Challenging the boundaries of local and scientific knowledge in Australia: Opportunities for social learning in managing temperate upland pastures

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Abstract. Evidence of an emerging focus on the role of farmer knowledge in developed countries is highlighted by the debate on the nature of local and scientific knowledge. Less attention has been paid to the interaction of different ways of knowing for sustainable capital-intensive agriculture. This paper explores the relationship between local and scientific knowledge in managing temperate pasture and grazing systems in Australia. The nature of farmer knowledge is firstly examined by describing the experiences of farm families in managing native and introduced perennial grasses in upland areas of the Murray-Darling Basin. The building of knowledge and skills through social learning was explored in group case studies and interviews with stakeholders involved in pasture research and development. The interchange of local and scientific knowledge in groups was shown to have a synergistic effect, whereby local knowledge was broadened and strengthened, and scientific knowledge adapted and molded to specific situations. The effectiveness of social learning was greatest in collaborative programs based on small, local groups involved in monitoring and evaluation of whole farm pasture and grazing systems.

Key words: Farmer knowledge, Local knowledge, Native grasslands, Scientific knowledge, Social learning, Temperate pastures

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Introduction

The role of farmer or local knowledge in rural development has been widely researched in developing countries (Rhoades, 1984; Warren et al., 1989; Scoones and Thompson, 1994). Local knowledge is seen as an important source of information and insight about local farming systems, culture, and beliefs. Indeed, the skills and knowledge farmers gain from adapting ideas to their local conditions often form the basis for change in rural communities. Such knowledge relies strongly on past experience, intuition, and the environment (both physical and social) in which it evolves (Chambers et al., 1989; Reijnies et al., 1992).

There has been less debate surrounding the existence and role of local knowledge of farmers in developed societies, other than indigenous communities or minority groups. Historically, producers involved in capital-intensive agriculture have been studied within the boundaries of testing or examining constraints to the adoption of technology. Farmers are perceived as either adopters or rejectors of science-based technologies, and not as originators of technical knowledge or innovations (Thompson and Scoones, 1994; Raedeke and Rikoon, 1997). There is an assumption that farmer knowledge is largely influenced by science and production-driven imperatives (Beal et al., 1986). Diffusion of innovation and adoption studies have perpetuated this perspective of industrialized farmers, and prevented closer examination of the diversity of farmer knowledge arising from differences in social, environmental, and economic circumstances (Kloppenburg, 1991; Moock and Rhoades, 1992; Jiggins, 1993).

The evolution of science as a pervasive form of knowledge in the modernization of agriculture, (and industrialization in general) has prompted many philosophers of science and anthropology to contrast scientific knowledge with non-scientific knowledge. Kloppenburg (1991: 527-528) used paired concepts...
drawn from a range of sources to distinguish differences between ways of knowing (e.g., local/scientific, tacit/explicit, concrete/abstract, intuitive/rational, feminine/masculine, craft/science, relative/absolute, indigenous/scientific, practical labor/science). As Kloppenburg (1991) pointed out, these distinctions were based on the presumption that science produces objective, value- and context-free knowledge, whilst local knowledge is subjective, context-specific, and value-laden.

Agrawal (1995) challenged claims that indigenous or local knowledge could be distinguished from Western or scientific knowledge. There was general agreement amongst authors responding to Agrawal’s comments (IKDM, 1996) that equating science with Western knowledge is misleading as it implies that indigenous knowledge is unscientific and that there is no indigenous or local knowledge in Western cultures. In Western and non-Western societies, people may use both scientific and indigenous knowledge systems simultaneously according to their social and spiritual needs. Havercort (1996) gives examples of people going to science-trained doctors as well as spiritual or traditional healers, and farmers applying science-based technologies along with age-old rituals. Agrawal (1995) concluded that the emphasis should be on the diversity in knowledge creation among different groups of people according to socio-cultural contexts, rather than epistemic differences that create divisions between scientific and local knowledge.

