MANAGERS' PERSPECTIVES OF WEED MANAGEMENT WITHIN RANGELANDS MANAGEMENT SYSTEMS

Lynn Webber[1]
NSW National Parks and Wildlife Service, PO Box 1967 Hurstville, New South Wales 2220, Australia

Summary This paper discusses the emergence of R&D approaches which seek to recognise and value local knowledge as distinct from scientifically generated knowledge. A review of papers presented in this forum since 1984 reflect a technology focus in presentations about on-the-ground weed management. The 1990s has signalled a move towards more people-centred approaches to addressing weed management issues, reflected in discussions about community approaches in the case of Landcare groups and Aboriginal communities.

Research in rangeland management systems with graziers has highlighted the diversity and complexity of local knowledge generated in the rangelands context. Research with Aboriginal people in rangelands has revealed other understandings to those of scientific knowledge or graziers local knowledge.

Recognition of local knowledge as important complements to scientific knowledge provides an opportunity to move towards co-researching partnerships which invite active participation by local people from the outset of the process at the problem formulation stage.

INTRODUCTION

The organizers of the 11th Australian Weeds Conference in inviting me to present this keynote paper have emphasized the importance of making this conference a watershed through exploring whether we have really achieved anything other than scientific data and publications. What on-the-ground weed management improvements have been achieved in the majority of the Australian mainland – the rangelands?

In exploring the nature of weed management improvements in rangelands, the traditional technology transfer approach of scientific research, development and then extension to potential users, provides much food for thought about the way research and development (R&D) contributes to improving on-the-ground rangeland management, and where the opportunities to move forward may lie. This particularly relates to recognising that other knowledges than scientific knowledge exist. Valuing different perspectives of rangelands weed management issues offers an exciting opportunity to move beyond our scientific understandings of weed management.

In 1996, forums in this Conference which provide an opportunity to hear what farmers and graziers think are called practitioner's perceptions. Perceptions relate to the way we see issues or understand them from our experiences. Are we making a statement about these sessions not being scientific, but just perceptions and therefore something of lesser value?

This Conference can be a watershed for recognising and valuing other knowledges such as Aboriginal peoples' knowledge and graziers' knowledge alongside scientific knowledge, establishing a broader and richer discussion on weed management.

PAST AUSTRALIAN WEED CONFERENCES

'Although there is a mass of information on "how" people do things, there appears to be an acute shortage of information on "why" people do things.'
(Fitzhardinge 1994)

An interesting insight into how weed management has been viewed over the past decade of these conferences is the table of contents and the nature of the discussion within that framework.

More than a decade ago the Australian Weed Conference proceedings (1984) saw a framework for discussion focused on technology (sprays, biological control and herbicides) and land use (forestry, cereal crops, industrial). A notable addition related herbicides to health and the law. Little attention was turned to the knowledge of those on-the-ground who were making weed management decisions in the context of their day to day management activities.

The year 1987 saw the inclusion of an extension theme in the proceedings. Papers concentrated on the adoption of technology related to weed management. This again presented a technology centred approach to understanding practitioner perspectives of weed management. Discussion about slow adoption of technology (Daniels 1987) and factors affecting adoption of weed technology (Chamala and Keith 1987) provided case examples of a traditional approach to research, development and extension (R,D&E). There was some interest in eliciting landholder perceptions, measuring government weed and pest control performance (Williams *et al*. 1987) and identifying worst weeds (Dellow *et al*. 1987).

[1] **Footnote.** The views expressed in this paper are those of the author.

The 1990 conference saw the inclusion of an extension, regulation and research techniques theme in the proceedings. Again there was a focus on technology adoption, but of particular interest was the work of Scott and Uren (1990) reporting on community approaches to containing Noogoora burr and a farmer-driven skeleton weed eradication program, which represented a deviation from traditional technology push extension approaches reflected in past conference proceedings.

Later, in 1993, we saw discussion of management of weeds on Aboriginal lands (Miller and Schultz 1993). This included some preliminary discussion of the values held by Aboriginal people for their land and their recognition that weeds were unfavourable to a traditional way of life and efforts to become self-sufficient. The introduction provided a refreshing contrast to perceptions of weeds as hindering production in a European sense, rather issues relating to water quality and degradation of the natural environment. The discussion then focused on a case of integrated control of mimosa (*Mimosa pigra*) on Aboriginal land in co-operation with an Aboriginal community.

