

EverGraze: a partnership between researchers, farmers and advisors to deliver effective grassland management

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ABSTRACT

The profitable and sustainable management of livestock production from grassland systems is challenging and it can be difficult to develop a research structure that addresses farmer's needs and has acceptable rigour and on-ground impact. This paper describes the attributes of research, development and extension (RD&E) programs that are required for a successful partnership between researchers, farmers and advisors. Insights are provided from the EverGraze program that designed, tested and implemented farming systems based on perennial pastures across southern Australia. With this project farmers and advisors were involved in setting research direction, designing experiments, providing strategic guidance over the management of the systems experiments and then the synthesis of regionally applicable key messages. This involvement ensured the relevance of the research and aided in the extension and uptake of the information. The result has been an effective partnership between researchers, farmers and advisors that had a high level of impact across the high rainfall zone (HRZ) of southern Australia, with 1950 farmers or ~8% of those in the HRZ documented as having changed practice over an area of 816,000 ha over a five year period (2009 to 2014).

Keywords: Adoption, Grazing systems, Livestock production, Research impact, RD & E

Introduction

The profitable and sustainable management of livestock production from grassland systems is challenging. These systems are complex and it can be difficult to develop a research structure that address farmer's needs and has acceptable rigour. While investigation of systems components, such as pasture species, fertiliser rates, grazing management and animal enterprise, are often assessed on production parameters (*e.g.* pasture growth rate) they need to either be separately evaluated in a systems experiment or at least assessed in a systems context (*e.g.* whole-farm models) (Sargeant and Glyde, 2013). A systems approach is necessary to determine the magnitude of economic or environmental benefits, what needs to change to realise the benefits, and whether there are

any unexpected negative outcomes, before robust and regionally relevant messages can be developed for farmers. While each farm is unique and some form of interpretation at the individual farm level will be necessary, providing assistance to farmers to consider systems implications can lead to greater whole farm benefits.

The evolution of farming systems research has been documented by McCown (2001). Farming system research evolved from being theoretical and general towards being more social and local, which is closer to real farm conditions, and similar to the Participatory Action Research model described by Oquist (1978). Action research provides a methodology for learning about phenomena that are related to 'human' activity, to which formal experimentation and 'hard' systems

analysis are inapplicable (McCown *et al.*, 2009). While farming systems approaches are designed to ensure that research is relevant to farmers by accounting for social and local aspects in the design, there is often a trade-off in rigour and broader relevance of the outcomes due to the high cost of this research and it is important to strike a balance between the two.

In developing a collaborative partnership between researchers and farmers the structure must allow input from farmers at various levels. Farmers can make valuable contributions to farming systems research because they understand the practical limitations of management and they have a different perspective from researchers. Farm advisors also play an important role, because they have contact with many farmers and they are often translate, modify and package research findings for farmers. The design of a successful program must include all these stakeholders. It must also be able to link together information from research and local demonstration farms to help build a more detailed understanding of farming systems issues and put in context the costs, potential impact and risk of an innovation's adoption.

This paper will describe the attributes of research, development and extension (RD&E) programs that are required for a successful partnership between researchers, farmers and advisors. Insights will be provided from EverGraze, a national program that designed, tested and implemented livestock production systems based on perennial pastures across southern Australia.

Factors that influence farmer decision making

Consideration of management practices in a farming system from a social perspective is a

crucial departure from the notion of a practice as a consistently reproduced technical behaviour (McCown, 2001). To understand variation in practices and to ascertain how improvement of practices can be achieved it is important to better understand farmers' decision making processes. When farmers adopt an innovation they expect that it will allow them to better achieve their goals (Pannell *et al.*, 2006). Providing information to farmers just focusing on either their business or ecosystems is too simplistic (McCown, 2001). Making money is one of several aspirations a farmer has and part of a higher order aspiration of securing family lifestyle (Pannell *et al.*, 2006). There are many other considerations that influence decisions including political, social and religious concerns (McCown *et al.*, 2009, van Eijk, 2000) and decisions may not always be rational. It is important to note that decision making is often a social process that involves peers, other family members, and experts, such as other farmers, company representatives, stock agents, consultants or researchers. Risky decisions that have important consequences often are stressful for the farmer and are generally shared with their social or family group (Pannell *et al.*, 2006).