A more recent focus on farmer knowledge in developed countries has been fueled by the ongoing examination of epistemological distinctions between local and scientific knowledge systems (Kloppenburg, 1991; Fischer, 1995; Lyon, 1996; Raedeke and Rikoon, 1997); the changing roles of farmers and scientists in agricultural research and extension (Kersten and Ison, 1994; Pretty and Chambers, 1994; Dunn et al., 1996; Pretty, 1997); and imperatives for social and environmental change (Röling, 1994; Hassanain and Kloppenburg, 1995; Hassanain, 1997). For example, Hassanain and Kloppenburg (1995) highlighted the role of local knowledge in producing alternative agricultural practices outside conventional science. However, local knowledge of farmers in developed countries is not restricted to those seeking alternative farming systems. Raedeke and Rikoon (1997) demonstrated how conventional farmers utilized different temporal and spatial dimensions of their local knowledge to make decisions regarding the management of nitrogen fertilizer. Farmers were described as being inclined towards using either local experiential subjective knowledge, or local experimental objective knowledge.

We would argue that local knowledge of farmers in developed societies cannot be delineated so easily or conveniently. We suggest that farmer knowledge is a dynamic process arising from experiences that integrate scientific information with practical considerations and outcomes. Knowledge is a continuum where local and scientific knowledge are in constant interplay, rather than contrasting or opposing knowledge systems (Leeuwis et al., 1990). Knowledge generation becomes a social process that emerges from interaction and dialogue between different people, networks, and communities (Long and Long, 1992; Thompson and Scoones, 1994, Agrawal, 1995). Raedeke and Rikoon (1997) identified the need for further research to investigate the process of negotiation and interaction between different ways of knowing for sustainable capital-intensive agriculture.

This paper explores the relationship between local and scientific knowledge in managing temperate pasture and grazing systems in Australia. Firstly, we examine the nature of farmer knowledge in Australia by describing the experiences of farm families in managing native and introduced perennial grasses in the upland areas of the Murray-Darling Basin. By acknowledging that knowledge is socially constructed and based on multiple perspectives, we then explore sites for co-learning between farmers, researchers, public and private extension agents, and community facilitators. The building of knowledge and skills for sustainable pasture management is researched in two group case studies, and from interviews with stakeholders involved in pasture research and development. Finally, we highlight the critical factors to be considered when planning and implementing research and development programs to ensure effective social learning and desirable outcomes for agriculture and natural resource management.

**Farmer knowledge of perennial grasslands: A changing dichotomy**

One could argue that Australian farmers do not have local knowledge due to the influence of agricultural modernization and the relatively short history of occupation by white settlers. However, Barr and Cary (1992) and Campbell (1994) have described how Australian farmers and communities are involved in an evolution of agricultural and environmental practices to develop more sustainable ways of managing fragile environments. Local knowledge has emerged as an important element in finding solutions to land degradation and adapting scientific knowledge to local conditions (Fischer, 1995; Curtis and De Lacy, 1996).
This research is set in the context of managing temperate pasture and grazing systems for the upland areas of the Murray-Darling Basin (MDB) in southeastern Australia (Figure 1). Grazing of sheep and beef cattle are the main agricultural enterprises in the temperate zone (600–1200 mm average annual rainfall). In some areas (e.g., southern tablelands of New South Wales) the production of fine and medium wool is the major source of local farm income. Other regions such as North East Victoria support a greater range of agricultural industries (e.g., dairying, horticulture, tobacco, viticulture, deer, emu, cashmere goats, peppermint and lavender oils) and have a higher level of off-farm income.

The increasing urgency to deal with dryland salinity, pasture decline, and decreasing terms of trade in the wool and beef industries has stimulated perennial pasture research and extension across the region. Perennial grasses are considered important for reversing the processes of land degradation to maintain farm profitability, and in the case of native grasslands, to protect biodiversity (Millar and Curtis, 1997a). Pasture
sowing of introduced perennial grasses on upland areas has been limited, due to the costs and risks involved in pasture establishment and maintenance.

Native or low input perennial pasture systems have an important role in these situations, but until recently have been largely ignored by the research community (Jones, 1996). Little is known of the harvesting, sowing, establishment, and management requirements of native grasses. Research into water use, drought tolerance, and productivity characteristics of a wide range of ecotypes is still in its infancy (Garden et al., 1996). Declining resources for research and advisory services in the public sector and continuing emphasis on introduced pastures, has also meant that much of the information regarding native grass research has not been “field-tested” to the same degree as research into introduced grasses.