The role of Landcare groups as playing a key role in weed control in Australia was discussed by Atkins and Molloy (1993). It was recognised that many groups were using a participative action research/learning approach in their activities, yet there was still some hesitancy in acknowledging action research/learning as a people-centred approach. It became apparent that technology-push rather than co-learning/researching (CARR 1993) was considered to be a key issue: 'A role which [Landcare] groups fill is in promoting available information and technology to other producers' (Atkins and Molloy 1993).

An important theme emerging from the 1993 conference was the non-scientist. A stereotype of a scientist listening to a farmer's perspective of a problem provided an interesting perception about how scientists value farmers' knowledge and experience: 'why doesn't this nitwit shut up, he doesn't understand the subject, he is being parochial with tunnel vision, he wanders all over the place, and he is dull' (Harvey 1993). Another paper mentioned in passing a perception of a Landcare group member referring to 'single issue enthusiasts' and a 'lack of understanding [of a large scale weed control issue] overshadowing realism' (Atkins and Molloy 1993).

GRAZIER PERSPECTIVES OF WEED MANAGEMENT

'Good management is never simply an application of good science; frequently, value judgements have to be made.' (Freudenberger and Freudenberger 1994)

A weed is generally defined as a plant growing in a place where it is not desired, stifling the growth of what is seen to be superior vegetation. Weeds are defined by how we value them as undesirable, and label them as such. This is not as straight forward as it initially appears in a rangelands context when consideration offered from a graziers' perspective.

Research undertaken in rangelands with graziers revealed a classification of rangeland plants consisting of four main groupings: inedible plants, trees, edible plants, and poisonous or harmful plants (Kersten 1995 p. 102). Plants were seen in the first instance as animal feed (Kersten 1995 p. 101). It follows that grazing livestock are not concerned with the desirability or beauty of weeds, but with palatability and availability (Carter 1990). However, graziers did not only see plants through the eyes of their animals – other features of plants nominated by graziers as important included landscape embellishment, shade, windbreaks, prevention of erosion, sand dune shifting and dust storms (Kersten 1995 p. 101).

What could be considered an undesirable by plant one land manager may be seen as desirable by another. For example, Paterson's curse and salvation Jane are two common names referring to the same plant – *Echium plantagineum* (Carter 1990). In rangelands, the issue of woody shrubs offers a contrast in perceptions about desirability. On one hand, some graziers see woody weeds as the most critical problem in rangelands and a threat to production livelihoods. These shrubs are seen as part of the landscape for many generations but not dominating the landscape as they do in some large areas (Webber 1994 p. 10). On the other hand, some graziers see the use of the term weed as implying woody shrubs are totally undesirable when in situations, such as stabilization of soft, red country and decreasing risk of erosion by wind and rain, they can have beneficial effects (Webber 1994 p. 11). Other graziers see the problem of woody weeds as a potential benefit as an income opportunity for supplying woody product demand for pulp paper, roofing, fencing, oil and fire brick manufacturing (Webber 1994 p. 11).

Some plants may be desirable at certain times but at other times, undesirable. For example, grasses which are seen as palatable and nutritious until they have spiky seeds, when they become undesirable because they may cripple lambs, blind sheep or contaminate wool. What is considered by graziers to be good sheep country is turned into cattle country when Noogoora and Bathurst burr reach the stage when they contaminate wool. At this stage, sheep are moved onto non-affected paddocks.

Recognition of context in formulating problems is important to achieving a total management perspective of weeds, rather than seeing them as a variable in isolation to be managed as a separate entity. Graziers have little controlling influence in the rangeland context, and views often reflect working with and adapting to circumstances which are presented in making management decisions based on their local knowledge. Weed management is a dimension of a whole management system, where decision-making is not necessarily based on the weed itself, but on reasons for its effect on the values of a production system.

Woody shrubs The term woody weed is used by graziers in reference to a number of native and non-native inedible, undesirable woody shrubs, including turpentine (*Eremophila sturtii*), narrow leaf hopbush (*Dodonea viscosa* subsp. *angustissima*), broadleaf hopbush (*Dodonea viscosa* subsp. *angustinifolia*), punty bush (*Senna artemisioides* subsp. *filifolia*), silver cassia (*Senna artemisioides* subsp. *artemisioides*), budda (*Eremophila mitchelli*), African boxthorn (*Lycium ferocissimum*), mesquite (*Prosopis juliflora*) and water bush (*Myoporum montanum*) (Kersten 1995 p. 106).

In classifying these shrubs, the main differences graziers saw between woody weeds were their relative edibility and the amount of other plant growth under them. Budda, African boxthorn, mesquite and water bush were seen as inedible. The pods and flowers of turpentine were seen by some graziers as edible, but generally inedible. Broadleaf hopbush was seen as a little edible. Punty bush and silver cassia were seen as the most edible of the woody weeds. Cassia species are not seen to be such as threat to production because they are relatively short lived (Kersten 1995 p. 106).

