

**LIVING WITH UNCERTAINTY:
NEW DIRECTIONS FOR PASTORAL
DEVELOPMENT IN AFRICA**

*Overview paper of the workshop on New Directions in African Range
Management and Policy, Woburn, UK, June 1993.*

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Rethinking range ecology: some implications

The last few years have seen a major rethinking of some of the hallowed assumptions of range ecology and range management practice. What were once the hallmarks of the discipline are now being questioned. The utility of terms and concepts such as 'vegetation succession', 'carrying capacity' and 'degradation' are being reassessed, particularly for the dry rangelands where system dynamics are dominated by highly variable rainfall and episodic, chance events such as drought (Ellis and Swift, 1988; Westoby et al, 1989; Behnke and Scoones, 1993).

This 'new' thinking² highlights in particular the differences between so-called equilibrium and non-equilibrium environments. Equilibrium environments are those that show the classic feedback mechanisms normally assumed in mainstream range management. In such settings vegetation change is gradual, following classical successional models (Clements, 1916; Stoddart et al, 1975). Livestock populations are in turn limited by available forage in a density dependent manner, so that excessive animal numbers, above a 'carrying capacity' level, result in negative effects on the vegetation. In the longer term this is assumed to cause more or less permanent damage - degradation or desertification. Such environments are typically found in wetter areas with more predictable patterns of rainfall.

By contrast, in non-equilibrium environments range degradation is not such an issue. Production potentials of both grassland and livestock are so dominated by rainfall (or other external variables)

¹. This overview paper represents an attempt to synthesise elements of the discussion held at a workshop on *New Directions in Range Management and Policy* held at Woburn, UK in June 1993. The writing of the theme papers and this overview paper was sponsored primarily by the Overseas Development Administration (UK) and the workshop held to discuss them was supported by the World Bank. This paper together with the major theme papers produced for the conference will be published during 1994 as a book entitled *Living with Uncertainty: New Directions for Pastoral Development in Africa* (Intermediate Technology Publications, London). The research project has been coordinated by Brian Kerr of the Commonwealth Secretariat. While they are not responsible for the content of this paper, the participants at the workshop, together with the theme paper and case study paper authors, have contributed enormously. I am grateful to the following for their comments on earlier drafts of this paper: Wolfgang Bayer, Roy Behnke, Andrea Cornwall, Ben Cousins, Adrian Cullis, Cees de Haan, John English, Brian Kerr, Robin Mearns, Richard Moorehead, Greg Perrier, Brigitte Thébaud and Camilla Toulmin.

². As with most 'new' thinking there are some long term precedents. Indeed ideas about non-equilibrium dynamics in ecosystems can be traced back to the early 1970s (eg. Holling, 1973; May, 1973, 1977; Ellis et al, 1993). Parallel shifts have occurred in other areas of the natural sciences where interest in non-linear dynamics and chaos has provoked much debate (Gleick, 1987; Ruelle, 1991).

that the livestock populations are kept low through the impact of drought or other episodic events. Livestock, under such conditions, do not have a long term negative effect on rangeland resources³. Such non-equilibrium environments have highly dynamic ecosystems and are typified by the arid or semi-arid zones where rainfall variability is high.

In practice, the distinction between these contrasting environments is often blurred. There is clearly a gradation between these two, separate ideal types. In some sites more stable, predictable equilibrium dynamics may occur in a run of wetter years, with non-equilibrium, uncertain, event-driven patterns emerging when a dry period strikes. Equally in any one area there may be certain areas which commonly show a more equilibrium pattern (eg. relatively wetter bottomland sites where primary production varies little between years) within a wider landscape of dry rangeland which shows non-equilibrium dynamic patterns with high levels of inter-annual variability (Scoones, 1993).

Pastoral populations in Africa largely live in dry environments with dynamic, non-equilibrium ecologies. Indeed 59% of all ruminant livestock in Africa are reported to be found in such areas⁴. This represents a significant proportion of Africa's agricultural production. The total value of livestock products is estimated to be 25% of the total agricultural output, equivalent to US\$12 billion in 1988 (USDA, 1990). If livestock benefits of manure and draft power are also included, this figure may increase to 35% of total agricultural GDP⁵ (Winrock, 1992). In other words, in considering the importance of arid and semi-arid production systems and the significance of dynamic, non-equilibrium ecologies we are talking of significant areas of land supporting large numbers of pastoral livelihoods and contributing a large amount to national economies⁶.

Recent ecological thinking suggests a number of propositions that potentially have far-reaching implications for the way we must conceive the theory and practice of range management and pastoral development in Africa and indeed other dryland areas of the world with significant pastoral populations. Three propositions summarise the key recent rethinking of range ecology (Behnke, 1992; Behnke et al, 1993; Sandford, 1994):

- Many arid and semi-arid grazing ecosystems are not at equilibrium and external factors (eg. drought) determine livestock numbers and vegetation status. Grazing therefore has a limited effect on long term grass productivity. In such situations opportunistic or tracking strategies are environmentally benign and waste less feed.
- The productivity of African rangelands is heterogeneous in space and variable over time, therefore flexible movement is critical.

³ Impacts on tree resources are more complex as heavy browsing or extensive lopping may affect long-term productivity due to slow regeneration rates (Bayer and Waters-Bayer, 1994).

⁴ 51% of cattle, 57% of sheep, 65% of goats and 100% of camels in Africa are found in the arid and semi-arid areas (ie. areas with rainfall below 600mm) (ILCA, 1987; Winrock, 1992).

⁵ The proportional contribution of commodity outputs from livestock to total agricultural GDP varies between different countries. For instance in Botswana, Mauritania and Namibia the contribution is over 80%. In Sudan, Nigeria and Ethiopia although the proportional contribution is lower the total amount is high with over US\$1.3 billion being realised annually (Winrock, 1992).

⁶ The degree to which outputs from the pastoral sector contribute directly to the national economy of course varies with the opportunities for cross-border trade, access to formal market channels etc. However the contribution of livestock in the drylands of Africa to pastoral livelihoods cannot be disputed.

- African pastoral production systems are influenced by a range of differentiated livelihood objectives. Therefore blueprint interventions aimed at boosting single outputs (eg. meat) using simplistic management tools (eg. fixed carrying capacity) as part of standardised models (eg. ranches) are unlikely to work.

The 'new' ecological thinking suggests a number of key principles for management and policy in the drylands of Africa. The high level of variability seen in dynamic ecosystems requires an emphasis on flexible responses to uncertain events, and mobility to allow the optimal use of a heterogeneous environment. Contingent responses are critical to successful survival in a hostile and uncertain environment. Because of unpredictability, prescriptive planning and imposed solutions will not work and locally derived responses are the key to success.

Recommending that development should take note of the need for flexibility, mobility and local level solutions is hardly new. Indeed much of the social science critique of development in pastoral areas has focused on just these issues (cf. Monod, 1975; Horowitz, 1979; Galaty et al, 1981; Swift, 1982; Sandford, 1983). Ethnographers of pastoral societies equally have documented in great detail the way pastoral livestock keeping is adapted to environmental variability (eg. Gulliver, 1955; Dupire, 1962; Dyson-Hudson, 1966; Spencer 1973; Dahl, 1979). What we are now seeing is a convergence of concepts, of interpretations and of analyses between the natural and social sciences. This convergence of course parallels what pastoralists have known and acted upon all along. The sad irony is that it is only now that the non-pastoralists, who dominate the professions who advise on and plan for pastoral areas, are catching up.

The last 30 years has seen the unrelenting failure of livestock development projects across Africa. Millions of dollars have been spent with few obvious returns and not a little damage. Most commentators agree that the experience has been a disaster, so much so that many donors and other international agencies have effectively abandoned the dry zone in their development efforts⁷. So should development agencies (international donors, national governments, NGOs) abandon the drylands as a 'no hope' area? Or should we reconsider, analyse in detail why the failure has been so consistent and what lessons can be learned from the convergence of recent ecological thinking, social science critiques and pastoralists' own practices?

This paper takes a positive view for three reasons. First, the costs of abandoning pastoral areas are potentially enormous. Second, many of the reasons for development failure are clear. Third, recent ecological thinking offers new perspectives and new insights that just might offer a way forward.

Conflict and civil strife dominate many pastoral areas today at great social cost, in parts of Somalia, Kenya, Ethiopia, Uganda, Mali and other areas. Such costs are borne most heavily by the residents of the pastoral areas, but also by national governments and the international community who, in a variety of ways, bear the costs of insecurity and famine. Without a recognition of the problems of pastoral areas and support for development needs, problems of security are likely to increase (Hjort and Salih, 1989; Markakis, 1993).

The reasons for the failure of many of the development projects imposed on pastoral areas from the 1960s are increasingly clear. In some quarters the lessons are being learned and a new era of more appropriate and apparently 'successful' projects are emerging (Oxby, 1989; Grell, 1992; Vedeld,

⁷. For instance, USAID once a major donor in dry Africa and the supporter of many of the ill-fated livestock development projects, has dramatically reduced its support in this sector. Similarly the International Livestock Centre for Africa (ILCA) redirected its research focus away from dry areas and now concentrates on milk and meat production in the 'high potential' zones (ILCA, 1987-1992).

1993). The 'new' thinking in range ecology puts much of this debate in sharper focus. In essence, the history of livestock development in Africa has been one of equilibrium solutions being imposed on non-equilibrium environments. The ranch model (and its many variants) has long dominated the curricula of professional training in range and livestock management. As a consequence the ranch model has been highly influential in development practice. But ranches with fenced paddocks, water points and reseeded rangeland are classic components of equilibrium systems. Management is focused on keeping things as stable as possible through the regulation of animal numbers and balancing grass species composition ('increasers' and 'decreasers'). Such management is ill-suited to highly dynamic ecosystems. Of course, ranchers and pastoralists making a living in dry areas recognise this. They have to, because text-book solutions do not work. They either adapt or abandon the ranch model recommendations and evolve alternative solutions that are viable. This has occurred in the US, where the ranch model originated, as well as in Africa (Gilles, 1993).

The problem is that the learning experiences of pastoralists or ranchers and the intricate knowledge that is embedded in practical action is so often overlooked or ignored by development agencies. At the same time, year after year graduates of universities and training colleges in Africa and elsewhere emerge into the world of practical development as planners, policy makers, extension workers, NGO staff, expatriate advisers and so on with a blueprint model for livestock development that is basically unworkable in many settings. The institutional learning process in many donor agencies and government departments is often so slow and so poor that field experiences are rarely fed back into revising strategies and approaches. Senior professionals who have learned much through bitter experience on the ground are quickly promoted up and away from practical implementation activities. Livestock keepers themselves, those with the most direct experience of practical management of all, are rarely consulted let alone fully involved in programme design and implementation (Perrier, 1994). The consequence is that failures are repeated and repeated, apparently *ad infinitum* (Roe, 1991a,b; 1993).

However, there are some encouraging signs which are beginning to gain wider currency among the development community. For instance, the World Bank has provided support for pastoral associations in the Sahel (Shammugaratnam et al, 1992; Sylla, 1994). This followed a critical analysis of pastoral investment approaches which firmly rejected the ranch model (de Haan, 1991). Similarly, the German development agency (GTZ) is emerging as a leader in exploring new ideas in field settings with pilot projects in the Sahel.