The characteristic of an innovation that is being considered by farmers is also important. Rogers (1995) proposed five attributes that influence the adoption of agricultural innovations: 1) it has a greater relative advantage than competing options; 2) it is compatible with current production systems; 3) the complexity of the innovation; 4) how easily it could be trialled; and 5) how easily it is to discern the benefits of the innovation. The attributes of farming systems innovations can be so complex as a consequence of intertwined social and intellectual factors that they are difficult to conceptualise in terms of these criteria (Reeve *et al.*, 2000). For example,

changing stocking rate, grazing management and enterprise structure to improve pasture composition may not be as readily observable as sowing a new pasture or using herbicides and fertilisers (Reeve *et al.*, 2000, Simpson *et al.*, 2003).

Most farming systems innovations require a certain level of knowledge and skill for them to be applied in practice, and there can be a wealth of choices in the method of implementation (*e.g.* timing, sequencing, intensity, scale) (Pannell *et al.*, 2006). Through learning by-doing, as well as by reading, listening and watching, the necessary skills can be established and enhanced. It is also important to note that decision making is local, *i.e.* relevant to conditions of that farm, and generally the farmers have the best knowledge of the management of that land. However, if there is a breakdown in the expected outcomes from known management, or a new innovation is introduced, then this is the time when detailed knowledge and input from outside sources is most crucial (McCown, 2001).

In general, decisions about changes to farm management are made without comprehensive information because there is a trade-off between the costs of acquiring additional information and the benefits of improved decision making, and farmers seek to strike a balance (Pannell *et al.*, 2006). Early in the decision making process, the farmers may be uncertain about the innovation and the quality of decision making may be low. As farmers become more experienced with a new innovation or processes, uncertainty is reduced and better decisions can be made (Marra *et al.*, 2003, Pannell *et al.*, 2006). Often heuristics ('rules of thumb' or 'principles') are used to overcome complexity in decision making, because individuals may not have the capacity to calculate all future contingencies (Klein and Methlie, 1995, Arora, 1996). With learning

about complex decisions over time they can become less reliant on heuristics (Pannell *et al.*, 2006, Ostrom *et al.*, 1994) but they may also validate heuristics as a valuable, practical decision making criteria.

Farmers cannot be treated as a generic unit, because they differ in their goals and beliefs, as discussed above, as well as the physical attributes of their farm and farming systems. This is where there is likely to be variation in the balance between prioritising improved financial outcomes and concerns over issues like time, the environment, lifestyle and risk. This can also be influenced by the demographic (*e.g.* age and gender) and situational (*e.g.* seasonal conditions) variables (*e.g.* Morrison and Lockwood, 2014). When disseminating information to farmers, it can be useful to understand there are different types of farmers and target farmers that are either open to change, or are leaders that are followed by neighbouring farmers (Rogers, 1995), or have the attributes that will be suitable to the innovation. These are often younger farmers (around 40 years of age) that are willing and financially able to trial new approaches. Often traditional, older and more conservative farmers are harder to engage, but there can be greater potential to improve their management. Moreover, farmers will not respond to each innovation in the same way, and issues such as social networks, memberships to organisations, proximity to other adopters or the information source, a respectful relationship between the farmer and the information source, and the promotion of the innovation all play a role in adoption (Pannell *et al.*, 2006).