Graziers saw a number of reasons for current woody shrub dominance in the landscape, which were seen by some graziers as a combination of factors:

- lack of fire (Kersten 1995 p. 107).
- heavy grazing (Kersten 1995 p. 107) which left only woody shrubs as the dominant vegetation and able to seed (Webber 1994 p. 10).
- climate changes (Kersten 1995 p. 107). Some graziers observed higher rainfall during the 1970s which coincided with the proliferation of woody shrubs.
- fewer rabbits during drought times meant shrubs could dominate because they were not ringbarked (Webber 1994 p. 10).
- a lot of mulga was cut in the early days for stock feed and to supply bore steam pumps which allowed other woody shrubs to take their place (Webber 1994 p. 10)
- woody shrub dominance is a stage in the rangeland cycle based on observations of previous generations, this has occurred before (Webber 1994 p. 10).

Graziers who have taken action to control woody shrubs saw them as causing management problems and anticipated future problems if they do not act now, or prepared to use tax incentives, or wanting to make more space for desirable plants to grow (Kersten 1995 p. 107).

Burrs and spear grasses Noogoora burr (*Xanthium occidentale*), bathurst burr (*X. spinosum*), saffron thistle (*Carthamus lanatus*) and spear grasses (*Stipa* spp.) were nominated by graziers as a potential problem. The effects of burrs in contamination of wool was the major reason why graziers saw burrs as an issue in their management system. The effects of spear grasses in causing infections in the joints of lambs, muleses and eyes were reasons that graziers perceived these as a specific issue in their management systems (Webber 1994 p. 12).

Graziers have observed the movement of stock off and onto properties has increased in frequency and distance with improvements in stock transport. There is concern that stock are going off to agistment and bringing back burrs, thistles and spear grasses. Sheep bought in other states were seen by graziers to be importing burrs and spear grasses into the area. Other identified problems such as prickly acacia and mesquite being brought from Queensland were also noted by graziers (Webber 1994 p. 13).

Supplementary feed and hay were also seen as ways in which these weeds could be transported into the area (Kersten 1995 p. 105). The wheels of vehicles were also nominated as carriers of undesirable seeds (Kersten 1995 p. 105). Burrs were also observed by graziers growing along roadsides (Webber 1994 p. 12).

Watercourses were seen by graziers as another way that burrs are transported from another area. Observations of uncommon vegetation growing in river flood country and creekbeds were nominated as potential problem areas (Webber 1995 p. 12).

WEED MANAGEMENT STRATEGIES

Weed management strategies developed by graziers in the northwestern NSW rangelands context reflects integrated weed management within a whole system. Areas of weed management can be seen as working around the effects of weeds, directly managing weeds, and concurrent weed management. Aspirations for future weed controls include those that ‘work while you sleep’.

Working with weeds Graziers have developed strategies of working with weeds to achieve their production goals without necessarily using direct weed control measures.

Graziers can have a same basic yearly operating calendar, but they may see themselves starting with different activities and have different reasons in preferring that system (Kersten 1994 p. 214). Shearing time was a main activity around which yearly calendars revolved. There were a number of reasons why particular times of the year were set. Some graziers had a preference for shearing their sheep in summer to avoid the contamination of wool by Noogoora burr and grass seeds. Other graziers prefer shearing in or before April to avoid Bathurst burr contamination of their wool (Kersten 1995 p. 95).

Graziers have observed the domination of woody shrubs changing their management. There is increased difficulty in mustering stock on-the-ground in paddocks with heavy woody shrub domination. This relates to the ability to find stock and safety in riding motorbike through thick scrub. One reason for the increased use of aerial technologies such as aircraft, ultralights, gyrocopters and helicopters for mustering has been the density and extent of woody shrubs in paddocks (Webber 1994).

Graziers also manage their paddocks in such a way that they achieve their production goals through knowledge of plants undesirable stages of growth and reproduction. To avoid contamination of wool by burrs in a potential problem area, sheep are grazed in the paddock until burrs are observed. The sheep are then moved into an unaffected paddock and cattle replace them (Webber 1994 p. 12).

Direct action A range of actions have been taken by graziers in attempts to control or eradicate woody shrubs. Some graziers indicated that they use more than one direct approach at a time (integrated). Strengths and weaknesses of woody weed control approaches offer some insight into grazier perspectives on this issue.

