KNOWLEDGE, POWER AND GRAZING MANAGEMENT: NEW CHALLENGES FOR RESEARCH AND EXTENSION SYSTEMS

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ABSTRACT
Conventional linear models of research and extension, based on simplistic assumptions of diffusion, adoption and technology transfer, have been found wanting, particularly in complex and diverse agroecological settings, such as the grasslands of the world, where issues of sustainability and integrated resource management are central. This paper explores the relationships between different sources of knowledge on grazing management and power through a case study from the communal areas of Zimbabwe. The case study explores the assumptions embedded in the design of fenced, paddocked, rotational grazing schemes and the conflicts over knowledge emerging during their planning and implementation. Researchers' and extensionists' perspectives on carrying capacity, grazing rotation and ecological dynamics are contrasted with those expressed by local farmers. The paper concludes with a discussion of future challenges for research and extension systems, highlighting the importance of a participatory approach which recognises multiple sources of knowledge and technological innovation. This suggests new roles for extension, moving beyond a linear model of technology transfer towards a co-learning approach. This, in turn, will require new skills, new attitudes and behaviours, new methods and, above all, new organisational forms for research and extension.

KEYWORDS
technology transfer, extension, knowledge, participation, power, grazing scheme, Zimbabwe

INTRODUCTION
Research and extension systems have, for many years, been dominated by models of diffusion, adoption and technology transfer (e.g. Rogers, 1962; Havelock, 1969; Hagestand, 1968). Embedded within such models are certain assumptions about the nature of agricultural knowledge generation and transmission. The transfer of technology model sees knowledge as a commodity which can be transferred unproblematically in a more-or-less linear fashion between researchers, extensionists and farmers. The transfer of technology model, which has come to dominate agricultural research and extension across the world (Chambers et al, 1989), sees knowledge being generated in the scientific domain, being transformed into technologies which are adopted by farmers through a process of diffusion, facilitated by extension, whose role is seen as communicating the benefits of scientifically generated technologies to user groups.

A number of highly effective management systems have been evolved to facilitate such a process of extension, with the Training and Visit system promoted by the World Bank, being the most famous. Equally, whole government, and indeed international, research organisations have been shaped by the assumptions embedded in the transfer of technology model, with science and scientists being given exclusive responsibility for innovation and technology generation. Globally, considerable amounts of human and financial capital have been invested in this endeavour over the past decades [1].

In this paper, I do not want to argue that the transfer of technology approach has not yielded significant benefits. It has. Witness the major breakthroughs in plant breeding through the 1960s and 1970s which heralded the beginning of the "Green Revolution". In part due to such successes, this model of technology transfer remains the major influence on strategic thinking in agriculture. But, although such a model may be effective for particular types of innovation, such as new crop varieties, it appears less than adequate for addressing more complex, integrated agricultural resource management problems (Conway, and Barbier, 1990). Increasingly, such systemic problems are the ones which agricultural scientists and local resource managers are facing. Today, questions of sustainability, risk management and multiple use are at the top of the agenda. This is particularly true in the extensive grassland systems of the world, where complex ecological dynamics combine with potentially competing social and economic uses (Scoones, 1996a).

In such settings, where uncertainty prevails and where the perceptions and values of land users count, scientific knowledge must articulate with other knowledges, based on land users' experiences and insights. Thus the process of research, planning and extension must be characterised by negotiation, conflict management and compromise by different actors with often competing worldviews. Therefore, different conceptions of the role of scientific and local knowledges and different relationships of power between actors are suggested, prompting new challenges for research and extension in the grasslands.

This paper explores these issues through the use of a case study of grazing scheme intervention in the communal area grasslands of Zimbabwe. A series of assumptions are contained within the technical knowledge on which the intervention rationale, design and implementation is based. These are questioned from the perspective of local land users, using their own commentaries[2]. The wider implications of the case study findings are then explored, and some broader challenges for approaches to research and extension are proposed.

KNOWLEDGE AND POWER: SOME CONSIDERATIONS
Before entering into the details of the case study, it is worth exploring some of the concepts central to a discussion of knowledge, power and grazing management. Much social science writing has dwelt on extending our understanding of the nature of knowledge and its transfer. Central to these discussions is the relationship between knowledge and power. This is highlighted most starkly in the debate over so-called "local" or "indigenous" knowledge. Such knowledges are often contrasted with "scientific" or "expert" knowledges, although, on closer examination, the distinctions between them are unclear and there is much blurring of boundaries (Agarwal, 1995).