A discussion of new directions for pastoral development prompts a convergence of many strands of thinking, a weaving together of ideas and concepts that have diverse origins yet similar implications. This paper concentrates on one strand, exploring the applied implications of recent ecological thinking for practical policy and management issues. There is little point in proclaiming the emergence of a new paradigm of thinking in range ecology without exploring the implications. This paper attempts to ask the basic question: how will recent ecological thinking change policy and practice in pastoral development in Africa? This is a major challenge in a complex area and this paper is clearly only a preliminary attempt. A significant hurdle lies in the effective translation of languages between disciplines. Ecological issues provide a starting point for the debate (see Behnke et al., 1993), but the *policy and management implications of recent thinking are mediated by political, economic, social and cultural considerations*. Finding a way of bridging between issues and interpretations will be key in finding practical ways forward. This overview paper thus attempts to pick through a variety of interlocking and overlapping debates and suggests a number of key policy and management themes

that will guide new directions in pastoral development in Africa⁸.

Unpredictable change: alternatives to conventional planning and intervention

Pastoral areas are typified by high levels of unpredictable variability. From one season to the next you cannot know what will happen. Contingent responses to uncertain events characterise pastoral strategies. This involves seizing opportunities and avoiding hazards (Westoby et al., 1989). The more uncertainty there is at the local level, the more planners try and impose order through generalised development solutions. Millions of dollars have been spent trying to make unpredictable environments more predictable (eg. through expensive early warning systems or irrigation schemes). Rather than addressing the issues of variability and uncertainty head-on, the development debate becomes dominated by unworkable, generalised solutions derived from simplistic analyses of complex problems (Roe, 1991a). So, for instance, range privatisation follows from the "tragedy of the commons" or ranch development follows from technology transfer and modernisation approaches.

Under conditions of environmental uncertainty, planned intervention of any sort becomes problematic. Conventional planning and mainstream development intervention are premised on assumptions that the future can be predicted, inferred from patterns that have occurred in the past. Blueprint plans are designed and development investments approved on this basis. But is this mistaken under such conditions of variability and uncertainty?

Blueprint or adaptive planning?

There are two basic alternatives for planning in an uncertain world. The first aims to reduce uncertainties to probabilistic descriptions of variability by the collection of more and more data on more and more variables. The assumption is that with more information, this will allow the prediction of outcomes at least in a probabilistic way. The result will be, it is hoped, a better defined problem (appropriately differentiated and accounting for recognised complexity) allowing for more effective plans. These are still blueprint plans, but better informed ones.

The alternative is to accept that uncertainty and indeterminacy are fundamental and central (Wynne, 1992). No matter how much information is collected in a sensitive and differentiated manner, there is no way that all possible outcomes can be predicted and planned for. Rather than aim for 'complete' information (elaborate, multi-variate surveys) prior to intervention, it is better to act incrementally and initiate a learning process that monitors experience and feeds back lessons (Korten, 1980; Schön, 1983). This is adaptive management. Adaptive management relies on principles and guidelines rather than blueprints and prescriptions; it relies on a continuous learning process, rather than temporally separated planning, implementation and monitoring/evaluation (Holling, 1978; Walker et al, 1978; Walters and Hilborn, 1978; Walters, 1986).

These two options are obviously not mutually exclusive. For instance, adaptive management approaches may rely on pre-defined contingency planning: a suite of blueprints that allow response to a variety of circumstances (see below). In other words, formal planning and policy-making may provide a framework within which adaptive management to locally occurring, contingent events can operate. Despite the potentials for overlap between these two approaches to planning, the differences between them are fundamental and have important implications. If the variability that characterises

⁸. Each section draws heavily on issues highlighted by the theme papers prepared for the Woburn workshop (see Bayer and Waters-Bayer; Holtzman and Kulibaba; Lane and Moorehead; Perrier; Swift; Sylla and Toulmin, all 1994). In addition the debate held during the Woburn workshop has also provided additional detail.

pastoral systems is unpredictable and uncertainty prevails, then we are forced to explore approaches to planning and intervention that involve adaptive and incremental change, based on local conditions and local circumstances.

These must be based on an in-built learning process, assuming that knowledge is never complete but action is always necessary (Korten, 1980). As Norman Uphoff comments on the adaptive learning process approach that evolved during the rehabilitation of a failed irrigation system in Sri Lanka:

With a learning process approach we did not expect to impose a linear logic on a non-linear world. Blueprints would not succeed because the situation was inherently uncertain and relations of cause and effect were probabilistic and contingent (Uphoff, 1992b: 397).

But the learning process in uncertain environments is episodic. Particular events, such as droughts or disease outbreaks, provide important learning occasions. Establishing the facility to learn during and respond to episodic events requires new forms of institutional and organisational arrangement. Such set-ups must be both flexible and locally based, they must be able to change in response to both successes and failures, and they must be open to the risks and possibilities of failure.

Rethinking planned intervention in pastoral areas

There is a need to rethink planned intervention in pastoral areas (cf. Long and van der Ploeg, 1989). Global solutions (eg. the ranch model) imposed on local problems do not work. The assumption that western science and technology can provide planned solutions to particular problems under conditions of high unpredictability and immense variability is clearly unfounded. Yet the domination of western science has engulfed so much of the development process (Marglin and Marglin, 1990), putting forward technical solutions to political problems such as poverty. Blueprint solutions so often ignore the important contextual issues of politics, history and culture that necessarily impinge on technical development.

Such imposed, blueprint plans are almost inevitably rejected, either openly or by more subtle means (Scott, 1985, 1990). For instance, in Lesotho, Ferguson (1990) shows how local resistance to imposed plans involved both active sabotage and simple non-compliance. He argues that blueprint plans are not simply the result of poor or inadequate information. Instead plans reflect political ambitions, whereby livestock development in Lesotho has acted as a smoke-screen for other agendas being played out in the development arena, ones involving the expansion of state control or the assertion of authority by local elites. Blueprint, technicist, imposed plans thus suit the wider political objectives of these actors. It is this political dimension to conventional planning approaches that helps to explain the tenacity of the blueprint planning approach.

A learning or process approach to development accepts that there are multiple sources of knowledge to draw on, both locally and externally derived; there are a diversity of perceptions and interpretations of a particular situation; there are always a variety of interests in a range of alternative options; and that the process of development and change is inevitably one of negotiation, sometimes conflictual, sometimes consensual (Long and Long, 1992; Scoones and Thompson, 1993). In other words, development planning must recognise the variety of actors involved and accept that planning is ultimately a political process of consensus building often between divergent interests. Hybrid plans or evolving adaptations will be the most likely outcome rather than pre-specified blueprints. Such process planning, if facilitated skilfully, may offer unexpected and potentially successful solutions for the challenges faced in pastoral areas (TFDG, 1991).

New methods, skills and professionalism

Process planning and adaptive management require new methods, new skills and, above all, a new professionalism (Chambers, 1992, 1993). Conventional livestock development has been dominated by such technical disciplines as animal breeding, veterinary science or improved forage agronomy. The applied discipline of range management has had some influence, although, as we have seen, its contribution has been almost exclusively geared towards equilibrium settings. Social science inputs have been fairly limited, with economics perhaps contributing most when questions of livestock marketing and trade are considered. Insights from institutional sociology, organisational management, social anthropology or law have been marginal⁹. There is now a need to rethink the disciplinary balance of research expertise in livestock development. This is not to say that technical research is not required. It certainly is; there are many issues ranging from veterinary epidemiology to fodder improvement that require sustained, well-supported basic research (Winrock, 1992). However for this research to be well focused, providing the right answers to the right questions, it must be complemented with other inputs. But perhaps more importantly, there are a number of key issues that require particular social science attention. The uncertainty that dominates dryland environments means that local solutions are key, demanding flexible responses and diverse institutional settings and negotiation of interest groups and arbitration of disputes.

But perhaps even more important than reviewing the disciplinary mix of researchers is a re-examination of the context for research. Conventional, blueprint approaches to planning assume a stable world within which technical solutions can be implanted. The technology transfer model assumes that there is a more or less linear flow of information and ideas from basic researcher to applied researcher to extension worker to pastoral producer (Chambers, 1983; Chambers et al, 1989). This transfer mode is reinforced by the structural separation of basic and applied research activities¹⁰. The linear mode is also reinforced by the separation of research and extension activities, with extension expected to take 'off-the-shelf' messages or packages and deliver them to producers (eg. through the Training and Visit system) (Moris, 1991; Pretty and Chambers, 1993). Aspects of this system may be appropriate to equilibrium environments (such as the rainfed lands of the so-called Green Revolution areas of Asia)¹¹, but the transfer of technology approach is wholly inappropriate for the highly variable, unpredictable and complex environments found in pastoral areas. The context for research and extension must be changed for such settings.

Tracking a variable environment: how to support opportunistic management strategies?

In uncertain environments fodder availability fluctuates widely over time and space. Grass production may range from zero to several tonnes per hectare, depending on rainfall. Such variation is spatially

⁹. This pattern of disciplinary expertise is reflected in most livestock research organisations in Africa. ILCA's main 'thrusts' are focused on technical (so-called upstream) research on commodity production. The staff complement reflects this bias towards technical issues (ILCA Annual Reports, 1987-1992). This pattern is repeated in most national agricultural research centres (Ravnborg, 1992; Merrill-Sands et al, 1992).

¹⁰. As in the separation of the mandates of the International Agricultural Research Centres, such as ILCA, who are supposed to concentrate on 'basic' or 'up-stream' research and the National Agricultural Research institutes who are supposed to focus on applied research activities.

¹¹. But even this claim is disputed by those with long association with such areas who argue that despite certain 'equilibrium' properties (such as reliable rainfall), these areas are complex, diverse and risk prone in other ways. However the basic objective of mainstream Green Revolution agricultural interventions is to impose equilibrium solutions on these complex settings.

differentiated, with some areas showing more stable patterns of primary production while others are highly unstable. Making use of such a variable fodder resource requires tracking. Tracking involves the matching of available feed supply with animal numbers at a particular site. This is opportunistic management. Opportunistic management involves seizing opportunities when and where they exist and is thus highly flexible and responsive. Effective tracking may be achieved in four ways:

- Increasing locally available fodder by importing feed from elsewhere or by enhancing fodder production, especially drought feed, through investment in key resource sites;
- Moving animals to areas where fodder is available;
- Reducing animal feed intake during drought through shifts in watering regimes, reducing parasite loads or breeding for animals with low basal metabolic rates;
- Destocking animals through sales during drought and restocking when fodder is available following drought.

These four strategies are discussed in turn in the following sections.

Existing livestock management strategies in dryland Africa combine all four of these options to varying extents (Box 1). Drought feeding strategies involve extensive lopping of browse species or the collection of tree pods. In some parts of Africa, particularly in North Africa where feed grain is heavily subsidised, livestock keepers maintain animals through the importation of supplementary feed. Indigenous zebu cattle are physiologically adapted to low feed intake with metabolic shifts allowing reduced need for survival feeding. The same applies to camels and smallstock. Movement is central to the survival strategies of transhumant pastoral systems. Equally local level movement is important in agropastoral systems. Drought sales of livestock are also important, although often a last resort.

