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Redesigning for risk: tracking and buffering environmental variability in Africa's rangelands

"Arid and semi-arid lands cover about one-third of the earth's land surface, but nearly two-thirds of the African continent. The majority of African livestock and possibly 30 million livestock-dependent people reside in these dry zones along with the greatest and most diverse concentrations of large wild mammals in existence" (Ellis, 1994). Of the world's 20 poorest countries, many are situated here. Considerations of economic importance, environmental interest, geographical extent and human welfare suggest that African rangelands should be high on the development agenda. They are not. This paper discusses some of the reasons for neglect, and proposes some remedies.

By Roy Behnke and Carol Kerven

Throughout the 1960s and 1970s there was a blueprint for African range and livestock development projects: the ranching model. By the early 1980s poor project performance had undermined confidence in this model. There ensued a decade of experimentation involving large donors (the World Bank's pastoral associations) and small (NGO work on water harvesting, restocking and para-vets), extensive field research (including the pastoral systems studies conducted by the International Livestock Centre for Africa), and theoretical retooling (notably in scientific ecology). Much of this work was innovative and practical. But it did not provide a framework for assembling new research ideas and intervention techniques into a more adequate policy for rangeland development. This, we will argue here, is now possible.

The 'ranching model' projects of the 1960s and 1970s presumed that enlightened resource management was both intrinsically good and likely to pay economic dividends. For rangelands, economics and conservation were linked by the presumption of pastoral overstocking. Overstocking explained why Africa pastures were degraded, herd output was low, and pastoralists were poor. The problem with the ranching projects was that they could not deliver lower stocking rates.

Whatever their other successes, the development initiatives of the 1980s suggested few new techniques for adjusting livestock numbers to forage supply on Africa's open rangelands. Recent advances in scientific ecology and pastoral studies also have not 'solved' the overstocking problem by suggesting more effective ways to eliminate surplus animals. They have, however, encouraged us to reframe the problem by compare project designs of the 1970s with those proposed for the 1990s. This has revealed both remarkable continuities and important changes in pastoral and range development projects from 1960 to the present.

Overall objectives

Both the former 'ranching' projects and those now proposed share an important characteristic: They are attempts at natural resource management. In this respect both the very old and the very new project formats are distinct from most pastoral development efforts of the 1980s. The typical projects of the 1980s sought to provide services, ameliorate welfare problems, improve pastoral incomes, or develop pastoral community organisations, but had little success in accounting for how these activities contributed to sustainable resource management. This linkage between economic development and environmental management is reasserted in **Table 2**.

But there are also fundamental differences between the objectives of range resource management in the 1960-70s and in the 1990s. These changes are signalled by the abandonment of the earlier goal of 'rangeland conservation' in **Table 1** and the substitution of 'sustainable rangeland production' in **Table 2**.

For rangeland managers of the 1960s and 1970s, domesticated livestock were an intrusive element that destabilised -natural' botanical systems. The notion that domesticated herbivores were a foreign intrusion had considerable intuitive appeal in North America and Australia, where European-owned stock had suddenly burst upon the scene, where the natural 'before' and the disturbed 'after' were clearly demarcated over historical time, and where the requirements of industrialised agriculture confronted a nostalgia for a bygone landscape. In this setting, concepts of plant community succession and climax provided a powerful theoretical rationale for the conservation of pristine rangeland flora. Conceived in these terms, traditional range management was fundamentally 'botano-centric'. It was the state of the vegetation that marked the success or failure of a management regime, with botanical indices (measures of plant population, vegetative mass and species composition) providing evidence of range trend, condition and livestock carrying capacity.

Despite its enduring popularity, this method of rangeland assessment suffered in Africa from several limitations. Here the distinction between natural and manmade rangeland vegetation posed both philosophical problems and operational ambiguities. Humans, their fires, and domesticated herbivores contributed to creating some of Africa's most productive and picturesque savanna landscapes. Parts of North Africa, on the other hand, are undoubtedly degraded by human use, but have been so since Graeco-Roman times.

One might also question the use of predominately botanical indices to assess the performance of a form of agriculture in which plants are not directly used or consumed by humans. If profits are to be made, rangeland vegetation must be eaten

by animals. In areas where rainfall is reasonably constant, large livestock populations may indeed consume enough vegetation to alter the plant life that they leave behind. Range livestock production - like most forms of agriculture - may alter the natural vegetation to produce food, fibre and other products suitable for human use.