Attributes of a successful research program designed for farmer uptake

The cornerstone of successful partnerships between researchers and farmers

is providing high quality research that addresses the needs of the farmer and builds on understanding and messages from previous programs. There are several other attributes that are important. 1) There has to be high relative advantage which meets the farmers' goals. 2) A participatory approach, where researchers work with farmers and farm advisors, allows for the joint goals to be understood and met. It also removes the likelihood of incorrect or oversimplified assumptions, and gives farmers understanding and ownership of the research. 3) Ensure there is an understanding of the social aspects of farming systems (Pannell *et al.*, 2006). This should result in practical technologies that are readily adoptable by farmers because they have participated in the process.

The extension and sharing of information is a key component in successful farmer and researcher partnerships. Simpson *et al.* (2003) states that the attributes of a successful extension program included: 1) farmers need to decide what is appropriate for them; 2) farmers need to link with a multitude of information providers (*i.e.* other farmers, extension officers and researchers); 3) farmers need to have the appropriate skills and technical language; 4) practice change needs to be demonstrable, feasible and profitable; and 5) systematic support to underpin learning. Extension activities will at best only reach those farmers who are in a position to be receptive at the time the activities are delivered and the structure of activities must also account for farmers seeking information at other times. Much advice fails to explain the risks and costs associated with adopting new technologies when compared to traditional farming practices they are familiar with (Sutherland *et al.*, 2013). Overall, trust between the farmers, the information provider and deliverer of

information is extremely important.

The development of networks of farmers, researchers and extension experts provide opportunities for farmers to familiarise themselves with new technologies in a supportive learning environment (Reeve *et al.*, 2000, Simpson *et al.*, 2003) provided they have a shared goal. A network also allows researchers to understand the day-to-day management constraints faced by farmers (Simpson *et al.*, 2003). There is some trade-off in working together, with structure and consistency needed for rigorous scientific research, but flexibility to include feedback from farmers at various times is also important. The active integration of farmers is necessary for them to participate. For example, in a district where little attempt was made to reach farmers, as few as 6% of farmers took part in the extensions activities (Trompf and Sale, 2006). Continuity of groups is also important in maintaining the relationships between researchers, farmers and advisors (Sutherland *et al.*, 2013) and breaks in these relationships may require confidence to be built again to a level where there is mutual trust and groups are working most effectively.

The unique funding model in Australia, where government funds are supplemented by industry funds through research and development corporations (approximately 50:50), also provides an opportunity for farmer input at multiple levels ranging from setting high level, strategic research priorities through to farmer groups conducting their own research. In most other countries agricultural research and extension services are publicly funded (Aker, 2011) and the lack of investment by farmers reduces their input to setting research priorities. While there is a great diversity in models used for RD&E, the integration of farmers into setting research

objectives and reviewing outcomes is important.

The evolution of farmer involvement in Australian grassland systems research

There have been three major projects addressing the profitability and sustainability in livestock systems of the high rainfall zone (HRZ) of southern Australia. The Temperate Pasture Sustainability Key Program (TPSKP) operated from 1993 until 1996 and the second, Sustainable Grazing Systems (SGS) operated from 1996 until 2001 (Mason *et al.*, 2003a). EverGraze, a partnership between researchers, farmers and advisors to deliver effective grassland management, was the third. A related program, Lifetimewool, operated from 2006 to 2010 and addressed issues of managing ewe nutrition. Lifetimewool was important defining best practice ewe management for the EverGraze research sites, and in refining regionally relevant extension messages.

There have been lessons learnt in the evolution of these projects. Notably, a survey of farmers in TPSKP found they did not understand the potential for grazing management to enhance pasture composition and productivity and they had a very local focus when valuing information on grazing management (Mason and Kay, 2000). While there was considerable farmer input into the TPSKP program, these results indicated more extensive input was required for the SGS program which in itself would require adequate resources including funds. Farmer input to the development and governance of SGS occurred at three levels: 1) a farmer group inspected relevant research sites in Australia and New Zealand to develop priorities on what was needed for farmers to adopt improved

grazing strategies; 2) farmer representatives were included on the national program management committee; and 3) regional committees were established to identify critical local issues and implement local activities (Mason and Kay, 2000, Mason *et al.*, 2003a).