[1] For instance, the World Bank invested some US $3 billion in extension, largely through the Training and Visit system, between 1977 and 1992 in nominal terms (World Bank, 1994), while the Consultative Group for International Research spent some US$250 million per annum, around 6% of global expenditure on agricultural research, in the late 1980s (Ravnborg, 1992).
[2] Interviews with farmers reported here are based on fieldwork carried out in Zimbabwe since 1986. Many interviews are derived from a case study of the Indava ward grazing scheme in Mazvihwa communal area.

Three different perspectives on “local” knowledge can be discerned. These are (following Scoones and Thompson, 1994: 17):

i) Local knowledge is backward, irrational and unscientific. Formal research and extension should educate, direct and transform in order to develop and modernise such systems.

ii) Local knowledge represents a valuable stock or body of knowledge which is currently an under-utilised resource. Indigenous knowledge needs to be incorporated in formal research and extension systems through the participation of local people.

iii) Neither local knowledges nor western science can be regarded as unitary bodies of knowledge. Instead, they represent contrasting and multiple ways of knowing, created in particular contexts by situated actors. Interactions between different knowledge systems are often contested, with encounters between actors reflecting differential power relationships.

Each of these conceptions of local and scientific knowledges has implications for the way interactions between actors involved in research and extension are interpreted. In the first case, typical of the most extreme transfer of technology/modernisation proponents, a top-down approach is all that is expected in a highly directive approach to extension and technology transfer. In the second case, a more populist view is expressed. This recognises the value of local knowledge, but advocates a strategy of incorporation, whereby local inputs are made into formal research and extension systems through a process of collaborative participation. The third case has a more complex view of multiple and competing knowledges, and recognises more explicitly the implications of power in the negotiation of participation and interaction between different actors.

This third view takes us beyond a dominating, top-down, modernisation perspective and beyond a simplistic and populist view of participation and interaction of knowledge systems. In this view, knowledges are context-bound and multiple. Knowledge depends on who you are and where you come from; it is not value free or necessarily objective (Rorty, 1990). Interactions between the knowledge of different social actors also involves relations of power. As noted by Michel Foucault, “the criteria of what constitutes knowledge, what is to be excluded and who is designated as qualified to know involves acts of power” (Foucault, 1971). Encounters between farmers, researchers and extensionists can be seen as “battlefields of knowledge” (Long and Long, 1992), where what is spoken, and what is left silent, is an important reflection of power relations (Scott, 1985; 1990). Processes of communication, technology transfer or extension are therefore deeply affected by relationships of power.

As the closing section of this paper will illustrate, taking such issues of knowledge and power seriously when thinking about extension and technology transfer suggests some fundamental changes to conventional practice. Why this is an important challenge for grazing management is explored through a case study in the next section.

KNOWLEDGES IN CONFLICT: THE CASE OF GRAZING SCHEMES IN ZIMBABWE

Grazing schemes are supposed to fulfil the dual aims of improving animal production and conserving the grassland. Schemes vary in size, but are normally associated with a ward or several villages, covering up to 100km^2. The schemes use fencing to divide the area into a series of paddocks through which animals are meant to be rotated. Improved management of the range through rotational grazing, it is argued, should increase the output from animals and, at the same time, protect the grassland from degradation.

Ever since the 1960s, grazing schemes have been the favoured intervention in the rangelands of the communal areas of Zimbabwe (Dankwerts, 1974; Froude, 1974). Tried and tested in numerous on-station trials and the basis of successful ranch production in many parts of the country, the technology appeared ideal. However, grazing schemes have met much resistance in the communal areas. Indeed, they became a focus for nationalist protest during the liberation war of the 1970s. But despite this, extension, backed now by considerable donor support, vigorously continues to promote them.

In the following sections, I want to look at three areas, central to the technical design of grazing schemes, which are the subject of dispute between research/extension and different groups of farmers. In so doing, I want to highlight the nature of the debates, both between farmers and scientists, as well as among farmers and scientists themselves, exposing some of the complexities of the discussion and highlighting the points where different knowledges are most in conflict.

Carrying capacity: it depends who you are and what you want. The notion of carrying capacity is a major focus for dispute. Researchers and extensionists in Zimbabwe doggedly stick to a standard number applicable across wide areas. In the case of the dry southern part of the country, the carrying capacity is deemed to be ten hectares per livestock unit. Stock censuses are carried out to assess whether the area is under or over-stocked, and these are complemented by vegetation assessments using standard decreaser/increaser indicators. Stocking strategies for grazing schemes are designed on this basis, along with restocking or destocking plans.