These botanical changes are not proof of degradation, unless agriculture is equated with degradation and no distinction is made between agricultural systems that can produce for prolonged periods and those that cannot. For agriculturalists, the conservation of pristine vegetation is of less concern than the expected length of time that output can be maintained from altered vegetative states under different management regimes. In short, the objective of botanical immutability is less useful than a workable notion of sustainability. These concerns are expressed in the top row of **Table 2**, in which indicators of project achievement are stated as the maintenance of livestock product output over an extended time.

Project purpose

Both the old and new kinds of projects share a common purpose - to increase producers - incomes from livestock. What distinguishes the new type of project from its predecessors is the way in which livestock income is defined and measured, a more significant change than one would, at first, suspect.

In the older ranching projects, livestock income was effectively defined as the cash income from sales of animals for slaughter. This definition presumed that pastoral development was a matter of technology transfer. Most industrial ranchers supported themselves by marketing carcasses, and it was assumed that modern African pastoralists should do the same. This reasoning was an important link in the logical structure, and hence the appeal, of the ranching project. These schemes assumed that animal sales had three beneficial functions - increasing pastoral incomes, destocking and conserving rangelands, and supplying urban consumers with an essential commodity (see the 'assumptions' column of **Table 1**). There were no uncomfortable trade-offs; everybody was a winner.

In the last decade, applied research on pastoral economies has explained why this scenario was over optimistic. The explanation hinges on the volume and the kinds of produce yielded by pastoral herds. Contrary to the assumptions of the ranching projects, traditionally managed livestock often provided their owners with cash and in kind benefits in excess of those which could be derived from additional animal sales - unless meat prices increased. If urban consumers were to eat more meat, they had to pay prices high enough to bid against the alternate uses of livestock - in rural trade networks, for immediate household consumption, as inputs into other productive processes, or for breeding/growing out. Studies of herd structures also suggested that urban consumers (or pastoral cooking pots) were already claiming those categories of animals suitable for slaughter and having few other competing uses. There was, in other words, no vast, underexploited reservoir of meat standing around on the ranges chewing its cud. Finally, comparative studies showed that pastoral productivity consistently equalled and frequently exceeded the caloric, protein, or ascribed cash value of output per unit land area from ranches in comparable ecological circumstances. Rational pastoralists therefore took their place beside rational peasants in the academic and development literature of the 1980s. But the 'great leap forward'

in pastoral output and income never materialised; it had been based on an illusion all along.

There remains, nonetheless, scope for genuinely improving pastoral incomes and output through the increased commercialisation of pastoral systems of production, product disposal and household provisioning. Increasing pastoral incomes will therefore remain the purpose of the new generation of projects proposed here. The opportunity for these improvements is created by the differential between the caloric and cash terms of trade for livestock products and grain. With certain important exceptions, prices for grain, meat and milk are such that pastoralists obtain more calories by selling livestock produce and buying grain, than they could obtain by directly consuming the protein-rich products of their herds. For poor pastoralists this means a chance at survival, despite reduced per capita herd wealth; for the rich, favourable terms of trade provide an opportunity to improve their standard of living, or to invest surplus earnings back into pastoral production.

Commercial investment in pastoralism is required since traditional production systems are well adapted to the exigencies of their natural environment, and output levels per hectare are already high. Consequently, increased output is dependent upon the use of new industrial inputs. If producers are to obtain the cash to purchase these inputs, then commercial livestock production is unavoidable.

It is not only unavoidable; it is happening. Field research over the last decade has revealed that small-scale commercial innovations are continuously undertaken in most pastoral economies. These spontaneous changes are the exact opposite of the carefully engineered leaps envisaged in the ranching model. The more modest pastoral development efforts of the 1980s also successfully promoted incremental changes, a point to which we will return in the discussion of project activities.

Results

The maintenance of a constant, low stocking rate was the primary intended result of the ranching project. In hindsight, however, there existed little scientific evidence that destocking programmes could either fulfil their environmental objectives (expressed in the top row of **Table 1**) or increase total livestock output (as promised in the second row of **Table 1**). As it turned out, lower stocking densities could actually damage pastoral incomes.