The resulting structure of the SGS program included: grazing systems research sites, regional farmer network activities, the development and delivery of training (Prograze), and national integration and management (Mason *et al.*, 2003a). Evaluation of the project demonstrated wide-spread engagement in training and other activities that resulted in changes to attitudes, practice and indications that changes would result in improved profitability. While the SGS program successfully addressed profitability and environmental aspects of livestock systems, it was highlighted late in the program that social issues were recognised as being equally important and that they should be addressed in future programs (Mason *et al.*, 2003b).

The Lifetimewool program was a separate program that aimed to develop and demonstrate profitable ewe feeding and management guidelines for wool producers to increase reproduction rates (Curnow *et al.*, 2011). The project consisted of plot-scale research, paddock scale validation, on-farm demonstration sites, modelling, communication, awareness activities, training (Lifetime Ewe Management) and evaluation of impact (Curnow *et al.*, 2011). In this project key messages from the research and tools for management were co-developed by scientists and advisers, and with input from farmers who were engaged in the network, particularly those engaged through validation sites. The key messages were a way of presenting the principles derived from research in language that was relevant to farmers and the decision

tools integrated this information to lead farmers in logical steps for making decisions (Sargeant, 2014).

The EverGraze program

The initial goal of EverGraze was to significantly increase profitability of livestock enterprises through the strategic use of productive perennial pastures and livestock systems while at the same time reducing ground water recharge and soil loss by water and wind in the HRZ of southern Australia. As the project evolved, it became clear that profitability of native perennial grass pasture systems and associated environmental issues should be included (native pastures occupy ~60% of the target area). EverGraze involved collaboration between many stakeholders including state and federal government agencies, local natural resource management

(NRM) boards, industry research and development corporations (RDCs), universities, retailers, private and public sector advisers and farmers (Sargeant and Glyde, 2013). It integrated many of the successful attributes of previous programs, such as farmer involvement in planning, national and regional governance, and information generated in these programs was critical for development of the farming systems.

There were six large scale (>40 ha) farm systems research sites (Proof Sites) across southern Australia that tested various perennial feedbase combinations, high performance livestock enterprises and best practice livestock, soil and grazing management. Systems based on sown perennial pastures were tested at Hamilton, Albany and Wagga Wagga from 2006-2011, while systems based on native pastures were

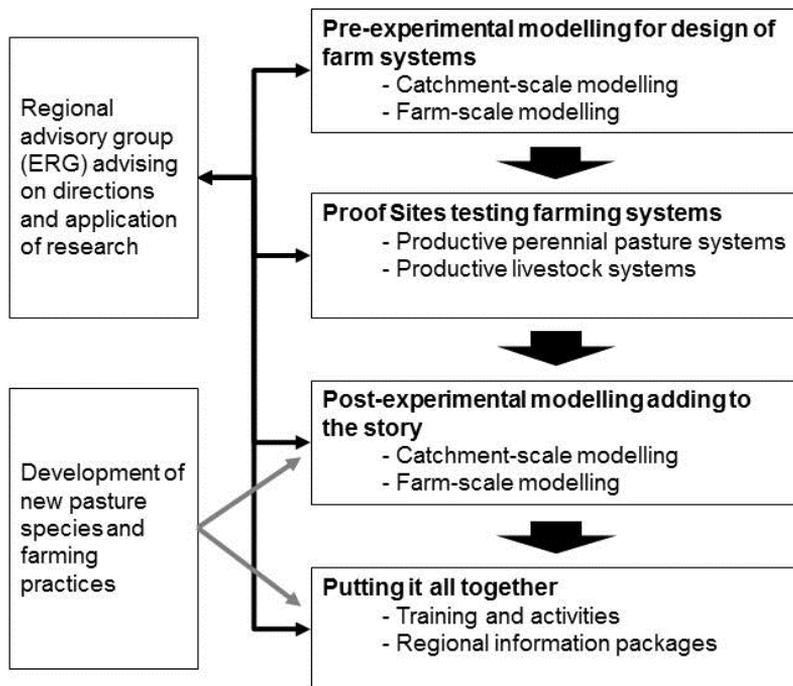


Fig. 1. The designing and testing of farming systems in EverGraze (Adapted from Sargeant, 2014).