This concept of carrying capacity, of course, carries with it a series of assumptions (Caughley, 1979; Scoones, 1989). First, a linear succession model is assumed, whereby stocking rates affect grass species composition in a highly predictable manner. Second, an homogeneous area of grassland is assumed across the area where carrying capacity is assessed. The grassland is assumed to have a uniform pattern of productivity and palatability in both space and time. Third, the concept has to be applied to a delimited area, where movement in and out is not allowed. Fourth, the assessment assumes a standard animal, as the “livestock unit” combines cattle, donkeys, goats, sheep and so on, and does not take account of the different feed requirements and preferences among species.

In the case of grazing schemes in Zimbabwe such assumptions are problematic to say the least. In many areas, simple successional patterns simply do not hold; grasslands are highly spatially heterogeneous and temporally variable; livestock are very mobile; and multiple species characterise stock populations. But perhaps most importantly, the carrying capacity concept assumes a particular and set relationship between animal numbers and grass in order to arrive at a “correct” carrying capacity figure. But, as many have pointed out, this relationship is not objectively set, it is a normative choice: it depends who you are and what you want. Richard Bell (1985: 153) concludes that the most accurate definition of carrying capacity is:

> “‘That density of animals and plants that allows the manager to get what he (sic) wants out of the system’. Thus any specific definition of carrying capacity must be expressed in relation to a particular objective...”

In Zimbabwe, the implicit objective, imposed by research and extension, is that livestock rearing in the communal lands is a beef ranching enterprise and that the on-station stocking rate and rotational grazing experiments and the beef ranching experience hold true elsewhere. This is simply not the case. Livestock keeping in the communal areas is a multi-product enterprise, with meat being only one output among others, including milk, hides, draft power, manure and so on (Scoones, 1992).

A number of commentators, working elsewhere in Africa, have concluded:

> "...that carrying capacity, as conceived in Western range management, is of questionable validity in livestock production systems in Africa, that it is virtually impossible to estimate it accurately, and that the concept cannot be meaningfully applied... Let us admit the problems with the carrying capacity concept, and stop trying to apply it" (Bartels et al, 1993).

Farmers in Zimbabwe would definitely concur with this statement. Over many years they have battled with the authorities over stocking rate policies. In the 1940s, the colonial government tried to impose destocking regulations in order to get the cattle population within the carrying capacity. This policy resulted in the widespread and enforced sale of cattle. Commenting on this period, one farmer recalled:

> "Destocking was a terrible pain and loss. But there was nothing we could do. It was the law".

But why does carrying capacity, as such as central design concept in grazing schemes and other rangeland interventions, persist? Again, the relationship between scientific knowledge, however inadequate, and power is highly pertinent. As the farmer commented, despite their objections on sound and rationale grounds, destocking was "the law". The carrying capacity regulations are held by those in authority, and there is little in the way of calm and rational argument, it seems, which can budge them.

Fencing the landscape: contests over rotational grazing. Following the classic approaches to rangeland management, regulation of animal numbers and strict rotational movement are seen as the two pivotal elements of grazing scheme design and management. As we have already seen, limiting animal numbers according to carrying capacity estimates has proved problematic. The idea of rotational grazing is equally controversial at the local level.

Rotational grazing design has a long pedigree in southern Africa, with the earliest experiments in Zimbabwe being carried out in the 1930s. By the mid-1980s, over 300 further multi-year experiments had been carried out in different sites across the region, using different paddock combinations, with different stocking rates (O'Connor, 1985). But these experimental insights have been quite equivocal about the merits of rotational grazing. Indeed, one review suggested that rotational paddock grazing did not show improved production benefits over continuous grazing and the conservation benefits were only speculative (Gammon, 1978). Despite this non-committal message from scientific research, extension advice has persisted[3], arguing, in often dogmatic terms, that rotational grazing is best, and that any other form of grazing management would potentially lead to damaging environmental degradation and production collapse.

Again, local views do not coincide with the conventional wisdom promulgated by extension. Many herders argue that free grazing, allowing animals opportunistically to seek out available grazing and move between different patches in the landscape, is most appropriate (Scoones, 1995). Commenting on the idea of paddocks, one farmer observed:

> "The areas where they want to make paddocks are very small. Also there is no grass in these areas. It is like putting a fence round this bare patch of ground here. It's better to let the animals wander free, otherwise they will just stand here and die".

The connection between stocking rate control and paddock schemes is also often commented upon. Another farmer noted:

> "The paddocks will mean only a limited number of cattle will be allowed and the extra would be sold. This would mean destocking in disguise".