Stocking rates low enough to ensure that forage shortfalls never occurred would be uneconomic to maintain in very dry environments with extreme fluctuations in rainfall. Economically optimal stocking densities also vary according to the kinds of products yielded by herds, the breeds and species kept, and the husbandry techniques employed. Pastoral stocking densities may be too high to maximise beef production per hectare, or too high to meet the botanical standards of professional observers trained in a ranching environment. These densities may, nonetheless, maximise the combined output of live-animal products such as milk, traction power, manure and animal fibre. Destocking these putatively 'overstocked' rangelands would likely depress both individual and aggregate pastoral incomes, which probably explains the near-universal rejection by pastoralists of enforced destocking programmes.

The environmental benefits of conservative stocking regimes are as dubious as their purported economic benefits. In climatically unstable environments, irreversible changes in plant life occur episodically, not incrementally. Moreover, the dominant variables that drive these ecological changes are physical factors - such as rainfall - which lie outside management control. In these 'event dominated' ecological systems, it is unrealistic for managers to try to forestall environmental change by tinkering with a single, dependent biological variable such as livestock numbers. Managers who cannot control their environment must, on the other hand, quickly adapt to it, if they are to minimise the environmental consequences of unpredictable rainfall fluctuations. This 'opportunistic' approach to rangeland exploitation demands temporary, but sudden and very substantial, adjustments in livestock feed demand in response to precipitous changes in feed supply (**Table 2**, third row down).

If producers are to adopt them, flexible strategies of resource exploitation must be profitable as well as environmentally beneficial. This requirement is reflected in **Table 2** in which environmental concerns dominate project 'objectives' but economic concerns define the project's 'purpose.' In practice, these dual intentions require both biological and economic indices of project success - the tracking and buffering of environmental fluctuations cited in the third row of **Table 2**. 'Tracking' refers to a biological phenomenon - the prompt realignment of livestock forage demands with fluctuating levels of primary production. The buffering of environmental fluctuations refers, on the other hand, to an economic phenomenon - the shielding of pastoral incomes from the worst effects of the climatological and biological roller-coaster.

Quantifiable measures of project success are different for biological tracking and economic buffering. Parallel changes in livestock feed requirements and feed supply provide evidence of successful biological tracking. Economic buffering, on the other hand, dampens the effects of environmental variability, by maintaining livestock-generated incomes that are more stable than rainfall or primary production levels. What is required for range livestock development are activities, or combinations of activities, which simultaneously produce both these results - high coefficients of variation for feed demand and low coefficients of variation for the value of product output. This is 'opportunistic' rangeland management - the attempt to maintain large, healthy and productive herds but, when conditions dictate, remove as many animals as necessary, doing so as quickly and profitably as possible.

Activities

Opportunistic resource management is not new to African pastoralists. Official endorsement of opportunism does not, therefore, demand the radical reform of existing husbandry systems. Rather, it brings government and donor management objectives into line with customary practices, anticipates evolutionary rather than sudden economic change and, belatedly, adds pastoral development to the growing list of participatory or client-oriented forms of development. Responsible project design must, however, balance local and national interests, and match community priorities with larger policy concerns. Environmental tracking and economic buffering are among these concerns, and provide criteria for screening local initiatives.

Over the past decade, field workers, often with NGOs, have developed many new techniques for delivering services to pastoralists. These include improved systems for primary animal health care, for water harvesting and storage, for the design of drought/famine early warning systems, and for post-drought restocking. Any range livestock development initiative already has a core of tested field techniques to draw upon, reject or modify in light of local circumstances and the policy framework summarised in **Table 2**.

There is also scope for amending existing project methods. The project components that urgently require revision are those that are expected to perform new functions in a regime of opportunistic management. In the older project framework, drought was an emergency - an unexpected, catastrophic event outside the parameters of normal planning. Within the present framework, erratic rainfall, i.e. drought of varying severity, is viewed as a continual hazard. Incorporating drought back into our notions of normal climatic variability demands a rethinking of how pastoral relief and development is to be achieved.