Given that most research and development of perennial grasses in Australia has been directed towards introduced grasses, we set out to examine whether there were differences in the nature of farmer knowledge of introduced and native grasses. Semi-structured interviews were conducted with 26 farm families in 1995. Family members were encouraged to volunteer their knowledge and opinions of perennial grasses they were familiar with, regardless of whether they knew the common or botanical name of the grass. In this way, their local knowledge of perennial grasses was revealed in the course of talking about their experiences with managing pastures on a paddock, whole farm, and catchment basis. Particular attention was given to farmer knowledge of grass characteristics, the production or conservation values farmers placed on different grasses, and their management practices.

The proportion of native and introduced perennial grasses on properties was variable. Farmer estimates revealed that fifteen properties had less than 10% of the total area sown to introduced perennial grasses and eighteen properties had more than 50% of the property with native perennial pastures. The remaining properties varied between 10% and 50% for both native and introduced perennial pastures, with annual pastures and cropping providing the rest. Native pastures were often highly variable in composition with naturalized annual grasses and weeds dominating.

According to Chambers (1993), the strength of local knowledge lies in temporal and spatial observations over time, which can bring increased understanding of ecological processes and influences. The capacity to elicit the richness of local knowledge in this sense, was limited by interviewing farmers at a single point in time. Nevertheless, farmer experiences with managing grasslands were often described from an historical perspective, illustrating the changing dynamics of farming as a way of life, and associated changes in vegetation management. The tacit nature of much of their local knowledge was tapped by drawing out these experiences.

**Farmer knowledge of native grasses: Grounded in history, observation, and experience**

Findings confirmed that farmer knowledge of native pastures had evolved with little or no outside scientific or technical information, and was based on personal experience, observations, and inherited information. Many of the farmers interviewed recalled how their grandparents or older farmers in the district regarded native grasses at a time when native grasslands were more abundant. For example, historical accounts told of concerted efforts to eradicate kangaroo grass (*Themeda triandra*) because of its poor feed quality and lack of winter growth. There was general agreement amongst landholders interviewed, that kangaroo grass would not persist under continuous grazing or fertilizer application. As one farmer said, “To my mind it doesn’t last where the grazing is heavy.”

The ability of native grasses to come away after summer storms and provide feed during prolonged dry periods was frequently mentioned. Producers readily acknowledged the virtues of native grasses such as wallaby grass (*Danthonia* spp.) and redgrass (*Bothriochloa macra*) in carrying livestock through a recent drought. The following comment from a wool producer illustrated this view.

> Native grasses seem to be the main standby even at present out there. Properties you’ve seen on the way up here are more or less dirt, well out there I’ve still got a good cover of grass, natural wallaby grass and kangaroo grass, all those natural grasses. Better standby than what some of the fancy grasses are.

More than half of those interviewed mentioned the value of having a mixed diet for sheep and cattle, with native pastures providing both fresh, green shoots and dry feed from a range of species. The following comment came from a beef and sheep producer who valued redgrass highly on hill country for its ability to maintain stock through the summer whilst providing groundcover and dry feed.

> It is surprising how it holds on. I find this country is ideal for the sheep if you are wanting to give them a little bit of grain, and you don’t want the country to get too bare. Then, when you start giving them this grain, they have got to have roughage. They can go and have their mouthful of high protein feed, and then go and get some roughage to keep their stomachs working properly. It is no good having all
ice-cream this week and next week having to have cabbage!

Farmers reported very low incidences of animal health problems with livestock grazing native pastures. Wool or skin contamination from native grass seed was generally overcome by management such as shearing before seeding or grazing heavily to prevent grasses from going to seed at critical times. Native pastures were considered important for growing fine wool and where maintenance feed for livestock was required. Cattle producers valued hill country native pastures for running dry stock (such as in-calf heifers or cows after weaning) to keep them fit and in good condition. The fact that cows were forced to walk to find water and feed was seen as an important factor in reducing calving problems, as explained by one producer.

I have still got quite a bit of native grass country at the back of my property which carries quite a good stand of kangaroo grass. I virtually only use it as a turn out paddock for running in-calf heifers to keep the weight off them.