Box 1: Pastoral tracking strategies

During drought

- Long distance transport of animals to feed-surplus areas (trekking, lorry transport etc.)
- Feed supplementation (lopping, hay making, concentrate purchases etc.)
- Cereal stores to prevent needless distress sales of livestock
- Animal health care (eg. dosing with antihelminthics), recognising that animals die of disease more than starvation in drought
- Diversification or switching of species composition within the family herd
- Herd and family splitting
- Supplementing or diversifying income from other livelihood sources besides animals

After drought

- Investment/re-investment of surpluses from other activities in livestock (especially smallstock with high reproductive rates)
- Transfers of animals within social networks (whether with kinship basis, or with stock associates etc.) on which individuals have legitimate claims
- Raiding (more in East than West or Southern Africa)
- Collecting in loans and debts, including bridewealth
- Small-scale trade (eg. in tobacco or sugar) with investment of profits in smallstock.

Source: Working group discussions. Rapporteur: Robin Mearns; Adrian Cullis, pers. comm.

Tracking is not easy and in most cases not very efficient. Tracking strategies also run counter to elements of the 'conventional wisdom' of many range managers and livestock development specialists. The mainstream view argues that a safe conservative strategy is desirable because it reduces the risk of large scale fluctuations in numbers and output, it buffers the potentially environmentally damaging effects of temporary overstocking and fits within the ranch model of development where particular interventions ('improved' breeds, fences, paddocks, rotations) can be implemented most effectively.

However, a conservative stocking strategy is also inefficient and can impose heavy costs. Over time, extended periods will occur where fodder is left unused. Low stocking rates may result in additional burdens with reduced grass palatability due to undergrazing and increased fire risks. On occasions when grass production collapses completely, the conservative stocking level will itself be too high to be sustained in a constrained area. Such occasions may be devastating for a rancher who, hemmed in by fences, has little option for flexible movement and is poorly practised at responding to such rare events. In addition, conservatively stocked ranches invariably have lower financial returns than opportunistically managed 'traditional' systems on a per area basis (Table 1).

Table 1: Comparisons between ranching and pastoral production systems in Africa

Country	Comments	Sources
Zimbabwe	All studies show that the value of communal area (CA) cattle production far exceeds returns from ranching. If actual stocking rates are used, CA returns are 10 times higher per hectare	Danckwerts (1974) Jackson (1989) Barrett (1992) Scoones (1992)
Botswana	Communal area production (in cash, energy and protein terms) per hectare exceeds by at least 3 times per hectare returns from ranches, even though technical production parameters are lower. The difference in soil erosion levels between the two production systems is negligible despite differences in stocking rate	Rennie et al (1977) Carl Bro (1982) Hubbard (1982) De Ridder and Wagenaar (1984) Abel (1993)
Mozambique	'Traditional' systems have higher overall returns per hectare because of the multiple benefits of draft, transport, manure, milk and meat compared to the single beef output from ranches	Rocha et al (1991)
South Africa	Cattle production systems in the Transkei show higher returns per hectare but lower productivity indicators compared to ranches in the commercial white farming sector	Tapson (1991, 1993) Richardson (1992)
Kenya	Gross output levels in individual ranches and undeveloped group ranches are comparable	De Leeuw et al (1984) Bekure et al (1991)
Tanzania	The productivity of pastoral herds in the Ngorongoro Conservation Area were found to be comparable to commercial herds. The patterns of productivity were similar to those found in Kenyan Maasai herds	Birley (1982) Homewood & Rodgers (1991) Homewood (1992)
Uganda	Recalculations of figures to include full range of costs and benefits show that \$ returns per hectare under pastoralism is 2 times higher than for ranching. \$ returns per animal are a third higher	Ruthenberg (1980) Behnke (1985a)
Ethiopia	The pastoral Borana system has higher returns of both energy and protein per hectare compared to industrialised ranching systems in Australia. Australian Northern Territory ranches only realise 16% of the energy and 30% of the protein per hectare compared to the Borana system	Cossins (1985) Upton (1986) Cossins and Upton (1988)
Mali	Transhumant pastoral systems yield on average at least 2 times the amount of protein per hectare per year compared to both sedentary agropastoralists and ranchers in the US and Australia	Breman and de Wit (1983) Wilson et al (1983)

However the primary trade-off may not be between opportunistic, tracking strategies and conservative, ranch management strategies. Conventional ranching systems represent less than 5% of the total livestock population in Africa (Winrock, 1992). In most cases they follow conservative regimes for very good reasons. Despite the rhetoric of some protagonists, ranching is not an alternative for most African livestock systems. While this has been recognised by some of the major donor agencies (cf. de Haan, 1990), the ranch model, in various guises, continues to be promoted by both national governments and donor agencies.

The most important trade-off is between efficient and inefficient opportunism or tracking. The development challenge is thus not the transformation of pastoral systems into ranching systems, but increasing the efficiency of tracking (Sandford, 1994). How can this be done? There are a number of development options suggested by this analysis that can be grouped under the four tracking strategies outlined above. Again such options are not mutually exclusive, but each derives from an acceptance that, in order to improve the livelihoods of livestock keepers living in a highly variable, often uncertain environment, enhancing tracking opportunities and reducing the chances of livelihood loss through drought (or other episodic events) are key principles for designing practical options.

Feed alternatives to rangeland during drought

Most fodder research has concentrated on the enhancement of range productivity in 'normal' years. Reseeding with legumes or planting of fodder trees appear to provide some promise of boosting productivity in more humid agroecosystems, but such technologies have rarely proved viable in drier situations, especially when repeated droughts or intense grazing wipe out vulnerable grass and legume species or kill trees (Bayer and Waters-Bayer, 1994). The attempts by fodder agronomists or agroforesters to provide equilibrium solutions for non-equilibrium settings has thus proved very disappointing.

Understanding how most pastoral herds use the fodder landscape in dry areas however suggests an alternative strategy for such interventions. In dry seasons or in dry years, animals depend on relatively small patches within a wider dryland landscape. These are the 'key resources' that sustain animals in times of fodder shortage (Scoones, 1994). Traditional tracking strategies usually involve strategic movement to such sites. It is these areas, rather than the open range, that should be the focus for fodder improvement. Enhancing (or even creating) key resource areas through investment in fodder management, reseedling and environmental rehabilitation appears to offer chances for productivity enhancement in good years and survival feeding in poor years (Barton, 1993). For it is in such key resource areas, characterised as they are by a more 'equilibrium' environment (often run-on sites with high available soil water and nutrients), where legume seeding and tree planting (of existing species using existing management techniques) may have some chances of success.

Depending on the livestock species, browse may also act as an important key resource. The availability of coppiced trees and shrubs in dryland areas is often critical to the nutrition of livestock in times of drought (Le Houérou, 1980; Barrow, 1991). Tree pods in particular may be an important protein supplement that increase appetite and ensure maintenance of animals during periods of stress (Coppock and Reed, 1992; Oba, 1993). To many mainstream range managers trees within rangeland areas represent 'bush encroachment'. Great effort has been invested in cutting down such trees, removing in many cases the very key browse resources that can allow animals to cope with drought. In dynamic ecosystems, the trade-offs between productivity under good rainfall conditions (where bush decreases grass growth through competition under conventional equilibrium dynamics) must be traded off against productivity under drought conditions where non-equilibrium conditions apply and the browse component of the fodder landscape is critical. Thus for pastoralists attempting to track a

highly variable environment it is important to sustain a scrub woodland where browse fodder is accessible to animals within range areas.

Pastoral-agricultural linkages

Some commentators argue that closer linkages between pastoral and agricultural systems and the evolution of integrated, mixed farming systems is both inevitable and highly desirable on the grounds of efficiency (McCown et al, 1979; McIntire et al, 1992). But does close crop-livestock interaction imply the potential for improved tracking? Various arguments are put forward to justify crop-livestock integration. Below I will examine three of these.

Mixed farming systems are more efficient. This claim is based on a number of related arguments. The first relates to the 'inevitability' of intensification due to population pressure. As increases in population occur the premium on land grows as does the availability of labour. The result is an 'evolutionary' process of intensification (Boserup, 1965, 1981; Pingali et al, 1987; Tiffen and Mortimore, 1992), resulting in a move from extensive pastoralism to intensive mixed farming. As intensity of production increases, so the argument goes, the costs of production decrease, especially those that relate to transportation of inputs. In addition, in an integrated agropastoral system the transaction costs of negotiating contract herding or manure-crop residue exchanges disappear (Toulmin, 1992; Bayer and Waters-Bayer, 1994).

Despite the appealing logic of arguments in favour of livestock-crop integration 'on-farm', there are a number of pitfalls (Gass and Sumberg, 1993). Although certain efficiencies may increase at the level of the farm unit, there are a range of inefficiencies at the broader geographical scale that arise through integration particularly in the semi-arid zone. The production efficiency of individual animals may decrease in settled farming areas as compared to transhumant pastoral settings (Wilson and Clarke, 1976), although this will depend on the particular local conditions¹².

For instance, in some settings, such as in the West African Sahel, the comparative advantages of the agricultural and pastoral areas may be lost through integration. If pastoral livestock are increasingly incorporated into agropastoral areas, and transhumant movement tracking the production vagaries of the dry rangelands is abandoned in favour of more 'efficient' settled production systems in more equilibrium environments, then the opportunity for exploiting large areas of dry range will be lost. Under conditions of land pressure, to encourage the abandonment of the dry rangelands may be an inefficient solution. On top of this, the loss of pastoral livelihoods will result in additional costs as people migrate to the towns in search of casual employment or are driven to destitution. In terms of wider social welfare, in any country with a pastoral population, this can hardly be regarded as an efficient solution.

Mixed farming increases feed diversity and decreases variability in feed production. Mixed farming systems usually increase the diversity of feed available to animals compared with access to range resources alone. Crop residues, feed concentrates, agro-industrial by-products, as well as graze and browse in rangelands and between fields, offers a wide diversity of alternative feed. The variability

¹² Wilson and Clarke (1976) report the higher production indices of migratory livestock in western Sudan. However, other research is more equivocal. Wilson (1982) found no significant differences between transhumant and agropastoral livestock in Mali, while van Raay and de Leeuw (1974) found settled livestock to be more productive in northern Nigeria because of their preferential access to prime grazing. However, generalisations are difficult to make, as there are highly efficient mixed farming systems found in the dry areas of southern Africa (Scoones, 1992; Abel, 1993), where there has been a long tradition of integration.

of primary production in dry rangelands is high primarily due to rainfall variability¹³. Coefficients of variation of crop residue production in comparable areas are lower (although CVs of grain production are higher). This implies that in most semi-arid areas it is easier to track a variable environment with access to crop residues, as crop residues act to dampen some of the variability of production seen in the rangelands (Sandford, 1988; Bayer and Waters-Bayer, 1994).