Famine relief: In droughts, stress sales force many animals to market, driving livestock prices down at a time when poor harvests and grain scarcities are inflating cereal prices. If market forces set food prices under these adverse conditions, some pastoralists may starve unless they receive relief provisions. Development agents are thereby confronted with an apparent dilemma. Either they let human and animal populations 'track' environmental fluctuations, and people suffer, or they 'buffer' pastoral incomes from environmental stress, but foster dependency.

A more attractive approach to relief provisioning would attempt to maintain high levels of grain availability through normal commercial channels. This could be achieved by bulk sales of relief supplies at concessionary prices, with hoarding and speculation controlled by adjusting the volume of external supply relative to the strength of internal demand. To estimate these supply-demand factors it would be necessary to maintain drought early-warning systems to provide information on the geographical extent and severity of a crisis. Influencing supply-demand factors would require adequate transport infrastructures, and, possibly, transport subsidies to insure that the food moved in the desired direction. Consistent with the project results anticipated in **Table 2**, these arrangements would promote both buffering and tracking, since pastoralists could maintain their incomes only by selling stock during droughts.

Livestock marketing: Tracking and buffering would also require improved livestock marketing systems. Previously, livestock marketing was seen by project designers as a mechanism for maintaining continuous but high offtake and low but steady stocking rates, to prevent overstocking and livestock die-offs during droughts. Ecological research suggests, however, that livestock population crashes are unavoidable when rainfall is erratic. Under these conditions, a more realistic project goal is not to design marketing systems that forestall fluctuations in marketed throughput, but to design marketing systems which can absorb such fluctuations. Low-cost techniques of meat preservation, improved transport infrastructure, access to the largest possible consumer market for meat, and the elimination of subsidised international competition may be components of this effort. Equally important may be the withdrawal of

government regulatory agencies or marketing monopolies that add to the covert costs of trading, stifle competition and depress producer prices.

Land tenure: In the past, project-managed land tenure reforms attempted to limit herd growth by confining herds to restricted areas; project managers viewed permeable territorial boundaries as undesirable since livestock owners were thereby allowed to escape the negative effects of overstocking.

Opportunistic strategies of resource exploitation stand this reasoning on its head. Forage shortfalls are often localised, because of the erratic distribution rather than the total absence of rain. If adjacent grazing areas experience asynchronous productivity flushes and crashes, herd mobility, and the nonexclusive tenure arrangements that permit mobility, are a cost-effective way for animals to walk away from temporary, local imbalances in stock numbers and feed supply. The practical question for project design is, therefore, not how to eliminate nonexclusive tenure systems, but how to ensure that pastoralists can take advantage of them.

Rangeland resources must be co-managed by local communities and government authorities. Government cannot intensively administer rangelands, because their output is generally low, erratic, and insufficient to pay the costs of direct administration. The only economic solution is for users to bear the costs of resource management, which they will be willing and capable of doing only if they have proprietary rights. However, in pastoral areas administrators cannot expect to allocate resources once and for all, and then walk away from the problem. These are environments in which rainfall and forage productivity are fleeting resources, and human and livestock populations must rearrange themselves in space on a seasonal and inter-annual basis. In conferring basic property rights on producers and local communities, impartial intercession will still be required to sort out the conflicting, shifting and multiple entitlements implied by these rights. To do this, local government authorities must establish their neutrality, institute procedures for conflict resolution, and enforce their decisions.

Cultivated forage: Forage development programmes have concentrated in the past on improving yields from cultivated fodders. Opportunistic management would de-emphasise the search for yield increases, and concentrate on the production of forage when it was most needed in low rainfall years. Measures of success would be indicated by cultivated fodder yields which were less variable than yields from surrounding natural vegetation, and improved profits from livestock keeping as a result of a more stable feed supply.

Conclusion

A review of existing research has produced recommendations for project activity in the areas discussed above (Scoones, 1994). Field research on problems of opportunistic management would, undoubtedly, produce more precise recommendations or increase our confidence in those already proposed.

In the short term we are left with a mixed picture. Some activities - paraveterinary programmes, water harvesting techniques and famine early warning systems, for example - are ready for use on a wider scale. Other potential project components - famine relief, land tenure, livestock marketing and fodder production - still need

research and field experimentation, but are likely over the long term to improve the tracking and buffering of environmental variability in Africa's rangelands.

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Further Reading

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