Despite internal disagreements within the scientific community about the efficacy of rotational grazing, particularly in semi-arid grazing systems, the idea of rotational paddocks as part of grazing schemes is presented without question by planners and extensionists. Through their networks of power, backed up by donor finance, technical doubts are erased. Thus the technical intervention is not a subject of debate and negotiation, but is seen to be the result of force. Linkages with previous periods of top-down and heavy-handed development intervention during the colonial era are quickly made:

> "The fence is just coming by force, as a law from the government... the ideas of paddocks first came at the same time as the "lines"[4] and destocking - it could mean the same again".

In practice, destocking has not been a feature of contemporary grazing schemes in Zimbabwe. Although stock control to carrying capacity levels remains one of the technical objectives, the political costs of implementing such a strategy are perceived to be too high. The memories of resistance by local people to earlier attempts at destocking are still present.

This fundamental lack of understanding between extensionists and local farmers has resulted in a bizarre set of circumstances in some schemes. At great expense, fences have been erected in rigid straight lines across the landscape, but farmers have, by and large, ignored them. Some paddocks near villages may have been retained for holding animals for periods when herding labour is scarce, but other paddocks have effectively ceased to exist, and animals have been herded outside the fence lines. This has especially been the case during droughts, when movement to key resource grazing areas, often outside the scheme, is necessary. As for small stock, they have largely been oblivious to the fences from the beginning, as the barbed wire

[3] This approach and design has been recommended, more or less without change, since the 1940s when the South African adviser, Pole-Evans, first promoted the idea, see Scoones, 1996b for a further exploration of the history of grassland science and range management ideas in the region.

[4] Land reorganisation and settlement programmes were carried out between the 1930s and early 1960s in different parts of Zimbabwe, resulting in the creation of consolidated grazing and arable areas, separated by linear settlements, known locally as the "lines".

was rarely effective at preventing their movement. In some schemes, the fences have gradually been removed, as interest from extension workers and donors waned, and the valuable wire has been put to other uses, such as fencing gardens.

Equilibrium thinking versus non-equilibrium practice. The design dilemmas highlighted by the grazing scheme experience focuses attention, at a more fundamental level, on the paradigms informing scientific knowledge and associated interventions. The design elements of grazing schemes - stocking rate control, paddocks, regulated movement etc. - derive from a classic, equilibrium view of ecology, where linear Clementsian succession holds, and management through regulation is possible. This view has dominated thinking in grassland science and rangeland management for much of this century (Ellis and Swift, 1988; Westoby et al, 1989). But such notions are increasingly being challenged, not least from empirical evidence on the actual practice of herders operating in arid and semi-arid environments. An alternative, non-equilibrium view suggests that, instead of tight and predictable regulation of plants and animals through biotic factors, abiotic factors and contingent and uncertain events dominate the system. This means that a much more flexible and opportunistic system of management is required, involving movement and the exploitation of temporally and spatially variable resources (Behnke and Scoones, 1993; Sandford, 1995). From this perspective, it is not surprising that interventions based on equilibrium assumptions have failed in non-equilibrium environments.

Although not expressed as such, farmers in Zimbabwe offer a non-equilibrium perspective in their analysis of grassland systems:

> "Grass comes and goes with the rains. It doesn't matter how many animals you have, it just depends on the rains. Once rains return there is plenty of grass and animal numbers can grow. When rains are poor, animals must search the area for the grass, moving to the rivers and into the mountains".

The convergence of the scientific debate about non-equilibrium ecologies and herders' analysis of their own environments and systems of management is clearly encouraging. But, as yet, this has still to permeate through into the realms of practical implementation. Grazing schemes still represent a classic equilibrium intervention, ill-suited to many of the non-equilibrium environments for which they are being designed.

During the 1980s and early 1990s several hundred grazing schemes were implemented across Zimbabwe (Cousins, 1992, 1996). In their plans, each have the central elements of technical design outlined here. But each, in practice, has evolved differently. In each setting, the negotiations between local people and extension workers have taken a different course: different balances of power have been evident, different forms of resistance employed and different compromises reached. The process of technology transfer has not been straightforward. Fundamental disputes over knowledge and meaning have been evident, which have been resolved in different ways. While the extension handbooks and planning guidelines remain fixed with one, apparently objective, view, other interpretations have been negotiated in practice. Knowledge in theory and knowledge in practice are often quite different, with different actors with different power relations, resulting in different outcomes in different settings. The practical implications of this for the processes of technology transfer are explored in the next sections.