Some argue that the feed diversity and reduced variability of fodder production found in mixed agropastoral systems offer greater fodder security, making tracking variable environments more efficient in mixed agropastoral systems. However, while mixed farming systems offer a diversity of feed sources, this is also true for many pastoral systems. Flexible movement over extensive rangelands means that a great variety of grass and tree associations can be exploited, making good use of the varied phenology, production dynamics and forage quality of the different sources. In addition, pastoralists almost invariably have some access to crop residues and other agricultural by-products. Catch cropping¹⁴ by pastoralists often results in more fodder than grain. In addition, grazing arrangements between pastoralists and agriculturalists have long been a route for pastoralists to gain access to farm resources (Powell and Waters-Bayer, 1985; Toulmin, 1992; Powell and Williams, 1993). Pastoralists also purchase feed concentrates and other supplements to complement range resources and facilitate tracking.

Account must also be taken of scale. Production variations may be very high between seasons or years if a restricted single farm area is considered. However if the scale is increased production variability decreases substantially, especially if the biomass variability of different parts of the larger area is uncorrelated. This is what happens in an extensive range setting, where animals can be moved between different sites with different levels of production at any given time. This flexibility is often not feasible for a mixed farmer and the high local level variability must be coped with on a reduced scale. Landscape form will also affect the ability of livestock to respond to spatial and temporal variability. In highly dissected landscapes, such as in southern Zimbabwe, where habitat heterogeneity is high and key resource patches are plentiful, livestock may be herded in relatively restricted areas and within an agropastoral setting, except in extreme droughts when long-distance movement may be required (Scoones, 1992b; 1994). By contrast, in more uniform landscapes, such as the Kalahari sands areas of Botswana, more extensive pastoral production systems are required, involving frequent movement between agricultural areas and cattle-posts (White, 1992).

Mixed farming offers opportunities for stratification of production systems. Advocates of production system stratification argue that in order to exploit the comparative advantages of different ecological zones, it makes sense to stratify the production system, with different components of the livestock production process occurring in different areas. For instance, the dry areas of the Sahel have a comparative advantage for breeding animals. The low disease incidence, the high quality feed and the skills of pastoral producers suggest that an efficient breeding operation can be sustained in such areas.

¹³. Data from the southern rangelands of Ethiopia shows the coefficients of variation of grass biomass production to range between 19%-59% (short rains) and 25%-47% (long rains) (Bille, 1982; Cossins and Upton, 1988; Coppock, forthcoming). In Zimbabwe the primary production coefficients of variation depended on soil type and degree of bush cover; they were 59% in Tuli where rainfall cv was 47% and 27% at Matopos where rainfall cv was 38%. The highest variability of grass production over 17 years was found in thornveld, clay soil areas which had been cleared (Dye and Spear, 1982; Noy-Meir and Walker, 1986). In Mali, coefficients of variation ranged from 86% in the northern part of the Gourma to 64% in the south over the period 1984-1990 (de Leeuw et al, 1993).

¹⁴. 'Catch-cropping' is opportunistic crop production where grains are sown, usually in microenvironments with higher moisture availability, and left in the hope that some yields either of stover or grains will result.

However, the dynamic ecological conditions are not conducive for efficient fattening operations. Such operations, it is argued, are more efficiently carried out in more equilibrium environments, where fodder and water supplies are guaranteed. Such areas are found in the mixed farming areas of the sub-humid savannas, with greater access to input supplies (feed concentrates, agroindustrial by-products etc) and output markets, which in the case of West Africa are further south on the coast (Staatz, 1979; Jahnke, 1982; Holtzmann and Kulibaba, 1992, 1994).

Again, the simple logic of the argument is highly appealing. But, as before, there are complications made more pertinent by our consideration of tracking strategies. Stratification is a poor mechanism for tracking. The logic assumes that the comparative advantage is static over time. Clearly this is not the case. Rainfall variations in the 'breeding zone' will mean a highly variable supply of young animals. In periods of drought, such animals may be in poor condition and receive low prices, thus increasing the incentives for pastoralists to hold onto them for sale at a higher price. Equally during periods of good rainfall the 'breeding zone' may be quite a good 'fattening zone' too. In such periods where plentiful fodder exists, pastoralists will be unlikely to pass on animals that have a real potential for locally added value. Thus because of the dynamic variability of the pastoral areas, static notions of stratification are largely unworkable. However, local forms of stratification do exist. For instance, in the Sahel some farmers are diversifying into livestock rearing (eg. *mouton de case*) as a risk minimisation strategy.

Tracking ecosystem variability is potentially an efficient solution for dry areas. The complementarities with agricultural areas are obviously a necessary component of the future of pastoral areas. However arguments for mixed farming must be tempered by considerations of what efficiency means in a dynamic ecological context.

Livestock movement

Movement of animals in response to spatial and temporal variation in resource availability is perhaps the most classic of all the tracking strategies (Swallow, 1993). Movement allows herders to track fodder across the landscape, making use of patchy grass production caused by uneven rainfall or variations in landscape topography. Rather than manipulating herd numbers in response to climatic variability, as would a rancher operating in an enclosed area, pastoralists move and so shift their resource endowments (Behnke, 1994). Efficient tracking requires movement over different scales depending on the temporal and spatial pattern of primary production variability. For illustration, let us contrast two different areas. The first is in a highly dynamic ecological setting where primary production varies enormously between years, where a dramatic fall in fodder availability is common and where similar conditions apply over wide areas. The second case is in a more equilibrium setting where primary production variability is lower, extreme droughts are rarer and the diversity of fodder sources within a relatively small area is higher. In the first case, it is clear that access to large grazing territories are required. But as production variability decreases, the scale of grazing territory required to sustain an effective tracking strategy also decreases. However even in the second case, the occasional extremely dry year occurs and large scale movement may be necessary ¹⁵.

In addition to the scale of movement, the regularity of movement will differ between the two cases. Under uncertain environmental conditions, movement over long distances must be a regular occurrence, as for transhumant pastoralism (Breman and de Wit, 1983). In the second case, more

¹⁵ A similar contrast can be made between the mono-modal rainfall setting of the Sahel, typified by north-south movements, and the bi-modal rainfall situation of East Africa, where relatively localised and more erratic movements are common.

typical of agropastoral settings, movement is more irregular. Exploitation of local level variability (local key resources, browse, crop residues) is sufficient in most years, and only occasional movements over longer distances are needed under conditions of extreme drought (Scoones, 1992b).

Flexible and responsive movement requires institutional arrangements that ensure occasional access and that can resolve disputes and develop contingency plans for movement (Swift, 1994; Sylla, 1994). In cases where large scale movement is highly irregular, organisational and administrative arrangements are not geared up to facilitate movement. Very often large costs are imposed on livestock-owning people by regulations that restrict movement. Most administrative arrangements (movement permits, veterinary regulations etc.) assume a stable environment where movement is discouraged. However under more dynamic ecological conditions, movement becomes increasingly central and such administrative structures impose a major cost on the production system (Scoones, 1992b)¹⁶. When movement to particular sites occurs on a regular basis, negotiation of trekking routes and access to seasonal grazing must occur more frequently. Under such conditions institutional and administrative arrangements evolve that explicitly deal with ensuring movement and resolving conflicts.

Increasingly, arrangements that facilitate transhumance are no longer viable as key grazing land has been removed from pastoral use and put under the plough, or expropriated for conservation purposes. For instance, the Kenyan Maasai have lost over 1000 square miles of grazing over the past century as the Laikipia plateau, the Ngong hills, the Mara plains, the Amboseli swamp and the Mau forest area were removed from their control by other interests (agriculturalists, settler farmers, national parks) (Little, 1987). This pattern continues today in Maasailand (Kituyi, 1990), as well as many other pastoral areas (Galaty and Johnson, 1990). Conflicts between agriculturalists and pastoralists have increased, particularly over 'key resource' sites, areas which are important for both agriculture and livestock production. Under such conditions, tracking through movement becomes increasingly difficult.

Physiological tracking by low-input animals

Adaptations of animal physiology may offset expected mortality levels during drought and increase recovery rates afterwards. Indigenous zebu cattle have energy sparing mechanisms that act as an adaptation to undernutrition and water deprivation (Finch and King, 1979; King, 1983; Nicholson, 1987). Trials show that increasing the walking distance and decreasing the watering frequency, as might happen in a period of drought, did not result in any significant loss of weight in African zebu (Finch and King, 1979). Fasting metabolic rate decreased by around 30%, especially in the first 30 days of undernutrition and this led to decreased water requirements (Western and Finch, 1986).

Adjustments to low feed intake are also observed among calves. Studies of Borana cattle in Ethiopia show that reduction in milk supply to the calf (through human consumption or reduced cow production due to poor nutrition in drought) does not affect the longer term target weight of calves, despite reducing calf growth rates in the short term (Coppock, 1992). Recovery following drought is equally rapid. When food is available again there is a rapid response in metabolic rate levels and, with an increased plane of nutrition, conception rates greatly increase amongst mature female zebus.

¹⁶ Clearly, there will be occasions when movement restrictions to limit the spread of contagious diseases and the imposition of quarantine regulations are warranted. However, in the design of veterinary regulations and associated administrative arrangements, the trade-off between veterinary control and mobility must be taken into account.

Shifts in metabolic rate have two important implications. First, there are apparently no extra weight losses imposed by longer foraging treks and reduced water availability during periods of undernutrition in drought. Therefore indigenous animals are physiologically adapted to mobility and flexible responses to uncertain fodder and water availability. Second, due to reductions in fasting metabolism, more animals can be sustained on a given amount of available fodder during periods of drought than would be possible if there was no physiological tracking of the environment. In other words, forage needs in drought may be reduced by as much as 30% through shifts in metabolic rate. This will likely result in significant reductions in drought induced mortality among zebu cattle (Western and Finch, 1986).

Healthy animals are best able to track environmental fluctuations. Animals with high parasite loads, for instance, are less resilient to stress. For this reason, veterinary interventions during drought periods (eg. anti-helminth drug campaigns) may increase tracking ability of pastoral herds and flocks. Such interventions could usefully be complemented by support for indigenous systems of veterinary care, such as the feeding of browse fodder with anti-helminthic properties.

Pastoralists' own breeding strategies emphasise breeding for survival. Breeding occurs under conditions of stress, with selection pressures which encourage certain traits. This is unlike most conventional animal breeding where selection for milk or meat occurs under high-input conditions (Bayer, 1989). It is not surprising that the introduction of so-called 'improved' breeds into areas with highly variable and sometimes very low feed availability have been disastrous. Breeding for physiological tracking and low-input conditions remains a challenge that remains to be taken up by animal scientists.

Marketing

Livestock sales levels in pastoral areas are often correlated with rainfall. In periods of drought, pastoralists tend to sell more and in wetter periods, pastoralists tend to accumulate their herd capital. For instance in Swaziland, 25% of the variation in annual cattle herd offtake rates was attributable to rainfall variation, 40% to price changes and 35% remained unexplained in an analysis of sales patterns from small-scale herds between 1950 and 1976 (Doran et al, 1979)¹⁷. The supply of livestock also depends on the structure of herds. In many pastoral areas, commercialisation of livestock production is constrained by herd size (Behnke, 1987) and herd composition (Dyson-Hudson and McCabe, 1983). Livestock marketing in uncertain environments therefore must be responsive to highly variable levels of supply, both between years and between seasons.

High variability in throughput is experienced by parastatal marketing authorities and private traders alike. For instance in Kenya, the Livestock Marketing Division experienced an interannual coefficient of variation of purchases of 51% between 1960 and 1978. Private traders equally had high variability in purchase levels (cv = 36%) over the same period (White and Meadows, 1980).