Blade ploughing was one mechanical technique considered by graziers. Strengths identified were:

- financial assistance through Landcare, in this case on a dollar for two dollar basis,
- useful for ploughing larger areas (but not broad scale enough in terms of efficiency),
- a natural approach (no chemicals),
- opens the soil up (increases infiltration of water), and
- provides an opportunity to plant grasses at the same time.

The weaknesses of blade ploughing were seen as:

- costs about three times as much as the land is worth,
- does not work while you sleep,
- grows faster than it can be cut down,
- poor ploughing technique can mean they are just cultivated,
- need a big crawler tractor and blade plough and
- need to get the shrub right out of the ground with its roots.

The mechanical technique of chaining/clearing areas of woody shrub infestation were seen as being useful for large scale clearing, but weaknesses in not discriminating between non-target trees such as leopardwood and mulga in amongst the scrub. Graziers saw working around non-target trees taking longer and requiring more effort.

The chemical technique of using Velpar® for controlling scattered bushes rather than large areas. The pellet form of Velpar was seen as having strengths is that they are easy to carry on a motorbike without need for vehicle and large drums, hoses and guns so they can be put around when mustering. Another strength considered by graziers was that pellets offered less risk of contaminating clothes.

Grazing techniques using goats for grazing woody shrubs were seen with a degree of concern about the way they destroy everything and eat everything else before the woody shrubs when confined to an area.

Fire was recognised by graziers as a land management tool used by Aboriginal people before European settlement of the area. In the current rangeland management system, they saw the use of fire as having strengths in that they:

- could establish a rotational grazing system for burning some paddocks in good years and
- could introduction of vigorous grasses to provide fuel for burning.

Graziers also saw some minuses in the use of fire:

- requires fuel to burn, so stock has to be kept off,
- loss of valuable plants – no grazing,
- causes a feed drought,
- soil exposed,
- not selective in burning, and
- signing of permits to burn can be very stressful for the local fire controller, especially if the fire gets out of control.

Concurrent weed management The nature of labour on properties in the north-western New South Wales rangelands context can include family, neighbours, waged employees, and contractors. Harder financial times means that there is more work done by families and neighbours to minimize costs of waged employees or contractors (Webber 1994 p. 28). Efficiency of labour is reflected in weed management strategies which are undertaken in tandem with other activities. For example, when mustering on motorbike, Velpar pellets are applied to scattered bushes at the same time, or when blade ploughing is undertaken grasses are sown.

Graziers have identified opportunities for R&D around the issue of woody shrub management through their own experiences and observations. These can be seen as direct approaches, a 'while you sleep' biological control and even changing the value of an undesirable woody weed to a desirable shrub (Webber 1994).

BEYOND TECHNOLOGY TRANSFER – VALUING LOCAL KNOWLEDGE IN THE R&D PROCESS

'We have come dangerously close to creating a situation that effectively denies recognition of the knowledge creating abilities in most peoples of the world.' (Hall 1979)

The intention of weed management R&D for use on-the-ground is to improve situations. Problems are often seen as a mismatch between what is scientifically known and technically feasible, and what is current practice. A new technology is designed by research scientists and then transferred to end-users who put it into action to address the problem (Russell and Ison 1991). Potential end-users are identified in terms of their readiness to adopt new technologies and the success of a technology is measured by the rate of adoption (Rogers 1983).

Adoption, or lack of adoption or implementation by practitioners of previously proposed principles and concepts in current weed management programs can be seen as a failure by science to recognise context in the formulation of problems and the conduct of R&D (Russell and Ison 1993). However, it is usually seen as a failure by practitioners to adopt technology. Technology transfer represents a technology-driven approach with a transfer of information focus rather than people centred, knowledge-sharing approaches (Russell *et al.* 1989).

Over the past decade, there has been increasing recognition of the importance of inviting practitioners (farmers, graziers, etc.) to participate in agricultural R&D. The relevance of R&D outcomes to potential adopters in many cases has been the impetus for inviting participation. The nature of such participation is reflected in particular power relationships between scientists and practitioners.

On-farm research (OFR) This approach was initially based on a respect by scientists for farmers' knowledge and experience, and their role as inventors (Ashby 1991). As more formal OFR methodology was developed, it became a vehicle for tailoring recommendations for the use of developed technology. The stages of diagnosis, design, technology development, testing, verification and diffusion (Zandstra *et al.* 1981). Incorporation of extension into this Farming Systems Research (FSR) equation returned the approach to its technology driven basis (Chambers and Jiggins 1987 p. 45). Criticism has been levelled that FSR is usually conducted in a top-down fashion, supported by various formal diagnostic and experimental techniques, often failing to capture the real priorities and interests of farmers (Tripp 1989 p. 2). On-farm Trials (OFT) provide few concessions to farmers' experimental capacities – what is to be tested, how it will be evaluated, design and management of variables is in the domain of the scientists.