KNOWLEDGES IN PRACTICE: SUCCESS AND FAILURE IN TECHNOLOGY TRANSFER

The experience of grazing scheme implementation in Zimbabwe suggests a series of questions: why have inappropriate designs prevailed, despite technical disputes both within science and with users? Why have local perspectives been silenced? And what approaches might improve communication and so technical design and technology transfer? This section will consider these questions in turn, and reflect on the broader lessons for research and extension systems.

Why has a clearly inappropriate technical design prevailed? As Thomas Kuhn and many others have noted, paradigms in science remain in place long after contradictory evidence emerges (Kuhn, 1962). Networks of knowledge extend from scientific journals, to professional associations, to curricula in schools and colleges, to manuals designed for extension workers (cf. Latour, 1987). Even if a debate continues among researchers, as in the case over the merits or otherwise of rotational grazing, this may not be reflected outside the immediate coterie of scientists involved. In the linear approach to technology transfer, the presentation of a firm and objective "truth" by research to extension is critical. Doubts are erased and complexities covered up. The formalisation of knowledge in textbooks and training manuals presents another route by which knowledges in dispute become transformed into safe certainties. The closure of professional practice around a particular line is, in turn, reinforced by the way research and extension organisations operate (Latour, 1987). Stepping out of line is not appropriate. For the researcher - particularly those who are young, inexperienced and poorly connected - it may be difficult to publish findings that contradict the conventional wisdom. This is especially so if those in more senior positions are wedded to the mainstream view, with their careers and professional reputations associated with such ideas. As with the conflicts over knowledges between farmers and extension workers, issues of power remain central.

Why are local voices not heard? Debates over grazing scheme design are not heard in the public sphere. The perspectives of farmers are silenced, and the dominant, hegemonic view prevails. Professional attitudes, instilled through years of training and practice, combine with organisational structures which discourage dissent, making dialogue, debate and constructive exchange unlikely. The norms of planning and the styles of implementation are often antithetical to effective interaction with local people.

For instance, the planning of grazing schemes largely takes place in offices distant from the site, using aerial photographs to plan out boundaries and paddocks. The details of local reality are only scantily observed, and "ground truthing" often only involves the checking of grassland classes according to increaser/decreaser categories. Local consultation is equally limited. Certainly, extension workers gain permission for the grazing scheme from the local leadership and a local committee is established. But a quick examination of most scheme committees shows the dominance of older, male elites (Cousins 1996). Wider consultation tends to come in the form of village meetings where the idea is "sold" to the community, often as part of a package including more popular measures, such as water supply. In such fora, discussion is highly constrained, and those who disagree remain silent, or do not attend.

Although local voices may not be heard in such formal processes and in public fora controlled by extension workers and local elites, this does not mean that local actors' agency is absent. Other forms of "everyday resistance" may be evident. James Scott argues that this may entail "footdragging, dissimulation, desertion, false compliance, pilfering, feigned ignorance, slander, arson, sabotage or a refusal to understand" (Scott, 1985: xvi). Networks of social organisation are drawn upon to galvanise resistance and recourse to traditional beliefs offers alternative sources of power to local people disputing external interventions. For instance, in one grazing scheme in southern Zimbabwe (Scoones, forthcoming), long running disputes between different lineage leaders became the focal point for conflicts over grazing scheme implementation, resulting in the changing of the fence line, as the extension worker was unable to convince either side. Equally, in another part of the scheme, a well-known local "witch" became the centre of local resistance, with the local councillor and extension worker effectively abandoning implementation in that area for fear of the consequences.

Thus disputes over knowledge and grazing management practice are played out in other arenas, when debates in formal settings are stifled or constrained. Even without access to the power created through official institutions and organisations and supported by external funding, local people can nevertheless exert influence through a range of tactics of resistance.

What alternatives for technology transfer exist? While a pattern of poor communication, domination by extension and resistance by locals may be dominant, it does not always prevail. In some instances, extension workers are able to step outside the strictures imposed by their profession and more fruitful communication takes place. Although such dialogue goes unrecorded in official reporting of planning and implementation, it nevertheless feeds into the process, often with tangible effects. When grazing scheme designs have been negotiated in this way, and planning and implementation has taken place in a flexible manner, they have almost invariably been more successful than those implemented by the book.

Opening up and facilitating such a debate is not easy. With a long, and largely negative, history of external intervention influencing people's perceptions and fuelling people's suspicions, there are many hurdles to be jumped (Long and van der Ploeg, 1989). Invariably it is those extension workers who have worked in an area for some time have had the most chance of building up local confidence.