tested at Tamworth, Orange, Holbrook and Chiltern from 2008-2012. Soil, pasture, livestock and natural resource attributes were measured as part of a common protocol used at all sites. There were also component research sites testing technologies such as shelter for lambing ewes, flushing ewes (stimulating ovulation) with green pasture prior to joining, and new pasture species. These components complemented the systems research by addressing issues that were identified in pre-experimental modelling (Fig. 1) as having significant impact on profitability and environmental outcomes (Avery *et al.*, 2013). A further 60 demonstration sites were established where farmer groups examined components of the farm systems experiments using paddock scale comparisons.

Farmers, in addition to being engaged in extension activities throughout the project, were involved in the governance of the project at two levels: 1) National Advisory Committee (NAC), which was responsible for overseeing the entire project, and included four farmer representatives (six over the life of the project); and 2) EverGraze Regional Groups (ERGs), which were steering committees that provided strategic guidance on regional research and extension and were based around each Proof Site. Around half of the members of each ERG were farmers, with the balance comprising of the research team, extension staff and private advisors (*i.e.* consultants and agribusiness).

The process that was used to design, implement and test the farming systems is demonstrated in Fig. 1. Pre-experimental modelling at a farm and catchment scale and input from an advisory group containing farmers, researchers and advisors were used to determine the structure of farming systems that could meet environmental and profit outcomes (Masters *et al.*, 2006). These farming systems then became the basis of systems

experiments for the sown pasture research sites. The native pasture sites did not have the same rigorous modelling, mostly due to a lack of confidence in the models to answer the research questions being contemplated at the time, and these sites relied on the expert opinion from the advisory groups and researchers to define the future farming systems.

The systems based experiments were then run for four to five years with input from the ERGs, which provided strategic guidance on the implementation of research and synthesis of results and key messages at the end of the project. The results from the sown pasture sites were largely consistent with the initial modelling, but the research exposed a number of management difficulties that were not identified with modelling (*e.g.* the persistence of perennial species) and identified additional benefits from perennial pastures in the farming systems (Avery *et al.*, 2013).

The post-experimental modelling phase allowed the strategies used in the systems experiment to be tested further, such as assumptions made about stocking rate or lamb sale strategies. It also allowed for the experimental results to be extrapolated over a greater range of seasons and management systems, particularly as many of the sites experienced below average rainfall for most of the experimental period resulting in conservative outcomes. In this process the input from farmers through the ERG was particularly important. They had the experience of following the systems based experiments and they could then stipulate insightful modelling questions, many of which they had developed over time as the experiments progressed.

Finally, the new findings were synthesised into key messages. Each key

message document consisted of a concise statement, a summary of key results from research underpinning the message, a statement of the problem, regional context, background information, what the farmer needed to know to put the research into practice, case study examples of how the research had been applied on farm, and a statement of what it all means to profit, environment, risk and lifestyle on farm. The research and extension team worked together to draft the key message documents, which were reviewed by the ERG, scientists from across sites, state borders and organisations, and a national coordinator who drew the links between messages across research sites. The conversation was often around what the research result meant technically and statistically, and then what was the application in wider farm systems. Careful tempering of the message and detail was required to avoid the risk of over interpreting the findings. On reflection of the process they had been through, the research team concluded that communicating their results in a way that would have direct meaning and application on farm created more discussion and scrutiny than most journal publications and thought the process added significant value to project findings. Once finalised the key messages were incorporated into web-based regional packages that provided regional context in terms of land use, soils, climate, pastures, livestock systems and benchmarks.