Farmer back to farmer (FBTF) This approach is based on a relationship between the farmer and the researcher in a way that local knowledge is recognised as important to the process (Rhoades and Booth 1982). The main characteristic of this approach is that it is farmer-referential at stages of the process, but the creative research or learning process remains the domain of the scientists.

Farmer first and last (FFL) This approach is a farmer-centric (Chambers and Ghildyal 1985) and is characterized by three main stages: diagnostic (researchers learning from farmers), on-farm technology development with farmers, and farmer evaluation (using farmer adoption levels to measure success). This approach entails reversals of explanation, learning and location but conceptualizes communication as the information/knowledge of farmers being transmitted to researchers, rather than creating space for another local knowledge to be heard (Webber and Ison 1995).

Co-researching partnerships The way non-scientific knowledge is valued in agricultural R&D has been given increasing attention with the emergence of co-researching partnerships. A partnership implies a particular relationship of sharing the benefits of each others knowledge, of learning, and of the outcomes. It also implies responsibility for action.

Historically, there has been little cognisance by researchers of what local people see as their issues and concerns. Ownership of a problem is vested in those involved in its formulation (Webber and Ison 1995 p. 110). R&D which accept contributions to the process by practitioners as valid in its own right and facilitate the formulation of problems together.

There are cases of scientists and multi-disciplinary teams co-researching with graziers on issues of con-cern to them and identified by them. Practitioners are invited to participate at the outset – from problem formulation through the research process. The Community

Table 1. Key features of local knowledge contrasted with scientific knowledge.

Local knowledge	Western science
Site specific (McCorkle 1989)	Finds general rules and laws (Kersten 1995 p. 61).
Not specifically coupled with a method of investigation (Kersten 1995 p. 63)	Follows a specific process known as the "scientific method" (Kersten 1995 p. 61).
Elaborated to fit a given agro-ecological, economic, sociocultural or political context – dynamic (McCorkle 1989)	Good scientific hypotheses are plausible, independently testable, concise and simple (Wilson and Morren 1990).
Knowledge passed from generation to generation through practices, stories, etc.	People are outside the system under investigation – they act upon a situation.
Detail orientation (Salas *et al.* 1989)	Understanding of ecological processes based on evolutionary theory and Linnaean taxonomy (Reid *et al.* 1992)
Complexity (Salas *et al.* 1989)	Passed on through research papers, etc. communicating experiences.
Does not isolate technical knowledge in its context within social relations (Mosse 1993).	
Certain complex practical or judgemental tasks require that underlying practice is non-linguistic (Bloch 1991).	

Approaches to Rangeland Research project (CARR 1993) is an example of a co-researching process based on an action research/learning framework which focused on graziers' perceptions of their situations and experiences rather than an account of the situation through so-called 'objective' research (CARR 1993).

EXPLORING KNOWLEDGES

'Local knowledge, on its own, should not be seen as more (or less) than scientifically generated knowledge. Local knowledge is potentially an important complement to scientifically generated knowledge..[..]..'
Kersten (1995 pp. 65-6)

In a technology transfer approach, knowledge is seen as centrally generated by scientists – power, prestige and skills are concentrated in these centres (Chambers and Ghildyal 1985 pp. 4–5). The argument that knowledge can be centrally generated and transferred as information to a recipient rests on an assumption that information has truth value, there is one reality, it can be known objectively, and that this one reality is identical for all knowers. In contrast to the argument that 'knowledge is based on picking up the relevant features of a pre-given world' (Maturana and Varela 1992 p. 252) is the view that knowledge as a continuous process of individual and social construction. Kelly (1955) proposes that individual knowledge is built through an individual's perception of events. What is experienced by an individual is subject to filters of relevance based on prior understanding or experiences. This constitutes a view of the world or a reality.

Knowledge can be described as behaviour which is acceptable to people in a particular domain (Maturana 1988). In the scientific domain for example, observation is prescribed by a set of rules applicable to that time and space, enthusiasms and observing capacities of the observers (Dervin 1989). The construction of knowledge through scientific discussion reveals particular knowledge which is accepted as adequate by others in that domain (peers). Scientific knowledge can be seen as 'fundamentally local knowledge' (Rouse 1987 p. 108).

The implications of viewing knowledge as something that is constructed by people in a particular domain is that there are other local knowledges that may contribute to the discussion on weed management. Where are they?