But it must be remembered that a local community is not homogeneous. Many different interests are represented. In a grazing scheme setting, older men with a number of cattle may have different views to younger men with only a few, or poorer men with none. Equally, men and women have different interests, with men owning more cattle and women owning more small stock. In the process of interaction at community level, it is all too easy for an extension worker to be seen to be associating with one interest group. Thus closeness and confidence raising has to be matched with distance and even-handedness.

NEW ROLES FOR RESEARCH AND EXTENSION IN THE GRASSLANDS?

The experience of grazing schemes in Zimbabwe - and many other comparable experiences from across the world - suggests the need for a fundamental shift in the roles of research and extension and a reassessment of the style and approach of technology transfer. This will mean taking the relationship between knowledges of different actors and power seriously, in the creation of what Robert Chambers terms, a new professionalism (Chambers, 1993).

A number of shifts in research and extension practice are suggested by the discussion in this paper. Some of these are highlighted in Table 1. Starting from a fairly fundamental reevaluation of the way we understand knowledge and relations of power, new approaches and new roles for research and extension are proposed. If the artificial barrier between local and scientific knowledges is broken down, and the assumption that scientific knowledge is necessarily superior abandoned, then, instead, it is possible to recognise that multiple knowledges exist as part of a range of different networks, and that multiple sources of innovation and choice exist in the process of technology development. This, in turn, has implications for the approach, style and role of those involved in the technology transfer process. Instead of being didactic teachers and trainers, extensionists become facilitators, catalysts and networkers. And farmers equally shift from being passive recipients, beneficiaries or targets, to being active participants in a co-learning process.

The earlier discussion of success in grazing scheme implementation emphasised the importance of communication, negotiation, confidence building and conflict management skills. But these are often not part of the repertoire of the inexperienced extension worker, who, in the case of Zimbabwe at least, is more likely to have emerged from agricultural college with detailed knowledge of technical issues surrounding grazing management on large ranches, and without much training in broader social skills or a sense of the diversity of knowledges and contested technical areas which exist in the communal areas. The skills required to convene a dialogue about technology choice and implementation and facilitate a process of negotiation around technical details, as well as deal with practical implementation issues, are significant. As the case study highlighted, a few experienced extension workers were able to step outside the strictures imposed by their formal job description and create a new type of interaction, based on different attitudes, different behaviours and different skills. But these approaches are not directly rewarded. The organisational structure of the extension service, geared as it is to a conventional form of technology transfer, does not provide the necessary support. Neither does the research system, which remains wedded to the technical notions of carrying capacity, rotational grazing, rooted in the equilibrium perspective of grassland management and the ranch production paradigm[5] .

In order to seek out new opportunities for technology transfer which are able to address the complexities of sustainable resource management and the varied social, economic and political contexts within which technologies are used, a number of challenges emerge. Three areas stand out as priorities for the reform of research and extension systems (Pretty and Chambers, 1994). First, support for fundamental shifts in the attitudes and behaviours of professionals, encouraging the "professional reversals" that "put farmers first" (Chambers, 1993). But individual change must be supported by organisational change. Therefore the second priority focuses on organisational reform, where job descriptions, line management structures, reporting formats, monitoring and evaluation approaches and funding procedures are geared to encourage the type of shifts in professional roles and approaches described above. Finally, in order to facilitate both individual and organisational change, new methods and ways of working are needed. In order to gain insights into the multiple perspectives constituting local and scientific knowledges, all actors in the technology transfer process - researchers, extension workers and farmers - need to be equipped with practical, field-based tools which allow such insights. Fortunately, the range of

[5] However, some recent positive changes are worth noting. These include initiatives in Masvingo Province by Agritex (the government extension service) who are encouraging a shift to participatory approaches at the same time as reviewing organisational issues, and the Farming Systems Research Unit of DRSS (the government research service) who have been pioneering farmer participatory research activities.

participatory and rapid rural appraisal techniques which has evolved over the last decade serve this purpose well (Chambers, 1992). But such methods only encourage participatory learning in the right setting. Thus the context for open learning, networking and sharing also needs to be supported through confidence building, conscientisation and skill development. Here, adult learning techniques are important, with the approaches drawing on Freirean styles of pedagogy, such as Training for Transformation, and conflict negotiation and management (eg. Hope et al, 1984), being particularly relevant.