The regional packages combined information from component and farm systems research, demonstration, case studies, fact sheets, tools and training to deliver evidence-based and relevant information to farmers. They provided regionally relevant information in a way that complements existing decision making behaviour by farmers while providing

them with the confidence necessary to change management practices. The final mix of key messages for each region was influenced by existing feed base, livestock system and grazing management techniques (Sargeant and Glyde, 2013).

The integrated nature of the whole farm approach presented a degree of complexity not previously encountered by other projects, which made uptake of an innovation difficult. The combinations of practices implemented on Proof Sites were unique to each particular site. Despite the involvement of farmers and advisors in the design and management of the systems, these practices as a whole could not simply be adopted onto another farm due to its unique landscape, enterprise setup, family and farm risk and business goals, lifestyle preferences, and existing combination of farm practices and associated management.

The capacity of research and advisory staff to undertake farming systems research was built, through interaction between the six research groups and across disciplines covering soils, pastures, animals and other environmental factors (*i.e.* water and greenhouse gases). The increased systems capacity (*i.e.* to be able to model complex farming systems) created a more in-depth understanding of the farming systems under investigation. The interaction that research teams had with farmers was also critical to not only understand the practical constraints of farming systems, but also the farmers often shared unique observations and interpretations of data that enhanced the systems level understanding. While experience from previous grazing system programs (*e.g.* SGS) was integrated into EverGraze, the enhanced farming systems research capacity and networks from EverGraze can contribute to future programs in this area.

Key outcomes from the EverGraze program

EverGraze research was underpinned by the hypothesis that simultaneous increases in profit and improvement in natural resource management could be achieved through the strategic use of perennial pastures and high performance livestock systems in the HRZ. While it is not possible to detail all of the experiments and results, some key messages are listed below (further information is available at <http://www.evergraze.com.au>).

More lucerne increases production and profit (Wagga): Including a higher proportion of lucerne in the system (40% compared to 20%) resulted in reduced supplementary feeding costs in drought years and higher lamb production and gross margins in years with a wet spring/summer. The benefit from lucerne depends on the degree of flexibility in the livestock system.

Right Plant, Right Place, Right Purpose, Right Management (Hamilton): The right combination of perennial pastures put in the right part of the landscape for the right purpose and with the right management can extend the growing season, increase profitability, and maintain ground cover and perennial persistence. Lucerne reduces risk, provides options for livestock and reduces leakage of water below the root zone

Adding 25% perennials will give the highest gross margin (Albany): Returns from perennial pasture systems on the south coast of WA are influenced by five factors; the area of perennial pasture in the system; stocking rate; time of lambing; weaning percentage and; the length of time that stock graze kikuyu in autumn.

Grazing intensity influenced production and profit from native pastures (Orange): Individual animal performance is greater for low intensity

grazing systems (1-Paddock) than higher intensity grazing systems (4-Paddock and 20-Paddock), but higher stocking rates can be run with increased intensity, due to greater feed on offer (FOO) giving greater production per hectare. When lambs can be retained for longer after weaning (estimated in 62% of years), gross margins are higher in a 20-Paddock system.

Lucerne-grass mixtures outperform pure grass pastures (Tamworth): Pastures with a mixture of lucerne and tropical perennial grass have potential to increase total dry matter production and spread its distribution more evenly through the year, thereby reducing feed gaps and providing greater resilience in variable seasons, while helping to conserve natural resources on farm.

Understanding Microlaena ecology improves management (Chiltern): Microlaena can spread by stolons, rhizomes and tillers arising from corms beneath the surface. The rhizomes and corms protect the plant from heavy grazing. The stolons can facilitate rapid spread in good seasons. Seed production, viability and germination is not competitive with annual species, so it's important that existing plants are protected to maintain composition.