The uncertainty of animal supply from pastoral areas is compounded by the high transaction costs involved in the marketing process. Because of the long distances between production areas and urban markets, transport costs may be high. Equally because of poor market infrastructure (holding grounds, storage facilities etc.), the costs of marketing for the producer may be high.

Efficient tracking responses require getting animals rapidly to markets before prices collapse during

¹⁷. Similar correlations between sales rates and rainfall levels are found in Zimbabwe between the 1920s and mid-1980s (Scoones, 1990).

drought. The availability of private traders' lorry transport may increase flexibility and speed of response, but costs may be high if there is limited competition in the transport business. Most studies show that trekking is a more efficient option for large stock, especially where trek route facilities exist (Staatz, 1979; Sandford, 1983; Holtzman and Kulibaba, 1994). Private or public investment may assist in offsetting some of these costs. For instance, government road schemes in pastoral areas may increase marketing opportunities. Private investment in transport (lorries and trucks), butcheries or small-scale meat and milk processing may increase the variety of marketing options in pastoral areas.

Most public investment in meat marketing in pastoral areas has failed. Large abattoirs or freezing plants often lie idle. The high overhead costs of maintaining large facilities working at low capacity for long periods means that most parastatal meat marketing systems have collapsed (Sandford, 1983; Bekure and McDonald, 1985; Holtzman and Kulibaba, 1994). But in some areas, parastatal marketing authorities have persisted. Political pressures have meant that the parastatals such as the Botswana Meat Commission or the Zimbabwe Cold Storage Commission have been allowed to continue operating at a loss, on the assumption that they are fulfilling a useful rural development role and should not be considered only on commercial criteria. In drought periods such parastatals operate buying schemes in order to provide a last-resort selling option for herd owners (Hubbard and Morrison, 1985; Rodriguez, 1986).

The mix of public and private investment in marketing systems needed to encourage tracking responses by pastoralists will vary from place to place. In general, governments bear high overhead costs and are constrained by bureaucratic procedures, while private operators are more flexible. This suggests that public investments are best directed to broader infrastructural support (roads, trekking facilities etc.), while private investment is likely to be most responsive to particular local market conditions.

Constraints to efficient tracking

The previous sections have outlined different ways pastoralists can track a highly variable environment. It is clear that a combination of these strategies can allow a highly efficient pastoral land use strategy making optimal use of variable fodder supplies for maximum return over time. However there are clearly constraints to efficient tracking strategies. These include:

Labour and skills. Tracking often involves high levels of skilled labour input. For instance, flexible and responsive movement (especially complex herd splitting and phased movement of different animal types) requires skilled herding labour. Similarly, fine-tuned fodder management through drought periods also requires knowledge about animal physiology, experience of different responses to different feed combinations and labour for fodder collection and selective feeding. Again such labour and skills may be difficult to find in some pastoral areas, due to the out-migration of male pastoralists in search of alternative employment opportunities. Very often available labour is unskilled and with limited experience. This reduces the efficacy of many of the tracking strategies discussed above.

Ownership and commitments. Today, an increasing proportion of pastoral herds are owned by absentee herd owners (Little, 1985a,b; 1987; Thébaud, 1993). They may be government officials, rich agriculturalists or urban businessmen with little knowledge about the complexities of pastoral production in dry, dynamic ecosystems. Hired herd managers do not own the animals themselves, and so have less incentive to invest in fine-tuned tracking management. The consequence is often a different set of objectives and a lower level of productivity in absentee owners' herds compared to those of resident pastoralists (Sutter, 1987; White, 1990). Absentee herd owners may be able to bear this cost as they have interests in other income earning activities outside the pastoral sector. However

this inefficiency in tracking imposed by the nature of ownership and the lower commitment to pastoral production is an opportunity cost, as the same herds could be yielding a higher return under different ownership and with greater care.

Access to land. Perhaps the greatest constraint to efficient tracking is limited access to land, particularly to key dry season grazing resources. This constraint is being felt by nearly all pastoral peoples. Securing rights of access to land and water is perhaps the most important challenge for the future of pastoralism. Appropriate resource tenure regimes and associated institutional and administrative arrangements are key to increasing the efficiency of tracking (see below; Lane and Moorehead, 1994; Swift, 1994; Sylla, 1994).

Borders, boundaries and conflicts. Efficient tracking very often requires access to large areas. Many pastoral populations straddle national boundaries or are resident in and around national parks or wildlife areas. To track an uncertain environment efficiently often requires access to areas across official borders or boundaries. Despite the ecological logic of flexible movement, this inevitably causes problems for state administrators who are obliged to defend the sanctity of lines marked on national maps. In some cases borders and boundaries remain notional and pastoralists can move uninhibited. Elsewhere, strong-arm tactics are employed when, for political or other reasons, it is deemed necessary to expel pastoralists from national parks or when a 'security threat' requires the state to prevent 'insurgent' pastoralists from crossing a national border (Homewood, 1993; Hogg, 1992). Local boundaries, within larger territories, are also the site for contests over access rights, particularly where key resource sites are limiting (Scoones and Cousins, 1994). Appropriate forms of governance and legal measures are required at both international, national and local levels to facilitate mobility and improve tracking efficiency.

Information. Efficient tracking requires good information. Ideally this information should include predictions about future patterns of resource availability. At the minimum effective tracking requires the ability to respond to current conditions, with regular up-dates, so flexible responses can continue. Pastoralists traditionally use complex weather forecasting techniques and networks of communication between different well sites, oases and outposts to be able to respond flexibly to variability. Such systems have proved very efficient under the conditions of poor electronic communication and low infrastructural development in most pastoral areas. Attempts to develop early warning systems using satellite technology, while technically feasible, have not been effective in the management of pastoral areas (Buchanan-Smith et al, 1992; Toulmin, 1994).

A number of issues combine to make satellite monitoring a poor solution to increasing tracking efficiency in most pastoral settings in Africa. First, flows of information from centralised satellite imagery processing facilities to pastoral areas are slow and inefficient. Second, the information, or more particularly the holder of the information (the local district administrator or animal development officer who is often not a herder or from a herding group), is often not trusted and most pastoralists are unprepared to risk their herds' survival and so their livelihoods on information from such a source. Third, the form of the information supplied may not be what the pastoralist needs. For instance, the scale of resolution of most fodder availability maps is so coarse that its utility for fine-tuned management remains limited. Although it is feasible to gain high resolution, high quality information, the processing costs and information overload implications are excessive. As a result, pastoralists tend to prefer information that is generated by them, rather than information generated by satellites and scientists. Finally, the costs of implementing (and sustaining the recurrent costs) of such a system are beyond most national governments in Africa. While satellite images and image processing are becoming progressively cheaper, the administrative and bureaucratic costs of

disseminating information remain high¹⁸. It is difficult to escape the conclusion that the use of such techniques is driven by a need to find a use for the technology.

Service provision. The provision of services in pastoral areas can both constrain or support efficient tracking. Constraints arise when services are provided in a way which either limits the ability to move flexibly or withdraw labour from herding and livestock management activities. Although approaches to mobile service delivery (schools, clinics, veterinary care) have been devised and in some instances implemented (Antenneh, 1985; de Haan and Bekure, 1991; Iles and Young, 1991; Umali et al, 1992; Young, 1992), conventional state service provision has concentrated on the provision of services assuming a sedentary life-style or identical transhumant routes each year.

When tracking fails

Efficient tracking may not always work. There are many barriers and there will continue to be. The experience of pastoral areas in the past two decades has not been a happy one. Conflict is increasing, very often involving bloodshed; levels of destitution are rising, with increasing numbers of people being forced to leave the pastoral sector with little prospect of a return; and major food deficits sometimes leading to famine continue to haunt dry Africa. The costs of this situation, particularly locally, but also internationally are high, and escalating.

When effective tracking fails, other options are necessary. Safety nets that can help maintain livelihoods and avoid conflicts are critical components. Without such social security measures, the opportunities for a return to pastoral livelihoods and the efficient exploitation of a variable and hostile environment are lost, for some maybe forever.

Providing safety nets. Social welfare interventions may act to avoid destitution among pastoralists, reducing the ratchet effect of poverty. If livelihoods can be sustained through external intervention during periods of crisis, such as drought, there may be a greater chance of a return to a pastoral way of life following the crisis. The opportunity costs of doing nothing are potentially very high. Previous drought periods have seen pastoral populations driven to migrate to urban areas, often ending up in settlement camps with few prospects for the future. The social costs of such outcomes are high not only for the destitute pastoralists, but also for host communities and agencies obliged to intervene.

Strategic drought interventions. Welfare and development support can be strategically timed to offset the high costs of drought on pastoral livelihoods. Such interventions include:

- Livestock price interventions to avoid mass sales;
- Food aid or cash/food-for-work to avoid the necessity of further asset disposal or famine;
- Livestock aid (fodder imports, anti-helminth control etc) to avoid excessive livestock mortalities.

¹⁸. In Australia satellite technologies are used to good effect as a tool for range planning and management. The large size of ranch properties, the dispersed nature of the ranching community and the easy access to computer and telecommunication systems means that, in the Australian case, satellite, remote sensing systems provide an appropriate technological solution (Foran and Stafford-Smith, 1991; Stafford-Smith and Pickup, 1993). There is therefore nothing fundamentally wrong with the use of satellite systems, it is just that they are inappropriate for most African cases. However, in the future more low-cost, localized satellite systems may be developed that are appropriate for pastoral settings in Africa.

Such interventions are best implemented at a local level as part of a drought contingency plan where pre-planned actions are designed and actions implemented in relation to various 'warning' signals based on an understanding of pastoral livelihoods (cf. Buchanan-Smith, 1993 for Turkana, Kenya; Davies, 1993 for Mali). Too often drought interventions have arisen through relief, resulting often in aid dependency and the loss of indigenous coping mechanisms, rather than long-term development responses. They have often been haphazard and uncoordinated, arriving too late and implemented in a poorly thought out manner without analysis of the longer term implications. In dryland environments 'crisis' events are, after all, 'normal'. Although unpredictable, they are certainly expected. Integrating relief with longer-term development activities is thus an important challenge.

Alternative livelihoods. Flexible exit and re-entry into the livestock sector are rare. The loss of a pastoralist's herd and flock during drought may be forever. Indigenous systems of stock redistribution (sharing, loaning, herding and stock stock associate relationships, raiding etc.) are increasingly rare (Toulmin, 1992). Small scale restocking operations initiated by NGOs and other development agencies (Oxby, 1989; Toulmin, 1994) have had some success, but they have limited impact overall. Wider interventions are required that allow opportunistic livelihood strategies that stretch beyond the pastoral sector. Providing alternative livelihood options during drought, which allow pastoralists some alternative to destitution, may provide a greater chance for re-entry into the livestock sector at a later date. Public works, cash-for-work schemes, assisted migration, pastoral reserve areas in high potential zones and provision of local income earning alternatives may represent legitimate public investment priorities in pastoral areas (Maxwell, 1992; Teklu et al, 1991; Webb et al, 1992).