One explanation (Foucault 1983) as to the whereabouts of other knowledges is that they already exist in people in other contexts, but that these knowledges are overpowered by scientific knowledge. Technology transfer can be seen as playing an important role in subjugating other knowledges, establishing scientific knowledge as the truth. Existence of other local knowledges is incompatible with Technology transfer because it is unable to reconcile other local knowledges within its framework.

This challenges the notion of western science as the sole and central source of knowledge generation. Technology transfer implies that the clients know nothing and that all the wisdom lies with scientists and development personnel (Moshin 1989).

Knowledges which contrast in their construction to that of western science are known by a number of names: Contextual Knowledge, Local Knowledge, Indigenous Technical Knowledge and Traditional Ecological Knowledge. Table 1 outlines some key features.

Local knowledge issues Often local knowledge is seen by scientists as some sort of relic of the past that must be kept untainted by new ideas to be of use in R&D processes (McCorkle 1989). Connotations of a static, rather than dynamic knowledge system fails to recognise the importance of new understandings emerging in local knowledges (Tripp 1982 p. 5). This view also obscures the constant innovation and experimentation of people everywhere (McCorkle 1989).

Many R&D approaches which invite participation by farmers revolve around the useful resource of local knowledge in the R&D process (Brokensha *et al.* 1980). The idea of local knowledge as 'ripe for mining' means that scientists set the framework for what is acceptable as knowledge.

Examples of participation for the purposes of extraction can include FSR, RRA and applied anthropological approaches. Often indigenous technical knowledge (with the emphasis on technology) is seen as the central component of the farmers' contribution to the research process (Farrington and Martin 1988a). Gleaning and sifting through the available local knowledge is seen by some as a good start to a research program, at the very least saving researchers from losing credibility with their clients (McCorkle 1989).

Blending local knowledge into formal scientific systems is often justified on the basis that if local knowledge and capacities are granted legitimacy within the scientific and development communities, existing research and extension services will pay greater attention to the priorities, needs and capacities of rural people (Scoones and Thompson 1994). This approach devalues farmers' contribution to emerging issues by ensuring that what they have to say is not heard in its own right. Rather, farmers discourses are subsumed into the scientific framework to the extent that can no longer be distinguished.

Notions of mining and blending local knowledge are reflected when researcher involvement with farmers serves the researchers' purposes, and any benefit accruing to farmers is an unintended bonus. Hall (1981) argues: 'experience has shown that power can easily accrue to those already in control. Participatory research has been used by some researchers to provide them with insights and views they would not ordinarily have access to or know about. (It) has become a key by which researchers have gained more power for themselves within the academic status quo.'

OPPORTUNITIES TO ENHANCE R&D RELATIONSHIPS

'If a researcher is concerned with increasing people's capacity and gaining some degree of control over their lives, then research methods can be part of the process, regarding local people as more than merely sources of information to be mined and having bits of isolated knowledge but incapable of analysing their social reality.' (Hall 1979)

In moving beyond the notion that all knowledge is constructed in a scientific framework, there emerges a recognition of the role that local knowledge constructed in context plays in land management and land use decision-making.

Aboriginal peoples' knowledge Aboriginal traditional ecological knowledge has contributed to a greater understanding of the use of fire in rangeland management, more detailed understanding of weather patterns, knowledge of plant and animal habitats, and ecological succession (Young and Ross 1994 p. 188).

Aboriginal cultural beliefs has the potential to influence rangeland management in a number of ways (Young and Ross 1994). Traditional responsibilities for land will determine who can speak for the country and make decisions on its use. The cultural value of the land is often seen to be more important than its commercial value. Cultural expressions of Aboriginal relationships to the land include the journeys of ancestral beings, which provides an alternative construct of land and therefore, forms of land management (Young 1992).

Aboriginal peoples' relationship with the land has influenced the perception of people as part of rather than superimposed on the environment. Aboriginal communities have broader land use goals relating to traditional and non-traditional elements, but there has been few attempts to identify the land use priorities of Aboriginal people not immediately involved in the pastoral enterprise (Stafford-Smith *et al.* 1994).

Graziers' knowledge Grazier communities working with researchers in north-western New South Wales have offered a different perspective of rangeland management to that generated by scientists (Davey 1991, Ison and

Russell 1991, Ison 1992, Webber *et al.* 1992, Kersten 1995, Webber 1995). Much of this research has raised issues of valuing graziers' local knowledge constructed in a rangeland context.