CONCLUSION

Changes in professional attitudes, combined with new participatory methods and a transformation of organisational structures, offer a set of major challenges for research, extension and the process of technology transfer in the future. Such challenges will not be easy to achieve. But, with a greater critical and reflective awareness of past failures in technology transfer, we are increasingly better equipped, both conceptually and practically, to meet them. A growing number of experiences, from across the world, suggest that there are many potentials for new styles of research and extension (cf. contributions in Scoones and Thompson (eds.) 1994).

A new contextual science for the rangelands (Russell and Ison, 1991), recognises the particularities of settings, avoids the transfer of technologies across contexts and allows for the creation of technologies through a participatory process of research, action and reflection. This is not an anti-technology position, but one which recognises local complexity, the potential for local adaptation and opportunities for a meeting of scientific and local knowledges in a process of constructive engagement and dialogue.

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REFERENCES

Agarwal, A. (1995). Indigenous and scientific knowledge: some critical comments. Indigenous Knowledge and Development Monitor, **3:** 3-5.
Bartels, G., B. Norton and G. Perrier (1993). An examination of the carrying capacity concept. In: Behnke, R.H., Scoones, I. and Kerven, C. (eds) Range Ecology at Disequilibrium: New Models of Natural Variability and Pastoral Adaptation in African Savannas. Overseas Development Institute, London.
Behnke R.H. and I. Scoones (1993). Rethinking range ecology: implications for rangeland management in Africa. In: Behnke, R.H., Scoones, I. and Kerven, C. (eds) Range Ecology at Disequilibrium: New Models of Natural Variability and Pastoral Adaptation in African Savannas. Overseas Development Institute, London.
Bell, R. (1985). Carrying capacity and offtake quotas. In: Bell, R.H.V and McShane Caluzi, E. (eds) Conservation and Wildlife Management in Africa. US Peace Corps, Washington.
Caughley, G. (1979). What is this thing called carrying capacity? In: Boyce, M.S. and Hayden-Wing, L.D. (eds) North American Elk: Ecology, Behaviour and Management, pp 2-8. University of Wyoming Press. Laramie, Wyoming.
Chambers, R. (1992). Rural appraisal: rapid, relaxed and participatory. IDS Discussion Paper, 311. Institute of Development Studies, Sussex.
Chambers, R. (1993), Challenging the Professions: Frontiers for Rural Development, London: Intermediate Technology Publications.
Chambers, R., A. Pacey and L. Thrupp (eds.) (1989). Farmer First: Farmer Innovation and Agricultural Research. Intermediate Technology Publications, London.
Conway, G. and E. Barbier (1990) After the Green Revolution. Sustainable Agriculture for Development. Earthscan Publications, London.
Cousins, B. (1992). Managing Communal Rangeland in Zimbabwe: Experiences and Lessons. Commonwealth Secretariat, London.
Cousins, B. (1996). Collective decision-making in grazing schemes in the communal areas of Zimbabwe. PhD thesis, University of Zimbabwe.
Danckwerts, J (1974). A socioeconomic study of veld management in the tribal areas of Victoria Province. The Tribal Areas of Rhodes ia Research Foundation, Salisbury.
Ellis, J.E. and D.M. Swift (1988). Stability of African pastoral ecosystems: alternative paradigms and implications for development. Journal of Range Management, **41(6)**: 458-9.
Foucault, M. (1971). The order of discouse. In: Young, R. (ed.). Untying the Text: Post Structuralist Reader. Routledge and Kegan Paul, London.
Froude, M. (1974). Veld management in the Victoria Province Tribal areas. Rhodesian Agriculture Journal, **71**: 29-33.
Gammon, M. (1978). A review of experiments comparing systems of grazing management on natural pasture. Proceedings of the Grassland Society of Southern Africa, **13**: 75-82.
Hagerstand, T. (1968). Innovation Diffusion as a Spatial Process. University of Chicago Press, Chicago.
Havelock, R. (1969). Planning for Innovation through Dissemination and Utilisation of Knowledge. Institute of Social Research, Ann Arbor, Michigan.
Hope, A., S. Timmel and C. Hodzi (1984). Training for Transformation. Mambo Press, Gweru, Zimbabwe
Kuhn, T. (1962). The Structure of Scientific Revolutions. Chicago University Press, Chicago.
Latour, B. (1987). Science in Action. Harvard University Press, Cambridge, Mass.
Long, N. and A. Long (eds.) (1992). Battlefields of Knowledge: The Interlocking of Theory and Practice in Social Research and Development. Routledge, London.
Long, N. and J. van der Ploeg (1989). Demythologizing planned intervention: an actor perspective. Sociologia Ruralis, **XXIX (3/4)**: 227-49.
Moris, J. (1991). Extension Alternatives in Tropical Africa. Overseas Development Institute, London.
O'Connor, T. (1985). A synthesis of field experiments concerning the grass layer in the semi-arid regions of southern Africa. South African Natural Science Programme Report, 144. Pretoria.
Pretty, J. and R. Chambers (1994). Towards a learning paradigm: new professionalism and institutions for agriculture. In: Scoones, I. and Thompson, J. (eds.). Beyond Farmer First. Rural People's Knowledge, Agricultural Research and Extension Practice. Intermediate Technology Publications, London.
Ravnborg, H. (1992). The CGIAR system in transition. Implications for the poor, sustainability and the national research systems. Agricultural Administration (Research and Extension) Network Paper, 31. ODI, London.
Rogers, E. (1962; 3rd ed, 1983) Diffusion of Innovation. The Free Press, Glencoe.
Roling, N. (1994). Facilitating sustainable agriculture: turning policy models upside down. In: Scoones, I. and Thompson, J. (eds.). Beyond Farmer First. Rural People's Knowledge, Agricultural Research and