Flexible resource tenure arrangements for variable environments

The conventional typology of resource tenure suggests a set of mutually exclusive property regimes. In the context of the pastoral development debate, the most common of these are private, communal and state property regimes¹⁹. Yet in pastoral areas, because of the extent of spatial heterogeneity and temporal variability in resources, different resource tenure systems co-exist and overlap. Different types of property regime may be more or less appropriate at different times and places. Empirical data from pastoral areas show no neat division between property regimes, but rather a complex set of overlapping rights that are continuously contested and renegotiated. These rights may shift over time and shift from place to place.

In uncertain environments the value of resources changes sharply over both space and time. This is why we see dynamic resource tenure systems in pastoral areas, with different levels of rent extracted from a resource, depending on where the resource is and the prevailing environmental conditions at the time. When rent extraction potential rises, the incentives increase to invest in managing that resource and exclude others, if at all possible. According to property rights theory, when the benefits derived from controlling access to the resource (as an individual or group) exceed the transaction costs of defending the resource from others and managing it, then we can expect a greater chance of more exclusive forms of property regime to emerge (Demsetz, 1967; Behnke, 1991; Bromley, 1992; Lane and Moorehead, 1994). Put simply, if it pays to keep others out, then people will do so if they can. Whether such exclusive forms of tenure turn out to be private or communal will depend on particular circumstances. Local politics, social organisation, assurance mechanisms and history (among many other things) may influence the emergence of new tenure settings in different ways in different places.

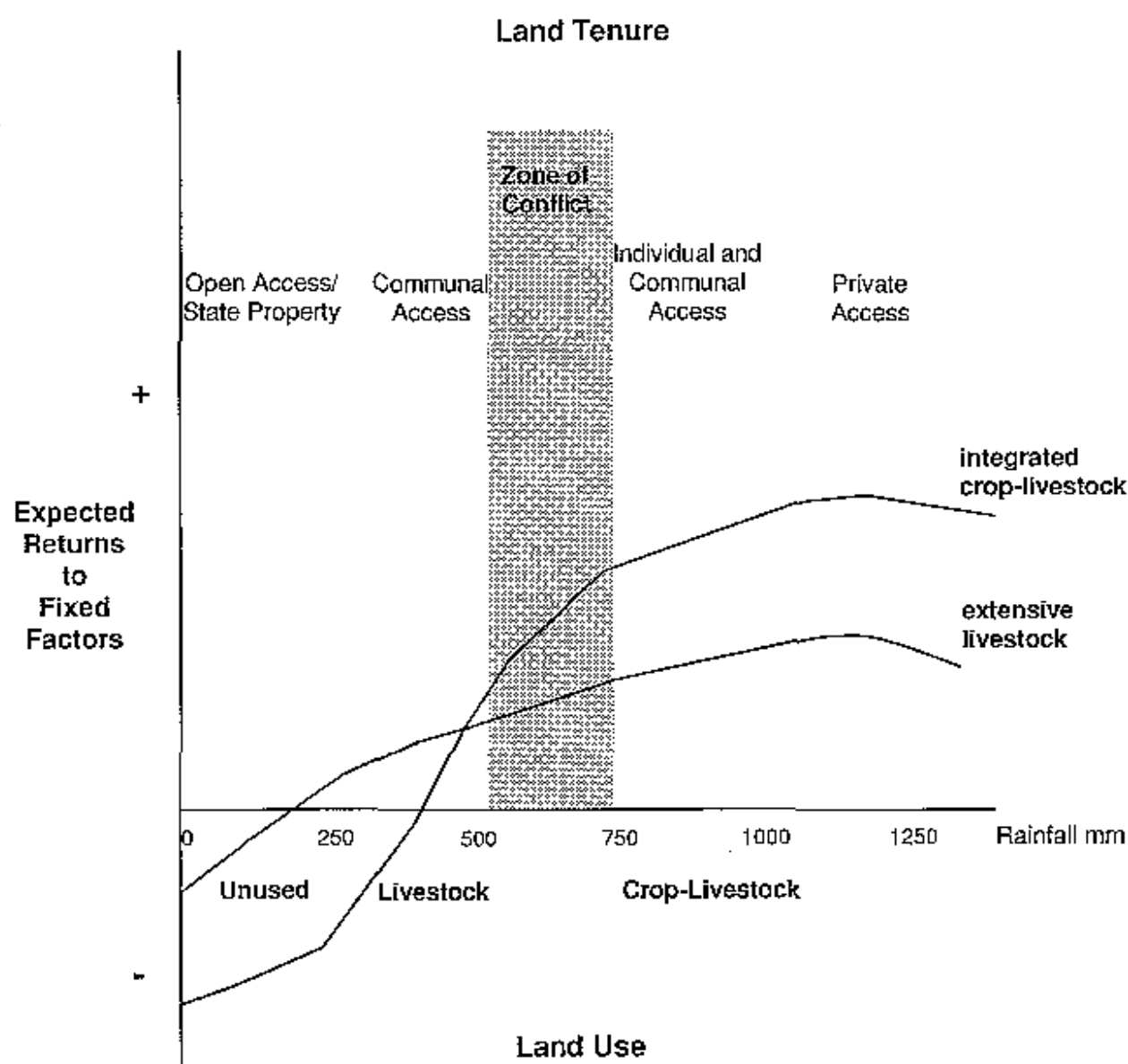
¹⁹. One other non-property regime is open access settings where no rights, rules and regulations exist over use. Most areas that are seen as 'open access' are in fact state property, as the state very often holds the residual legal rights over pastoral land.

Expected forms of tenure can be expected to change along an environmental gradient, from drier zones where resources are generally of low value per unit area and environmental variability is high, to more humid zones where resources are of higher value per unit area and the environment tends to be more stable (Swallow, workshop; Figure 1). A number of predictions follow from the property rights argument outlined above. In drier zones, more flexible forms of land tenure can be expected, involving few (coordinated access) or no property rights (open access). In wetter areas more exclusive forms of tenure can be expected (private property, exclusive communal tenure). In the semi-arid areas between, a more confused situation arises, with a greater range of options open depending on conditions. With few exceptions, this is exactly what we see in practice (Lane and Moorehead, 1994)²⁰.

Although the simple property rights model appears robust, there are a number of other important dimensions. The tenure situation described by Figure 1 is far from being static and must consider; first, the implications of dynamic variability at a particular site; second, the implications of spatial heterogeneity; third, the implications of longer term changes in land use across environmental gradients; and finally the social, political and historical context in each setting. These issues are examined below.

²⁰ A number of cases were presented at the Woburn workshop that illustrated this theme. For instance, Cousins (1993) for Zimbabwe; Galaty (1993) for group ranches in Kenya Maasailand and Thébaud (1993) for the western Sahel. Each case has particular contingent circumstances that make the simple model only part of the explanation. For instance, the historical legacy of land alienation in Zimbabwe clearly has a major impact on current communal area management practice. Equally the wider political and social dynamics within Kenyan society has ramifications for the land tenure issues in the group ranches (Kituyi, 1990). In the western Sahel, external interventions (eg. through borehole provision), combined with the social and political ambitions of particular groups also affect land tenure dynamics on the ground.

FIGURE 1: Tenure Change in Agro-ecological Zones
(after Swallow, workshop)



For given levels of:
Population Density
Macro-economic conditions
Technology

Interannual variability in resource productivity

In dryland areas fodder production varies enormously and unpredictably, as does its scarcity value. In dry years (or during the dry season) forage is at a premium, as livestock compete for the limited available fodder. In such situations the curve described in Figure 1 shifts upwards. Conversely, in seasons of relatively plenty, the curve shifts downwards. As the demand-supply situation changes, so does the resource value and consequently the incentives to engage in defending resource rights. In other words, the type of resource tenure and organisational arrangements will depend on how good the season has been.

For instance, in the Darfur area of Sudan an increasing number of grazing land enclosures were seen during the dry years of the mid-late 1980s. Such areas provided restricted access grazing to particularly powerful kin groups of settled farmers in the El Fasher region. Simple thorn fences were used to exclude others, including migrant herders (Behnke, 1985b; Curtis and Scoones, 1990)²¹.

Spatial variability in resource value

Environmental variability also has a spatial dimension. The value of different resources within the pastoral landscape at any point along the curve described in Figure 1 is not the same. Usually a variety of patches of different quality (in terms of fodder production or forage quality) make up a heterogeneous fodder resource base. Small, high value key resources (eg. drainage lines or sinks; river banks; water points; salt licks; strategic fodder reserves such as trees etc.) may be highly contested areas, particularly in periods of drought, and are thus often areas where more exclusive forms of tenure emerge. This pattern is observed in western Sudan in wadi areas (Behnke, 1985), in Zimbabwe in dambos (Cousins, 1992; Scoones and Cousins, 1994) and around boreholes and other water points (White, 1992 for Botswana; Thébaud, 1993 for Burkina Faso; Guèye, 1993 for Senegal). In these cases, it has become worthwhile to exclude others, either because of drought or because of increased population pressure or because of competition for a high value resource.

Access to key resources is often central to the survival of the whole pastoral production system, because without access to such areas, livestock cannot survive dry periods. Removal of relatively small patches (through encroachment by agriculturalists or expropriation by state farms or other interests) can be highly damaging, inflicting major costs on the pastoral sector (Lane and Scoones, 1993). It is for this reason that we see much of the conflict around resource use associated with such areas. This is particularly the case in the semi-arid zone, where such resources are especially valuable, since resource pressures are at their most intense with the competition between agricultural and pastoral uses of land. In many areas these pressures are increasing, resulting in greater contests for key resources, greater shifts in resource tenure and greater opportunities for conflict between land users.

In many pastoral areas a hierarchy of different tenure systems is seen within the same landscape: some areas are uncontested (effectively open access), other areas are managed communally according to locally negotiated rules (coordinated access, common property) and other areas are used exclusively

²¹. Other examples include the increased intensity of dambo grazing management in Zimbabwe during drought (Scoones and Cousins, 1994), the management of khors and wadis in Sudan (El Sammani, 1991; Fre, 1991) and the use of bas fonds in Burkina Faso (Hottinga et al, 1991).

(effectively private)²².

Secular changes in resource pressure

A number of longer term trends significantly affect the simple relationship described in Figure 1. Although the debate on global climatic change still rages, there appear to have been changes in some pastoral areas in Africa which have received progressively less rainfall with increased variability between years (Downing, 1982; Hulme, 1992). Substantial shifts in land-use have occurred in the Sabelian region over the period from 1973 to 1988 when a decline in rainfall of 20-30% was observed (Farmer, 1986; IUCN, 1989). In particular, as the rainfall isohyets moved south, so did the pastoral herds. This brought them into increasing conflict with settled agriculturalists (Bayer and Waters-Bayer, 1994).

Such changes may be combined with shifts in resource value brought about by changes in resource pressure. Increasing human populations in most parts of Africa have resulted in greater competition for available resources. As populations have increased, new forms of resource management and tenure have arisen. The expansion of arable farming into grazing areas has meant that livestock management has had to adapt. Fodder intake is maintained by the increased use of crop residues with high nutrient content, the use of arable fallows rich in legumes, the establishment of fodder trees and the practice of 'pastoral gardening' where careful grazing between fields and along field boundaries makes maximum use of available fodder (Bayer and Waters-Bayer, 1994; Thébaud, 1993). Adaptation to increased resource pressure requires new arrangements. These may involve negotiations between farming and pastoral groups or access restrictions during the cultivation season within agropastoral communities so that mixed crop-livestock farming can continue successfully²³. Whatever the case, increased resource pressure inevitably means heightened opportunities for conflict and an increasing need for negotiation and arbitration procedures.