The practice of burning native grasslands was spoken of as being commonplace in earlier times to improve the quality of feed and extend the growing season. However, this practice was now only carried out spasmodically on a few properties. Most landholders did not burn native grasses as their pastures were kept closely grazed or they saw it as another task to do at a busy time of year. One producer said he would not burn kangaroo grass on his country for fear of killing off native flowers and forbs. The following is an account from a producer who carried out burning of native pastures in NSW.

We usually don’t burn until the kangaroo grass is that thick with old residue that it would just about trip you to go through it. And then I like to burn only right at the end of winter or early spring, I like to make sure the ground is still wet in some places, there would be water lying on the ground in the flatter areas. If you can burn it then slowly, it doesn’t cook it and if there are seedlings like clover underneath they survive as well, but this year it was so dry, if there was anything else alive it would have killed it. Once the stock get on to it they’ll keep working those areas that haven’t got so much residue on them. I would say depending on the seasons and the stocking rates, it would be eight to ten years before it would need burning.

Management of native grasses is often constrained by terrain (remnants are often on hilly or non-arable country), the large size of paddocks and livestock units, lack of finance for fertiliser or fencing, and seasonal effects. Despite these limitations, some farmers interviewed showed considerable innovation aimed at increasing the productivity of native pastures by changing lambing or calving times, subdividing paddocks, burning or strip grazing native grasses, or fertilizing and introducing clovers. By changing to spring lambing or calving, producers could make greater use of available summer feed when feed demand was highest. The feed quality of native pastures was maintained for longer by burning before summer, subdividing paddocks, and using different grazing strategies. Most of these innovations had arisen from direct experimentation or had been passed on from previous generations or neighboring farmers.

Farmer knowledge of introduced grasses: Adapting technical information

In contrast to native pasture management, farmers interviewed developed specific local knowledge of introduced pastures through a process of ongoing experimentation with pasture technology. In most cases, introduced perennial pastures had been sown by the farmers themselves or by the previous generation, thereby providing direct involvement and access to information about the success or failure of establishment. Information was readily acquired from sources such as advisory services, media, farmer organizations, trials, and trade industries. Fine tuning of this knowledge occurred as farmers experimented with different establishment and management techniques and compared the results with the latest technical advice or experiences of other farmers.

For example, most farmers interviewed had changed from conventional cultivation to direct drilling of perennial pastures in the last 10 years. Direct drilling is a technique advocated by government agencies as having soil conservation benefits. Farmers were convinced that direct drilling provided better weed control, less soil disturbance, greater moisture retention and greater flexibility with the time of sowing. Farmers also described their experiences learning the art of direct drilling and the importance of understanding reasons for establishment failures. For one producer, successful establishment of phalaris had taken fifteen years of experimenting with different species, weed control techniques, fertilizers, sowing methods, and timing of operations.

What I’ve done now to establish phalaris on this country, was to virtually agro-plough on the contours and apply no less than three quarters of a
tonne of lime to the acre. By direct drilling in late August and early Spring I was able to get far better weed control than if I had gone in and done it conventionally.

**Balancing production and conservation: Using local and scientific knowledge**

Farmers demonstrated how their knowledge was constantly being challenged by immediate and long-term concerns for economic survival and environmental stability. For example, many of the farmers interviewed wanted to retain or enhance their native grasses after witnessing the detrimental effects of annual pastures and the poor persistence of introduced perennial grasses. Other farmers were aiming to increase the area sown to introduced grasses to achieve a corresponding increase in stocking rates or halt pasture decline on their properties. Producers engaged in fine wool production on large properties were inclined to favor low input native pasture systems, whereas farmers who had smaller properties relied on introduced perennial pastures to maintain farm viability. The challenge for many farmers interviewed was to balance the production and conservation values of perennial grasses by adjusting management techniques and finding niches for different grasses within their farm environment (Millar et al., 1997). Farmers interviewed identified the need for more information on how to manage both native and introduced perennial grasses using scientific information and the experiences of farmers in their locality. The following discussion draws on case studies of group learning to highlight the role of local and scientific knowledge in building knowledge and skills for sustainable pasture management.

**Building knowledge and skills for sustainable pasture management**

The relationship between local and scientific knowledge in group learning was explored in case studies of a Prograze group (a short term, agency-led pasture and grazing management course) and a Landcare group, (a state-sponsored community-based program dealing with a broader range of land management issues). Both groups focused their activities upon building knowledge and skills for sustainable pasture management. Participant observation and group interviewing were used to examine the role of local and scientific knowledge in reaching new levels of understanding on pasture management principles and practices.