Research with grazier communities has highlighted that the diversity and complexity in rangeland management systems, and weed management as a dimension of that system, does not exist in isolation to the broader context of life as a grazier. Decisions about land management may be heavily influenced by what appear to be unrelated issues, such as education and health. Graziers have broader land use goals than those of the production system, reflected in decisions influenced by emotions, ethics, lifestyle and vision for the next generation on the land.

Many scientists are recognising the value of other knowledges in contemporary research and land management, but there are some that find difficulty in accepting its validity. It could be argued that this inability to accept other knowledges may stem from efforts to reconcile these in a scientific framework. This perception is not one-way, as local people also see limitations in scientific knowledge (Baker and Mutitjulu Community 1992). Despite this mutual reservation, there is great potential for accepting and valuing knowledges to enhance all our understanding.

R&D processes undertaken with a view to work with people in co-researching partnerships offers great opportunities to learn about and value other local knowledges in their own right. This has the potential to contribute to building a richer picture of rangeland management and facilitate change for the better.

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REFERENCES

Ashby, J.A. (1991). Adopters and adapters: the participation of farmers in on-farm research. *In* 'Planned Change in Farming Systems: Progress in On-Farm Research', ed. R. Tripp (John Wiley and Sons, West Sussex, UK).

Atkins, D.L. and Molloy, J.M. (1993). The role of landcare groups in weed control. Proceedings of the 10th Australian and 14th Asian-Pacific Weed Conference, Brisbane, Australia, pp. 454-7.

Baker, L.M. and Mutitjulu Community (1992). Comparing two views of landscape: Aboriginal traditional ecological knowledge and modern scientific knowledge. *Rangeland Journal* 14(2) 174-89.

Bloch, M. (1991). Language, anthropology and cognitive science. *Man* 26(2), 183-98.

CARR (Community Approaches to Rangelands Research) (1993). Marketing of Middle Micron Wool: researching with people on issues that make a difference. Monograph, 44 pp.

Carter, E.D. (1990). The role of grazing animals in weed control. Proceedings of the 9th Australian Weeds Conference, Adelaide, South Australia, pp. 239-42.

Chamala, S. and Keith, K.J. (1987). Socio-economic and institutional factors in the adoption of new weed technology. Proceedings of the 8th Australian Weeds Conference, Sydney, NSW, pp. 251-65.

Chambers, R. and Ghildyal, B.P. (1985). Agricultural research for resource-poor farmers: the farmer first and last model. *Agricultural Administration* 20, 1-30.

Chambers, R. and Jiggins, J. (1987). Agricultural research for resource poor farmers, part 1: transfer of technology and farming systems research. *Agricultural Administration and Extension* 27, 35-52.

Davey, P.C. (1991). Rangeland Research and Extension in South Africa and the USA: implications for the NSW semi-arid rangelands. Winston Churchill Memorial Trust Study Tour Report, 37 pp.

Daniels, J. (1987). Participative groups—an extension tool for successful transfer of management technology. Proceedings of the 8th Australian Weeds Conference, Sydney, NSW, September, pp. 266-9.

Dellow, J.J., Seaman, J.T. and Gilmour, A.R. (1987). Landholders perceptions of the worst weeds in the central west of NSW. Proceedings of the 8th Australian Weeds Conference, Sydney, NSW, September, pp. 274-5.

Dervin, B. (1989). Audience as Listener and Learner, Teacher and Confidante: the Sense-Making Approach. *In* 'Public Communication Campaigns', 2nd edition, eds. R.E. Rice and C.K. Atkin. (Sage Publications, London).

Fitzhardinghe, G. (1994). An alternative understanding of the relationship between the ecosystem and the social system – implications for land management in semi-arid Australia. *Rangeland Journal* 16, 254-64.

Foucault, M. (1980). 'Power/Knowledge: selected interviews and other writings'. (Pantheon Books, New York).

Freudenberger, D.O. and Freudenberger, C.D. (1994). Good relationships: ethical and ecological perspectives on rangeland management. *Rangeland Journal* 16, 321-32.

Hall, B.L. (1979). Knowledge as a commodity and participatory research. *Prospects* 9(4), 393-408.

Hall, B.L. (1981). Participatory research, popular knowledge and power. *Convergence* 4(3), 6-17.

Harvey, R.G.M. (1993). Weed control boards – do we need non-scientists? Proceedings of the 10th Australian Weeds Conference and 14th Asian Pacific Weed Science Society Conference. Brisbane, Australia, pp. 458-60.

Ison, R.L. (1992). Changing community attitudes. Proceeding of the 7th Biennial Conference of the Australian Rangeland Society, Cobar, pp. 169-79.