Flexible tenure regimes

Overlapping claims to resources, shifting assertions of rights, and continuous contestation and negotiation of access rules dominate tenurial arrangements in uncertain environments. The solution is not to impose particular tenure types on a variable setting; whether these are uniquely communal or private they are unlikely to work. Instead the need for flexible tenure arrangements must be recognised. This is problematic for two reasons. First, flexible arrangements, by their very nature, are difficult to codify in law and second, because of this lack of codification, tenurial rights are difficult to defend through formal legal processes (Swift, 1994). This is why effective pastoral institutions are important. In the past, stable social groupings, based on kin, clan and tribal networks, were able to deal with these uncertainties. Today, this is less the case and new institutions to manage environmental variability and flexible tenure regimes are required.

Two aspects of variability require attention. First, where variability is unpredictable, then no form of prescriptive legal (or other) arrangement is of much use, except in terms of broad principles. Customary tenure systems operate shared, overlapping forms of tenure rights in such settings as maintaining strict boundaries is usually untenable. However in highly variable environments the need

²². There are important differences between the *de facto* and *de jure* situation in many pastoral areas. For instance some areas may be effectively open access although they are nominally state property. Similarly 'privatised' areas may not be strictly so because of a poorly functioning land market.

²³. A variety of examples were presented in cases to the Woburn workshop (eg. Guèye (1993) for Senegal; Toulmin (1992) for Mali; Thébaud (1993) for Burkina Faso; and Cousins (1993) for Zimbabwe).

for conflict mediation will be fairly constant (Behnke, 1994). In such cases, a form of conflict resolution *process* can be specified in law and attached to formal institutions. Such a procedural framework would have to be designed to deal with a range of unpredictable contingencies, but would offer a flexible mechanism for dealing with disputes (Vedeld, 1994). This avoids the need to transform customary land rights into formal law.

Second, when variation is more predictable, as in the case of identifiable key resources, or when longer term trends are evident, such as expansion of arable areas into pasture lands, then more formalised measures may be taken to secure access rights and specify tenurial regulations. In such situations, policy-makers must decide on the relative social, economic and other costs of different options (eg. between the use of a particular area for agriculture or grazing) and examine these trade-offs in the broadest sense. Clearly this represents a policy decision ultimately determined by political processes; processes in which pastoralists are usually at a major disadvantage. Resolution of such issues must therefore rely on an increased policy leverage and lobbying power afforded by more effective pastoral organisations (see below).

In all cases, the development of flexible tenure regimes will require the consideration of a variety of trade-offs. These affect rights and responsibilities, access to resources and the form of user group (see Box 2).

Box 2. Trade-offs central to negotiating tenure arrangements

Rights

Communal vs private rights
Historical vs current rights
Ownership vs stewardship vs usufruct rights
Permanent vs temporary rights
Negotiable vs fixed rights
Restricted vs unconditional rights
Primary vs secondary/tertiary rights

Access

Access to all resources vs selected resource access
Free vs paid access
Seasonal access vs year-round occupation

User Groups

Exclusivity vs inclusivity
Inheritable membership vs non-inheritable
Homogeneity vs heterogeneity of resource users

Source: Working Group discussions. Rapporteur: Camilla Toulmin

Institutional development for variable environments

Most management and policy prescriptions are not attuned to flexible responses and variable environments; instead they assume equilibrium and predictability. Each of the previous sections on planning, tracking and resource tenure draw the same conclusions with regard to institutional

development. In highly variable environments it is essential to develop solutions at the local level and not attempt to impose institutional and organisational²⁴ blueprints from above. In order to deal with complexity and variability in a flexible and adaptive manner, local institutions must be strong.

This section pursues this theme with a discussion of institutional development in variable environments. Two major themes run through this discussion, both of which are central to institutional and organisational arrangements for responding to the high variability and uncertainty typically found in dryland Africa. The first theme is the need for an effective hierarchy of institutional responsibility for resource management, that stretches from the local to the national and sometimes beyond. It is not simply a choice between 'bottom-up' and 'top-down' approaches as some of the populist rhetoric would have it. Since environmental variability occurs over different spatial scales, with events occurring with different frequencies, different types of institution will be appropriate for dealing with resource management and pastoral development issues at each level. Because of the uncertain and episodic nature of environmental variability, centralised and bureaucratic state institutions are generally poorly equipped for dealing with local level management issues. Centralised bureaucracies tend to aggregate, standardise and prescribe, rather than differentiate, fine-tune and adapt. It is in these latter qualities that local institutions have a comparative advantage.

Nevertheless, wider scale institutions have important roles to fulfil. Providing a broad and enabling legal framework which offers principles and guidelines for resolving issues through local level processes is one key area. Governmental institutions may be important in resolving disputes or negotiating between parties, acting as a broker and arbitrator. Credibility, transparency, accountability and impartiality are necessary attributes currently lacking amongst government structures in many pastoral areas. Equally governments and large donor projects are best able to provide certain services in pastoral areas (roads, marketing infrastructure, basic health care facilities etc.).

The second theme concerns issues of conflict negotiation, mediation and arbitration. If institutional responses are to be flexible, there are always going to be points of contest where different parties disagree. The previous section's discussion of flexible tenure systems has already highlighted this. Effective tenure systems that allow mobility and flexible response to contingent events must be firmly rooted in institutional arrangements that allow for the negotiation of resource access and resolution of conflicts. The focus on flexibility and mobility switches attention from 'ideal' tenure types that may be prescribed (private, communal etc.) to dealing with overlapping rights with greater or lesser exclusivity. As resource rights vary in space and time and between different groups of people, this requires a shift of focus to conflict resolution mechanisms and institutional approaches for dealing with these.

Four principles for institutional development in highly variable, unpredictable environments can be drawn from the discussion:

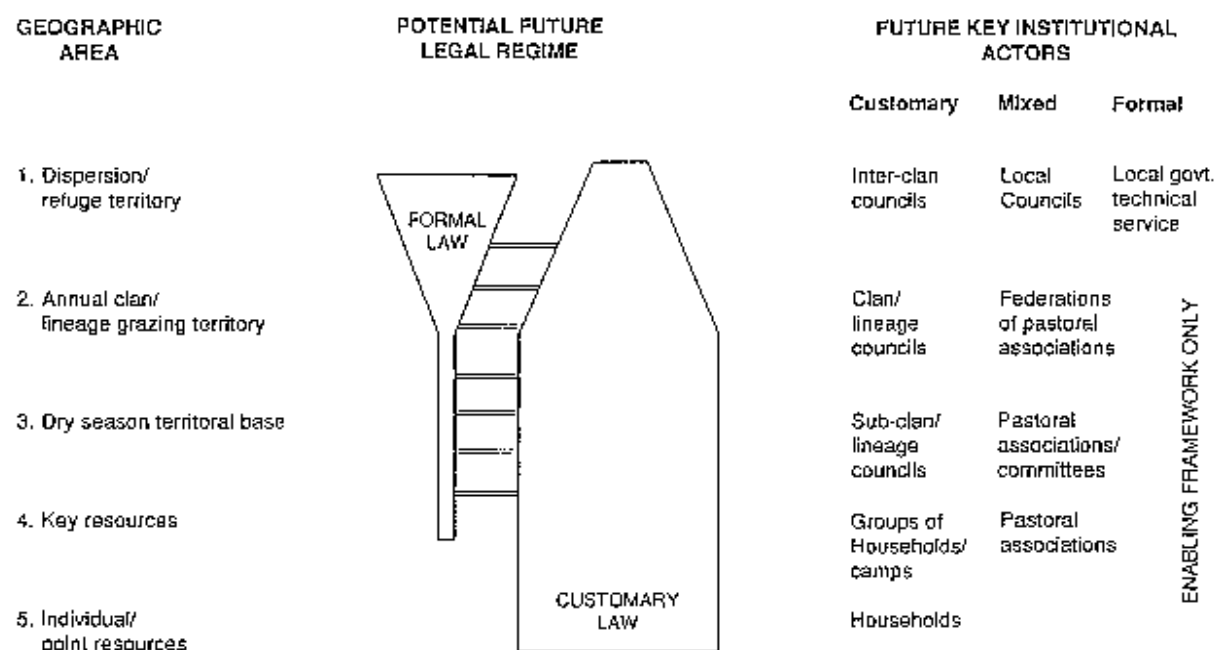
Subsidiarity. The principle of subsidiarity can be a guiding concept in thinking about institutional development and administration in pastoral areas (Swift, 1994). Subsidiarity implies that decentralisation of power and responsibility should be devolved to the lowest institutional level consistent with the provision of services and maintaining accountability.

In practice this implies a shift in responsibilities away from attempts at extensive state provision in pastoral areas to decentralised, local control. Figure 2 (from Swift, 1994) offers a schematic outline of how the roles of higher and lower level organisations might complement each other with respect

²⁴ An institution is a complex of norms and behaviours that persist over time by serving some socially valued purpose, while an organisation is a structure of recognised and accepted roles (Uphoff, 1986:8-9).

to legal issues and technical service support if the principle of subsidiarity was followed in pastoral areas. Rather than the state attempting to provide legal frameworks down to the lowest level, the state would offer a broad framework and require local groups to negotiate access rights and resource management agreements among themselves, while maintaining certain responsibilities for adjudication and arbitration. Similarly in the area of service provision, state support for veterinary health care or range management would be limited to basic infrastructural support with other elements being locally managed²⁵.

Figure 2. The Swift 'bottle and glass' model of pastoral administration.



²⁵. The debate on decentralisation and subsidiarity does not derive solely from the need to respond flexibly to variable environments. However the ecological argument provides another angle to the argument for increased attention to local level management issues derived from debates about participatory development (Chambers, 1993), state-civil society relations and democratisation (Clark, 1991) and the retreat of state service provision under liberalisation and structural adjustment (Mosely, 1991; Mosely and Weeks, 1993; Woodward, 1993).

Building bridges between customary systems and formal law. Another principle that emerges is the need to build bridges between customary systems (both *de jure* and *de facto*) and formal law. Formal legal systems, often anachronistic inheritances from the colonial era, often run counter to customary arrangements. The result is major conflict between state led intervention and pastoral populations, particularly surrounding access to land. If this is to be resolved, investment in building bridges between the two systems will be enormously important (Swift, 1994). Without this, emergent pastoral organisations at the local level will find it very difficult to operate, especially when such local level organisations come into conflict with the state.