A total of seven Prograze group meetings were attended from July, 1995 to March, 1996 with each meeting held over half a day on a different property. Of the twelve farm businesses involved in the Prograze course, six had mixed enterprises (cropping/livestock) and six were grazing properties. Properties were located within a 60-kilometer radius of each other. Ten farmers attended the first meeting, but numbers dropped to between five and eight in subsequent meetings. Group members were mostly male farmers, with two women farmers, including one couple. A group interview was conducted at the conclusion of the course to gain some understanding of how participants valued farmer and scientific knowledge in group learning.

For the Landcare group study, observations were made from February to October, 1996. During this time there were five general meetings, a weed field day, a pasture management course (three evening sessions and a farm walk), and a pasture field day. The group had 20 active members at the time, with 60 landholders on the mailing list. All landholders ran grazing enterprises (beef cattle, dairy, goats, horses, and sheep). The Landcare group had a greater proportion of participants with small properties and off-farm work than the Prograze group. For example, of the seventeen participants in the Landcare pasture management course, ten were part-time farmers and seven were full-time farmers. There was also greater involvement of women in the Landcare group, both on the committee and at field days and courses.

**Putting principles into practice**

The objective of the Prograze course was to learn about the scientific principles behind pasture and livestock management, acquire assessment and feed budgeting skills, and put these principles into practice on the farm. Farmers learnt how to assess pastures and fodder crops in terms of composition, digestibility, and quantity of feed at different times of the year. Course participants learnt how to judge the condition of livestock using condition scores and how to estimate livestock feed requirements at different stages of growth and reproduction. Farmers valued scientific information for providing general concepts, and an understanding of why certain practices were recommended. Learning the theory and principles of grazing management enabled participants to find out how and why certain practices were recommended, and to become more objective in their decision making. As one producer said, "We all know that you should leave your rams in for a certain time and lambs should be weaned at 12 weeks, but I've never known all the reasons why ...now it all adds up!"

However, it was not until technical information or concepts were applied to the whole farm or enter-
prise scale that local knowledge came into play. For example, at the fourth meeting the group carried out dry matter and digestibility estimations for a phalaris and clover pasture that had been locked up to go to seed, and an oat crop being grazed by hoggets (two-year-old sheep). Group members found the phalaris/clover pasture difficult to estimate for dry matter content because of the high proportion and density of clover. Most farmers estimated the oat crop as having a higher dry matter content. When the pasture samples were dried and weighed, the results revealed that the phalaris/clover pasture had almost twice the dry matter of the oats. When these results were put through a decision support computer program known as "Grazfeed," there was a livestock weight gain difference of 177 grams per day on clover compared to 74 grams per day on oats. The farmer who owned the property admitted his sheep would probably do better in the clover paddock. However, he had shut the paddock up to allow the phalaris to go to seed (a requirement for summer persistence) or to possibly harvest it for hay should spring conditions prove favorable. He was content that the oats would at least maintain the sheep.

Although the results indicated that on a scientific basis the farmer should be utilizing his pasture, the farmer had other considerations based on his background knowledge of management requirements for the persistence of the pasture and his future livestock feed requirements. The exercise generated a group discussion on the options available to the farmer, and demonstrated the importance of adapting scientific principles to real farm situations.

Farmer priorities and quest for knowledge may sometimes be at odds with scientists and extension agents. This was highlighted during assessment of a pasture species demonstration run by a local agronomist. The agronomist wanted to find a site with enough dry matter to record and to get species differences. The farmers preferred to assess pasture sites typical of the current feed availability on their properties. One producer at the group interview said he didn’t get anything out of the pasture species trial because it had been left ungrazed.

Who wants to look at a great bulk of pasture that is this high? I would have much preferred if they could have flogged it out down to the ground level a month before we got there, to show which one is going to grow the quickest. It was a well set up trial but I got nothing out of it.