Extension Practice. Intermediate Technology Publications, London.
Rorty, R. (1990) Philosophy and the Mirror of Nature. Basil Blackwell, Oxford.
Russell, D. and R. Ison (1991). The research development relationship in rangelands: an opportunity for contextual science. In: Proceedings of the fourth International Rangelands Congress, pp. 1047-1054, Volume 3. CIRAD, Montpellier.
Sandford, S. (1995). Improving the efficiency of opportunism: new directions for pastoral development, pp. 174-183. In: Scoones, I. (ed.). Living with Uncertainty: New Directions in Pastoral Development in Africa. IT Publications, London.
Scoones, I. (1989). Economic and ecological carrying capacity: implications for livestock development in Zimbabwe's communal areas. Pastoral Development Network paper, 27b. ODI, London.
Scoones, I. (1992). The economic value of livestock in the communal areas of Zimbabwe. Agricultural Systems, **39**: 339-59
Scoones, I. (1995). Exploiting heterogeneity: Habitat use by cattle in the communal areas of Zimbabwe. Journal of Arid Environments, **29**: 221-237.
Scoones, I. (1996a). New challenges for range management in the twenty-first century. Outlook on Agriculture, **25**: 253-256
Scoones, I. (1996b). Politics, polemics and pastures: range management science and policy in southern Africa. In: Leach, M. and Mearns, R. (eds.) The Lie of the Land. Challenging Received Wisdom in African Environmental Change and Policy. James Currey, London.
Scoones, I. and J. Thompson (eds.) (1994) Beyond Farmer First. Rural People's Knowledge, Agricultural Research and Extension Practice. Intermediate Technology Publications, London.
Scott, J. (1985) Weapons of the Weak. Everyday forms of Peasant Resistance. Yale University Press, New Haven, CT.
Scott, J. (1990). Domination and the Arts of Resistance: Hidden Transcripts. Yale University Press, New Haven, CT.
Westoby, M., B. Walker and I. Noy-Meir (1989). Opportunistic management for rangelands not at equilibrium. Journal of Range Management, **42**: 266-274.
World Bank Operations Evaluation Department (1994). Agricultural Extension: Lessons from Completed Projects. Report 13000. World Bank, Washington.

Table 1
New challenges for research and extension

	Transfer of technology approach	**New approaches, new roles?**
Focus	Technology adoption through the recommendation of optimal packages, based on the transfer of external knowledge	Combining local experimentation and adaptation, with the provision of a choice of new options from a range of sources
Knowledge and power	Communication and diffusion approaches; knowledge as a transferrable commodity; scientific knowledge is assumed to be superior	Knowledge situated within local practices and various social networks; multiple knowledges contested by different actors with different relations of power
Sources of knowledge and innovation	Limited sources of knowledge and innovation: linear research - extension -farmer transfer	Multiple sources of knowledge and innovation: open exchanges between different actors important
Extension worker approach	Didactic approach: lectures, group meetings, package delivery, demonstration, contact farmer training	Participatory/adult learning approach: skill sharing, networking, farmer-to-farmer and researcher exchanges, conflict negotiation, capacity building, organisational development
Extension worker roles	Teacher, demonstrator	Facilitator, convenor, catalyst, networker, negotiator, consultant
Farmers' roles	Adopter, target, beneficiary, trainee	Co-learner, experimenter, networker, facilitator

Sources: Moris, 1991; Pretty and Chambers, 1994; Roling, 1994.