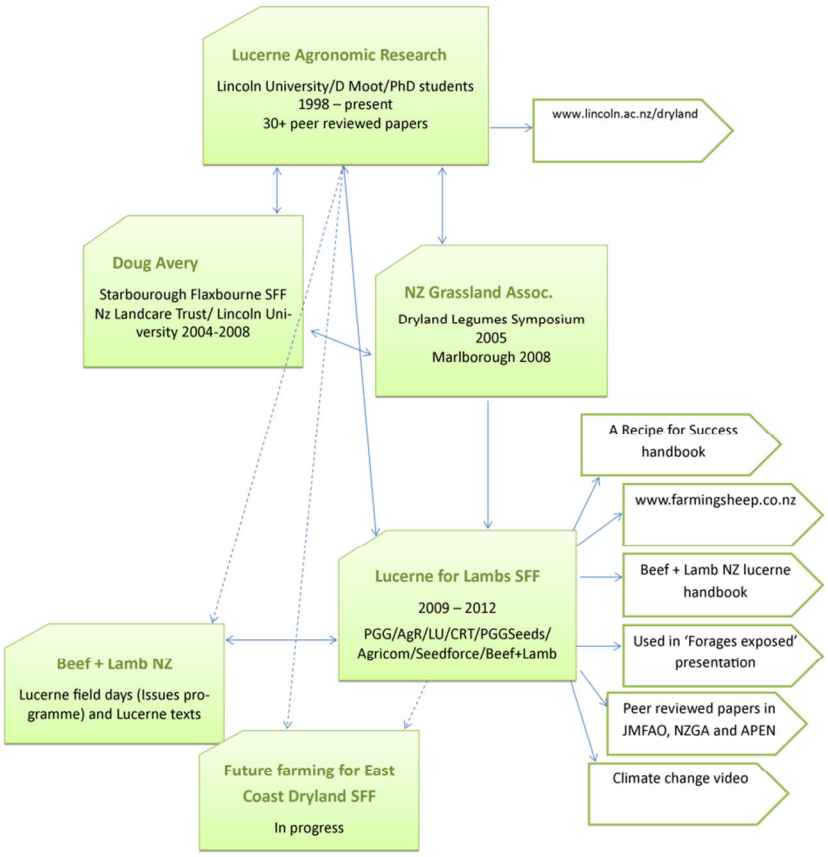
Crisp (2010) described four successive levels of change (developed from Bennett's hierarchy of outcomes (Bennett 1975; Bennett & Rockwell 1995) as a guide to identify the level of change a project is aiming for. The fourth level of change, improved environmental, economic and social outcomes, was met partially and documented in financial case studies (Anderson et al. 2014; Stevens & Casey 2014) of individual farms.

Table 3. Learnings by the extension team

Awareness raising	Create a project name that identifies the project clearly and simply
Building the team	Include scientists, farmers and agribusiness, but also include doers, listeners, sceptics and champions
Deliberative/action learning	Demonstrates the new practice on an appropriate scale and refine as required
Identify your project champions	People who identify with and inspire your target audience and may come from a range of backgrounds within the project
Identify gatekeepers or negative influencers	Identify and engage with potential 'gatekeepers' early
Understand the requirements of the specific farm system	Evolve/adapt the technology to suit
Identify and solve local problems	Rather than try to impose standard answers
Listen	Recognize the questions that were limiting uptake of new practice by farmers
Create simple tools to help farmers	Tools may not be needed for long but help initiate the process.
Communication processes	Aim to meet immediate and future information needs and be ready to change.

It is important to recognize the importance of earlier research and the accumulated experiences over time (Figure 1). Many new practices do not translate directly from trial or compartment research or different regions and farm systems. The network of research, development and extension for the Lucerne for Lambs project (Figure 1) highlights the importance of the accumulation of science and practice over time to underpin successful on-farm adoption.

Figure 1. Lucerne Co-innovation timeline: 15 years to success



Critical to any funded extension project are metrics that determine if the project has been successful. Farmer uptake of grazing lucerne as a technology has been significant both within this region and throughout New Zealand as a result of research and extension over the last 15 years (Figure 1).

Attendance at both field walks and field days was high compared to the average turnout for the region. Feedback from local agribusiness and farmers indicated a greater awareness of lucerne and the opportunity to graze it.

The messages and learnings from this programme and others were further developed with the support of Beef + Lamb NZ into a package of lucerne advice delivered via text message. This service now has over 700 subscribers (A Meikle 2015, pers. comm., 2 September).

Seed sales of lucerne increased significantly, both nationally and in the region (D Woodford 2014, PGG Wrightson Seeds, pers. comm., 14 February). Estimates of seed sales suggest that approximately 7,000 ha of new lucerne plantings have been established per annum over the past 5 years (Stevens & Casey 2014). This increase in area of lucerne planted cannot be assumed to directly relate to increased grazing of the lucerne. However increased seed sales in combination with uptake of the lucerne text service indicate a reasonable level of impact from the project.

An objective of the project was to leave project champions in the region (farmers, agribusiness and consultants) as well as ready access to ongoing information via the website and in this the project was successful. In addition, working alongside researchers informed further research and development of lucerne and farm systems and continues to build on this and other projects, again giving the project outcomes further longevity.

Conclusion

This extension programme developed by the project team resulted in both increased use and understanding of lucerne in the region both by the farmers, the researchers, consultants and agribusiness.