New boundaries for local and scientific knowledge

During the first few meetings of the Landcare group a working committee was formed to focus objectives and strategies for action. The Landcare group had little direction from outside agencies and endeavored to meet landholder interests by providing locally-based learning opportunities (Government agency representatives were largely absent from meetings unless invited to attend as guest speakers or to become involved in projects). As the group developed ownership of their meetings and confidence in decision-making, there was greater sharing of information and experiences, including the exchange of local knowledge. Members increasingly recognized the range and depth of knowledge and experiences of group members. They decided the pool of expertise in the community was sufficient to enable the group to conduct their own events without the assistance of outside experts. Although technical or scientific information was used at meetings, field days, and courses to provide background details or explain possible cause and effect relationships, the emphasis remained on how this information had been put into practice by local farmers.

The weeds field day was jointly organized by the Landcare group, the local branch of the farmers federation, a local adult education center, and the Cashmere Growers Association. Three properties were visited throughout the day and property owners explained how they used herbicides, fertilizer, pasture establishment, and grazing management to control weeds. The last property inspection at the field day gave participants an opportunity to hear about using goats for weed control and to look at both native and improved pasture. The landholders described their property when purchased twelve years ago as severely infested with blackberry, bracken fern, and wattle. The introduction of cashmere goats had reduced blackberry canes, wattle regrowth, thistles, and St. Johns Wort. A local farmer had assisted in the sowing of pasture which was now used for weaner goats and lactating does. The goats were put out in the bush when pregnant to keep them fit. The landholder explained that the goats did some damage to tree seedlings in the bush, but this was desirable to keep the bush open to allow more light in and enhance growth of native grasses. She also kept the goats out of the bush when orchids were flowering. Management decisions were made on the basis of her observations of goat behavior and their effect on the local environment, as well as information from local farmers, the Cashmere Growers Association, and government advisers.

It is all a matter of balance, I believe in having animals that complement each other in the plants.
they eat and the way they graze, and in keeping the diversity here.

The pasture management course was organized by the local education center and delivered by a local farmer who had worked as the Landcare group coordinator and a pastures adviser. Throughout the course, he imparted much of his local knowledge and experience, giving accounts of his successes and failures and stories of other farmers’ experiences. By interspersing anecdotes and practical advice with technical information, the local farmer helped to provide a whole farm perspective. He gave examples of how he had improved paddocks without sowing by spreading hay after liming (to get seed regeneration), by agroploughing (a form of deep tillage), by selective use of herbicides, use of fertilizer, and rotational grazing of paddocks to increase clover content of the pasture. He also used an example from on-farm high input fertilizer trials that showed that during the drought of 1995, those with high input pastures were able to retain cattle and did not need agistment.

The knowledge and experience farmers bring to a group learning environment was acknowledged as valuable by participants in both case studies. In the Prograze course, farmer knowledge enabled scientific principles to be applied to real farm situations, thereby increasing understanding and shared meaning among participants and advisers. In the Landcare study, local knowledge was the driving force behind learning about pasture management in a practical, holistic sense. As one producer attending the Prograze course stated, “All that farmer experience adds to the pinnacle of knowledge that you get out of it.”

Research findings also demonstrated that group objectives and approaches to learning influenced the extent farmer knowledge and experience was drawn upon. Farmer knowledge can remain dormant unless critical factors in group learning are addressed (Millar and Curtis, 1997b). In group situations with scientists present, farmers may lack confidence in their local knowledge, particularly if unfamiliar with scientific jargon. This can influence their willingness to contribute their knowledge and experience. Similarly, feedback from some Landcare course participants who were new to farming and pasture issues, revealed they felt somewhat intimidated by the vast technical and practical nature of farmer knowledge.

As landholders in both groups developed confidence in their ability to understand and use technical and scientific information, there was greater sharing of experiences and local knowledge. The interchange of local and scientific knowledge had a synergistic effect, allowing local knowledge to be broadened and strengthened, and scientific knowledge to be adapted and molded to specific situations.

**Opportunities for social learning in pasture research and extension**

Twenty researchers, extension agents, industry consultants, and community representatives were interviewed to discuss the role of local and scientific knowledge in pasture research and extension programs. All researchers and extension agents were employed by state government agencies. Of the five industry agents, four were self-employed consultants and one was employed by an agribusiness firm. Community representatives included four farmers (three of whom had off farm work as facilitators or technical officers) and a Landcare coordinator.