Pastoral institution building must recognise diverse interests. Building pastoral institutions is not an easy task. Too often an idealised notion of 'community' is imposed on pastoral societies. In fact, pastoral groups are highly differentiated, and increasingly so. There are often a wide range of diverse interests within groups, including women, men, richer herd owners, poorer people, those who are temporary migrants, absentee herd owners and so on. Some groups are more visible and vocal than others. Each group may have different options for responding to environmental uncertainty, and therefore require different things from a pastoral organisation. For instance, large herd owners may be able to split herds and carry out complex forms of transhumance, while poorer herders may be unable to respond through mobility and may need 'safety net' support in order to avoid their animals being wiped out in drought. The differentiated nature of pastoral society requires a slow and patient institution building process, and a recognition of different types of groups appropriate for different tasks. For instance, permanent pastoral organisations may be formed around regular and common tasks or needs that are widely felt, while *ad hoc* organisations may be more appropriate for dealing with episodic events (eg. negotiating resource access during drought) or with sectoral interests (eg. product processing carried out by women) (Sylla, 1994).

Conflicts should be addressed explicitly, not ignored. Conflicting interests are an inevitable consequence of dealing with complex resource management and development issues involving a diverse range of highly differentiated actors. Visible and expressed conflicts can be tackled through an early initiation of 'round-table' discussions and consultation with different actors to explore conflicting interests, the establishment of procedural legal frameworks for resolving conflicts when they arise and formalised institutional settings for conflict negotiation, arbitration and resolution.

Pastoral institutions should start small and help forge collective interests. The experience of pastoral institution building in all parts of Africa suggests that starting small and forging collective action around sets of common interests (eg. marketing, health care) is the most likely route to successful organisational development. Attempting to deal with complex issues at the start, such as range management or resource tenure, usually results in failure (Sylla, 1994). It is best to start small, working from existing organisational arrangements and build up from there (Esman and Uphoff, 1984; Perrier, 1994).

Lobbying for pastoral interests at national and international levels is an important role for pastoral organisations. A variety of changes in policy for pastoral areas are required if the practical implications of the 'new' thinking in range ecology are to be realised on the ground. Such policy changes (eg. in respect of resource rights) will not come easily. Pastoral groups are politically marginalised in most African countries and access to the political decision-making process is limited. However federations of smaller pastoral associations may be able to make pastoral interests heard at a national level through lobbying and advocacy, exploring the definition of rights through the legal system and through linkages and alliances in international arenas. The experience of forming such federations is so far limited, but there is a growing experience in Central African Republic, Mauritania, Burkina Faso and Senegal (de Haan, 1991; Vedeld, 1994; Zeidane, 1993). Successes in

other areas, such as associations of wildlife producing districts in Zimbabwe (Zimbabwe Trust, 1991) or farmer organisations in many parts of the world (Uphoff, 1992b; Bebbington, 1991) suggest that the shift from the local level to political change at the national level is probably the only effective route to long term policy change.

Extension support needs to shift from technical provision to institution building. Conventional extension at the local level has concentrated on technical advice on range management and animal health. While this is still needed, there is perhaps a more pressing need, that most fieldworkers (both state and NGO) are ill-equipped to supply - support to institutional development. Skills required of 'institutional organisers' (cf. Uphoff, 1992) as organisational facilitators, development catalysts, brokers of information and conflict mediators are not part of the 'normal professionalism' of most rural development workers (Korten, 1980; Chambers, 1993). Investment in retraining for such challenges is a key task for the future.

New roles for different actors: projects, programmes and investments in the pastoral sector

Pastoral development is plagued by an "equilibrium of low expectations" (Uphoff, 1992b: 359). What are the conditions of breaking away from this, making things happen and exploring possibilities, rather than accepting the probability of failure?

Rural development 'successes' appear to rely on a good fit between the needs of beneficiaries, the organisational competence for decision-making and implementation at the local level and the programme's outputs and requirements (Korten, 1980). Achieving such a fit must be high on the agenda of programmes in pastoral areas. This requires attention be paid to the context and the relationship between the project and the supposed beneficiaries. In addition, attention needs to be paid to the building of local capacity to diagnose and solve problems through institutions that are able to sustain activities (Korten, 1980; Uphoff, 1992a; Chambers, 1983).

Researchers, planners and administrators must interact closely if learning is to be encouraged. An action-oriented implementation, monitoring and assessment approach is central to adaptive management. This must be done in close contact with people on the ground, preferably with most tasks being carried out by them. Uncertainty, error and conflict must also be embraced in a learning process approach. Optimal intervention may be very limited where resource productivity is low, as in most dry rangelands. The costs of planning, administration and management must therefore be kept low, avoiding the tendencies for over-collection of data, excessive precision and zealous intrusion from outside (Behnke, 1994).

Donors and other development agencies are increasingly adopting the rhetoric of participation and flexible, open-ended planning approaches. However the establishment of effective adaptive management in practice is more elusive than the rhetoric suggests. There remain fundamental contradictions between declared purpose and actual procedures due to the reluctance to abandon rigid planning frames, commitments to strict procedures, the need to disburse money according to target deadlines, and the desire to see quick returns from capital investment, rather than long-term returns from human capacity building. As a result very few large development agencies can legitimately claim to have effectively evolved an adaptive planning approach.

This is an important lesson in itself. Maybe large development agencies are structurally incapable of being open-ended, flexible and able to learn adaptively. They do, nevertheless, have an important role to play through taking the lead in policy analysis and institutional development at a national level, funding of capital development projects and supporting intermediary organisations working with local

groups. Large development bureaucracies in pastoral areas should probably concentrate on simple, capital investments (roads, marketing facilities, basic infrastructure), while state agencies provide a certain number of regulatory, assurance functions (provision of legal frameworks, adjudication of disputes, securing of land access rights etc.). Pastoral institutions, perhaps supported by intermediary NGOs, are better suited to carry out local level adaptive planning and management, although they may need support for policy-level initiatives (Hogg, 1992). Intermediary organisations (federations of pastoral groups or other NGOs) may then act to channel funds and provide support for local level action (Farrington and Bebbington, 1994; Pretty and Chambers, 1993; Wellard and Copestake, 1993). Some principles for project or programme design in pastoral areas are outlined in Box 3.

Box 3. Some principles for project and programme design in uncertain environments

- Long time frames are needed for iterative planning with the involvement of pastoralists. Successful planning and intervention may take 15 years or more.
- Start small and build up, focusing on institutional capacity at a local level.
- Resist unrealistic disbursement targets.
- Projects are learning experiments: change course if necessary. Do not get stuck with out-dated or irrelevant project plans.
- Learn from experience, especially occasional episodic events. Monitoring and evaluation mechanisms need to be geared to the rhythm of learning in variable environments.
- Institutional and organisational flexibility are important to allow responses to unexpected events. Bureaucratic project structures and procedures will stifle innovation.
- A diversity of different organisations may be appropriate to tackle complex challenges found in pastoral areas. Pastoral organisations, service NGOs, producers' federations, government all may have roles. Do not get stuck with one organisational model.
- Local level development will be affected by macro-level policy. Tackling these wider issues through support to legal cases, policy advocacy and lobbying is directly relevant to local level pastoral development.

Sources: Workshop discussions

Conclusion: new directions for pastoral development in Africa

The new thinking in range ecology suggests a redirection of investment in the pastoral sector. The large livestock projects initiated in Africa during the 1970s and whose offspring are still highly influential both among national planners and donors were characterised by five elements (Sandford, 1983; workshop). These included: boreholes and water points, veterinary support, technical range management, ranches, abattoirs and market infrastructure. How would this suite of investments change if the implications of the new thinking in range ecology were taken seriously?

Table 2 (below) offers a summary of some of the issues highlighted by previous sections of this paper, contrasting 'old' with 'new' thinking. Obviously such simple contrasts over-simplify; very often the 'new' is not so new and the 'old' is quite rare. However the aim is to capture the essence of the debate, rather than the detailed nuances, and to stimulate some reflection on the practical implications for development projects, programmes and investments.

Table 2. Comparison between the 'old' and the 'new' thinking about pastoral development

Area	'Old' thinking	'New' thinking
Objectives	Focus on commodity production: livestock development	Focus on livelihoods: pastoral development
Range management	Open range improvement (legumes, fodder trees, rotations)	Focus on key resources: improvement, rehabilitation, creation
	Paddocking and restrictive movement: fences	Mobility and flexibility: no fences
Planning	Blueprint development planning	Flexible, adaptive planning, with local involvement and a recognition of uncertainty
Drought	'Normal' year development and drought relief separated	Drought 'proofing' and safety net provision integrated
	Focus on production issues in 'normal' years	Focus on tracking: de/restocking, supplementary feeding etc.
Tenure	Fixed tenure regimes: privatisation (or exclusive communal)	Flexible tenure: complex mix of overlapping and integrated regimes
	Conflict issues largely ignored	Focus on conflict negotiation, mediation and arbitration
Institutions and administration	Service delivery package through centralised extension services	Pastoral organisations for local management issues
	Extension worker for technical delivery	Extension workers as 'institutional organisers'

Source: Workshop discussions

Seven major shifts in pastoral development strategies are suggested by this analysis²⁶. These are:

- In highly dynamic, non-equilibrium environments land degradation is not the major issue it was once assumed. Therefore boreholes and water points should continue to be a priority in areas where water is a limiting factor. The cost of bare 'sacrifice' zones immediately surrounding each borehole is usually far outweighed by the benefits of more efficient fodder use and higher livestock populations (Hanan et al, 1991)²⁷. However, changes in resource access following borehole investment remains a concern (cf. White, 1992 for the Botswana case).
- Maintaining the size and health of animal populations through investment in veterinary care also remains a priority. High populations do not necessarily impose long-term environmental damage, and healthy animals are able to track environmental variations more effectively. Conventional veterinary support, through vaccination campaigns, needs to be complemented by decentralised animal health services and the indigenous knowledge of herders themselves.
- Conventional range management in dry areas is of limited value. Technical support should be focused on particular niches where productivity returns are most likely. Investment in the improvement or creation of key resource patches, for instance, deserves attention from technical experts. Breeding programmes using exotic breeds should be abandoned in favour of improving the physiological tracking capacity of indigenous breeds.
- So-called 'traditional' pastoral systems have higher returns than ranches under comparable conditions (see Table 1). The ranch model for livestock development in dryland Africa therefore should be abandoned in favour of support for existing systems.
- To make systems more flexible, pastoral institutions will have to be particularly strong. Greater emphasis needs to be paid to institutional capacity building. 'Institutional organisers' working with local pastoral associations provide opportunities for supporting the development of local institutions. This will require major retraining of field-based extension staff.
- Investment in marketing and infrastructure still has a role. The need to secure livelihoods through cash sales of animals remains an imperative in pastoral areas. Good access to market facilities and information permits more effective tracking. Investments should focus on improving tracking abilities in order to sustain pastoral economies, rather than simply focusing on red meat production. Instead of investment in large abattoirs or freezing facilities, investment in basic infrastructure, including roads, will remain important in pastoral areas.
- Policy analysis and reform need much greater attention. Instead of focusing on boosting meat production from pastoral areas, policies are needed to ensure the economic viability of pastoral communities and their contribution to the national economy. This means examining policy options that allow flexible planning and development, enhanced capacity for tracking, secure but flexible resource tenure systems and the development of effective and strong pastoral organisations at both local and national levels.

²⁶. From workshop discussions, in particular contributions by Stephen Sandford.

²⁷. However very high densities of boreholes in arid environments may ultimately result in a decreased resilience of the system as the patchy nature of the environment is destroyed.

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