Evaluation of the EverGraze program

The overall success of any RD&E program is determined by the level of adoption of practice change achieved in the industry. To quantify practice change, EverGraze defined adoption as 'consciously integrating EverGraze principles and practices into whole of farm management'. This acknowledged that the purpose of the project was to provide farmers with the evidence to make changes with full knowledge of the potential impacts and understanding of other changes that might be necessary to achieve these impacts for their unique farming system (Sargeant, 2014). The

substantial impact that the EverGraze program achieved (described below) demonstrated that the partnership between researchers and farmers was effective, and it also demonstrated a successful extension strategy and the importance of involving industry advisors.

Based on online survey results it was estimated that 1950 farmers (Table 1), ~8% of farmers (total number of farmers 23,689; Allan *et al.*, 2003) in the HRZ of southern Australia, made successful changes to management over 816,800 ha over a five year period (2009 to 2014), with EverGraze being the main influence for the change (Sargeant, 2014). These changes targeted the establishment of new pastures, grazing management, sheep reproductive management, establishment of shelter to increase lamb survival, flushing ewes with green feed to increase ovulation rates, fertiliser management and livestock systems (Table 1). To make these practice changes 11,800 producers (50% of producers in the HRZ) were engaged through group activities (Sargeant, 2014). Furthermore, 67% of advisors indicated that EverGraze contributed significantly to their skills and knowledge.

The most common reason farmers gave for making a practice change was the confidence the information gave them, with the 'how to' and 'why' important (QualDATA, 2012). While benefits to pasture and animal production were most strongly perceived by participants, other benefits such as improved biodiversity, aesthetic and spiritual outcomes were also recorded (Wallace *et al.*, 2015). Overall, the diverse range of projects and broad topics covered by the systems experiments, meant many different things were taken away from the project.

Returns from changes to the feedbase and grazing management were estimated to total \$306 M with additional returns from changes to livestock systems, soil management, tactical management and sheep reproductive management. The estimated benefit:cost ratio from the \$33M project investment (cash and in-kind from participants) from 2005-2014 was 9:1, based on 10-year net present value (NPV) estimates (Sargeant, 2014). This value estimate does not include returns from changes that will likely result from future interventions using EverGraze products and information, or from

Table 1. Summary of impact on farmers from EverGraze research (Adapted from Sargeant, 2014).

	Number of farmers changed	Number of ha impacted	Number of ewes	Estimated NPV (10-year)
Pasture establishment	1,072	197,300		\$139M
Grazing management	1,130	617,300		\$89M
Sheep reproduction management	729		1.8M	
Shelter for lamb survival	134	28,900	330,800	\$500,000
Flushing	258	307,000	634,500	\$77M
Fertiliser management	1114	616,000		
Livestock system changes	605			
*Total within client database population (online survey analysis)	1950	816,800		\$306M

* total number of individuals reporting change.

the improved capacity of researchers, advisers and agencies.

Conclusion

A program can be considered to be a successful partnership between researchers, farmers and advisors when the farmers become advocates for the research. It is at this point there is sufficient trust between the group, understanding of the innovation and confidence to promote messages to their peers. Furthermore, once farmers are advocating an innovation, it is more likely to gain traction with other farmers, particularly if the farmer is well respected. With EverGraze, farmers were involved in setting research direction, designing experiments and providing strategic guidance over the management of the systems experiments and then the synthesis of key messages. The farmers were able to pose questions and the researchers were able to address these questions (*i.e.* in the post-experimental modelling phase). Over time the ERG farmers became advocates for their Proof Site, and this aided in the extension of the information. The farmers who changed practice generally did so due to increased confidence as a result of being exposed to new information. The outcome has been an effective partnership between researchers, farmers and advisors that has had a high level of impact across the HRZ of southern Australia.

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