Research and extension agents acknowledged the value of farmer or local knowledge. To some researchers, local knowledge gave them insights into farming systems and provided ideas and innovations that could be investigated further using on-farm research. However, local knowledge was also described as lacking a sound basis for understanding cause and effect. Whilst most industry and extension agents acknowledged that farmers were very observant, and knew what worked in their area or on their properties, they were less likely to know why. Local knowledge was sometimes based on strongly held beliefs or “myths” within a rural community that could perpetuate certain practices and create resistance to change, according to several extension agents interviewed. Working individually with farmers and catering for different learning needs was seen by some consultants as a way of drawing out local knowledge and enhancing farmers’ capacity to learn.
Extension agents and industry consultants involved in group based programs such as Prograze and Landcare spoke of these programs as bringing farmers and scientists together in a mutual learning environment (Figure 2). Interaction of local and scientific knowledge was most evident in collaborative programs with a farming systems perspective, where learning took place in small, local groups. Through monitoring and evaluation of pastures and grazing systems, farmers could pass on their observations to scientists and enter into dialogue on possible cause and effect, and management options. In some cases, farmer knowledge transformed scientific thinking and changed the way pasture scientists approached their subject and methods. An extension officer involved in facilitating groups over several districts and farm enterprises said it was a case of learning together with farmers who were adapting this technology in their local environments.

We've got to get back to using farmer experience and the different histories of paddocks as learning environments, and replicating environments through farms and do a lot more onfarm monitoring and targeting and measuring.

The professional and social distance between farmers and scientists and changing institutional priorities made it difficult to bring farmers and scientists together for long term knowledge and information exchange. Differences in cultures and attitudes, funding imperatives to accomplish farmer participation with limited time and budgets, centralization of research centers and projects, lack of training in participatory methods, isolation and survival of rural communities, and a reduction in extension services were mentioned as constraining elements.

Several temperate pasture research and extension programs are endeavoring to overcome these limitations by giving farmers more ownership and control, and addressing long term whole farm and sustainability issues. Concern over resource degradation, farm viability and sustainability of temperate grasslands in Australia is demanding new ways of thinking, action, and cooperation. Approaches to developing temperate pasture and grazing systems are changing, with a shift towards a whole farm systems approach, conservation of native grasslands, and emergence of participatory research and development and group learning. There is a movement towards involving farmers and professionals in genuine participation and learning based on small, peer groups; in providing ongoing technical support for monitoring and evaluation; and providing training for group facilitators.

Conclusion

Farmer knowledge is as diverse as the different environments in which farmers live and work, and their family and social background. There is also a huge variation in the quality and depth of farmer knowledge depending on a farmer's stage in life, interests, and willingness to learn. It is these very factors that distinguish local knowledge from scientific knowledge. And yet as this research has shown, local knowledge can arise from the process of applying scientific information to local circumstances. The dynamic nature of farming requires management of multiple, interrelated systems and an intimate knowledge of these systems (Hassanein and Kloppenburg, 1995; Chambers, 1997). Farmer knowledge is constantly changing as new information and experiences are encountered, decisions are made, and action is taken (Portela, 1994). It is experiential, diverse, socially constructed, and serves a livelihood purpose.

In Australia, as in many other parts of the world, much of this vital knowledge has remained hidden and marginalized within the traditional “technology transfer” paradigm of agricultural science (Kloppenburg, 1991). The challenge is to allow local knowledge to be shared, and to join forces with scientific knowledge in providing learning opportunities and practical solutions. According to Chambers (1997: 205), “The key is to know whether, where and how the two knowledges can be combined, with modern science as servant not master.” The Landcare and Prograze case studies highlighted the potential of groups to blend local and scientific knowledge. Group learning needs to maximize farmer participation and use of both local and scientific knowledge in making decisions and finding solutions.

However, farmer participation in research and extension (including groups) does not guarantee that farmer knowledge is used and valued. Much of farmers’ local knowledge is tacit, and only emerges by asking or hearing about their experiences. Mechanisms or processes for achieving effective learning and collaboration are not always given as much attention as the content of information being shared. Collaborative programs need to be based on experiential activities that apply to whole farm systems and that facilitate ongoing learning between researchers, extension agents (public and private), and farmers. Further research into the application of local and scientific knowledge in monitoring and adapting practices for sustainable agriculture and land management, can only provide greater insights into methodological and theoretical possibilities.
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