Kelly, G.A. (1955). 'The Psychology of Personal Constructs', 190 pp. (Norton and Co., New York).

Kersten, Stephany (1995). 'In Search of Dialogue: Vegetation Management in Western NSW, Australia'. Unpublished Ph.D. Thesis, 271 pp. (The University of Sydney).

Maturana, H.R. and Varela, F. J. (1992). 'The Tree of Knowledge: The Biological Roots of Human Understanding', 263 pp. (Shambhala Publications, Boston, USA).

Miller, I.L. and Schultz, G.C. (1993). The management of weeds on Aboriginal land with special reference to *Mimosa pigra*. Proceedings of the 10th Australian Weeds Conference and 14th Asian Pacific Weed Science Society Conference, Brisbane, Australia, pp. 439-44.

McCorkle, C.M. (1989). Toward a knowledge of local knowledge and its importance for agricultural R,D&E. *Agriculture and Human Values*, 16(3), 4-12.

Mosse, D. (1993). Authority, gender and knowledge: theoretical reflections on the practice of participatory rural appraisal. Overseas Development Institute, Agricultural Administration (Research and Extension) Network. Network Paper 44, December.

Rogers, E.M. (1983). 'The Diffusion of Innovations', 3rd edition, 476 pp. (The Free Press, New York).

Rouse, J. (1987). 'Knowledge and Power: toward a political philosophy of science'. (Cornell University Press, Ithaca, USA).

Russell, D.B., Ison, R.L., Gamble, D.R. and Williams, R.K. (1989). A Critical Review of Extension Theory and Practice. Monograph, 67 pp. (Australian Wool Corporation, Melbourne).

Russell, D.B and Ison, R.L. (1993). The research-development relationship in rangelands: an opportunity for contextual science. Proceedings of the 4th International Rangelands Congress. Montpellier, pp. 1047-54.

Salas, Maria, Scheuermeier, Ueli and Gottschalk, Elke (1989). 'Training for PTD (Participatory Technology Development): Crucial Issues and Challenges'. Landwirtechftlibe, Beratungszentrale, Lindau, Switzerland.

Scott, P. and Uren, B. (1990). Community approaches to containing Noogoora burr in the north of western Australia. Proceedings of the 9th Australian Weeds Conference, August, Adelaide, South Australia, p. 171.

Scott, P. and Uren, B. (1990). 'The farmer-driven skeleton weed eradication program in Western Australia'. Proceedings of the 9th Australian Weeds Conference, Adelaide, p. 172.

Stafford-Smith, D.M., McNee, A., Rose, B., Snowden, G. and Carter, C.R. (1994). Goals and strategies for Aboriginal cattle enterprises. *Rangeland Journal* 16, 77-93.

Tripp, R. (1982). Data collection, site selection and farmer participation in on-farm experimentation. CIMMYT Working Paper 82/1.

Tripp, R (1989). Farmer Participation in Agricultural Research: New Directions or Old Problems? Discussion Paper 256, Institute of Development Studies, Brighton, UK.

Webber, L. (1994). 'Grazier Participation in Identifying and Setting Priorities for Research and Development'. Unpublished monograph, 157 pp. (Macquarie University).

Webber, L. (1995). 'A Participative Communication Process for Agricultural R&D Prioritization'. Unpublished Ph.D. Thesis, 299 pp. (Macquarie University).

Webber, L.M. and Ison, R.L. (1995). Participatory rural appraisal: conceptual and process issues. *Agricultural Systems* 47, 107-31.

Webber, L.M., Ison, R.L., Russell, D.B., Major, P. and Davey, P.C. (1992). Extending invitations to express enthusiasms for action: a basis for participatory research and development. Proceedings of the Second World Congress on Action Learning, Brisbane, pp. 101-4.

Williams, K., Syme, G., Crackel, L.J. and Roberts, E.J. (1987). Farmer attitudes to weeds and weed control in Western Australia—a preliminary study. Proceedings of the 8th Australian Weeds Conference, September, Sydney, NSW, pp. 270-3.

Wison, K. and Morren, G.E.B. (1990). 'Systems Approaches for Improvement in Agriculture and Resource Management', 361 pp. (MacMillan New York USA).

Young, E. and Ross, H. (1994). Using the Aboriginal rangelands: insider 'realities' and 'outsider' perceptions. *Rangeland Journal* 16, 184-97.

Zandstra, H.G., Price, E.C., Litsinger, J.A. and Mortiss, R.A. (1981). 'A Methodology for On-Farm Cropping Systems Research'. (The International Rice Research Institute, The Philippines).