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References

Allen, W & Kilvington, M 2002, Sustainable Development Extension. MAF Technical paper No: 2002/03, pp 33–71. http://maxa.maf.govt.nz/mafnet/rural-nz/people-and-their-issues/education/sustainable-development-extension/2002-03-sustainable.pdf, MAF, Wellington, NZ, 2002 [Accessed 20 May 2015].

Anderson, D, Anderson, L, Moot, DJ & Ogle, GI 2014, Integrating lucerne (Medicago sativa L.) into a high country merino system, *Proceedings of the New Zealand Grassland Association,* vol. 76, pp. 29-34.

Avery, D, Avery, F, Ogle, GI, Wills, BJ & Moot, DJ 2008, Adapting farm systems to a drier future, *Proceedings of the New Zealand Grassland Association*, vol. 70, pp. 13-18.

Bennett, C 1975, Up the hierarchy, *Journal of Extension,* vol. 13, no. 2, pp. 7-12.

Bennett, C & Rockwell, K 1995, Targetting outcomes of programs (TOP): an integrated approach in planning and evaluation, unpublished manuscript. Lincoln, NE: University of Nebraska.

Brash, DW & Beecroft, FG 1987, Soil resources of Central Otago, *Proceedings of the New Zealand Grassland Association*, vol. 48, pp. 23-30.

Brown, HE, Moot, DJ & McKenzie, BA 2005a, Temperature responses of lucerne radiation and water use efficiency, *Agronomy NZ,* vol. 35, pp. 23-32.

Brown, HE, Moot, DJ & Pollock, KM 2005b, Herbage production, persistence, nutritive characteristics and water use of perennial forages grown over 6 years on a Wakanui silt loam, *New Zealand Journal of Agricultural Research,* vol. 48, pp. 423-439.

Cossens, GG 1987, Agriculture and climate in Central Otago, *Proceedings of the New Zealand Grassland Association,* vol. 48, pp. 15-21.

Crisp, J 2010, Planning extension activities for impact, *Extension Farming Systems Journal,* vol. 6, no. 1, pp. 135-138.

Douglas, MH, Brash, DW, Barratt, BIP & Keoghan, JM 1987, Successful lucerne growing in inland Otago, *Proceedings of the New Zealand Grassland Association,* vol. 48, pp. 193-197.

Edwards, C, Gaden, C, Marchant, R, Coventry, T, Dutton, P & Scott, JM 2013, Delivering extension and adult learning outcomes from the Cicerone Project by 'comparing, measuring, learning and adopting', *Animal Production Science,* vol. 53, pp. 827–40.

Kearney, JK, Moot, DJ & Pollock, KM 2010, On-farm comparison of pasture production in relation to rainfall in Central Otago, *Proceedings of the New Zealand Grassland Association,* vol. 72, pp. 121-127.

Kelly, J 1987, Towards 2000: Farming and potential: Central Otago, *Proceedings of the New Zealand Grassland Association*, vol. 48, pp. 9-14.

McEntee, M 2013, Beyond linear technology transfer: Examining learning environments in six sustainable agriculture participatory research projects, *Extension Farming Systems Journal*, vol. 9, no. 1, pp. 114-123.

Moot, DJ, Brown, HE, Teixeira, EI & Pollock, KM 2003, Crop growth and development affect seasonal priorities for lucerne management, Legumes for dryland pastures, *Grassland Research and Practice Series,* vol. 11, pp. 201-208.

Moot, D 2014, Research and extension on lucerne in New Zealand, *Proceedings of the New Zealand Society of Animal Production*, vol. 74, pp. 86-93.

Otago Daily Times 1916, Available from http://paperspast.natlib.govt.nz/cgi-bin/paperspast?a=d&d=ODT19160601.2.5 [Accessed Sept 14, 2015].

Paine, M 2005, Teaching old dogs: Adult learning in action, *Proceedings of the Society of Dairy Cattle Veterinarians of the New Zealand Veterinary Association Annual Conference 2005*, pp. 61–70.

Pannell, DJ, Marshall, GR, Barr, N, Curtis, A, Vanclay, F & Wilkinson, R 2006, Understanding and promoting adoption of conservation practices by rural landholders, *Australian Journal of Experimental Agriculture,* vol. 46, pp. 1407-1424.

Research to Action 2015, Available from http://www.researchtoaction.org. [Accessed Sept 14, 2015]

Stevens, DR & Casey, MJ 2014, Changing farm management practices using lucerne for sheep grazing, Options Mediterraneennes 109, Series A, pp. 801-804

Stevens, DR, Thompson, BR, Carruthers, A, Wall, AJ, Casey, MJ, Phiskie, R, Young, P & Moot, DJ 2012, Understanding the role of spring grazing of lucerne in the Central Otago environment, *Proceedings of the New Zealand Grassland Association,* vol. 74, pp. 69-76.

Thompson, L & Reeve, I 2011, Knowledge types used by researchers and wool producers in Australia under a workplace learning typology: Implications for innovation in the Australian sheep industry, *The Journal of Agricultural Education and Extension,* vol. 17, pp. 445–58.

Vanclay, F 2004, Social principles for agricultural extension to assist in the promotion of natural resources management, *Australian Journal of Experimental Agriculture,* vol. 44, pp. 213–22.