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Management Interventions: Are They Feasible in Arid Zone Livestock Production Systems?

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Abstract: Management interventions in arid zone livestock production systems have generally failed to provide long term improvement in sustainability. The reasons for this are discussed. The differences between livestock production systems and rangeland development are also discussed and the management implications elaborated. The importance of a participatory approach to improvement of livestock-based systems in the arid zone is emphasized. This paper reviews the recent history of pastoral production systems and considers the prospects for successful management interventions in the light of the constraints under which they operate and the effect of the shift, in almost all of the world's pastoral regions, to a cash or market economy. By drawing on the mistakes of the past and putting technology in the context of people's real needs, our thinking is on track to produce some really effective solutions.

Key words: Livestock production systems, rangelands, pastoral development.

The arid regions of the world are characterized by short growing seasons, recurrent drought and great variability both within and between seasons. They are too dry or unreliable for cropping (Table 1). Livestock grazing allows the harvesting of the forage and the water and its conversion to useful products, food and fiber. As such, it represents an important activity for pastoral people the world over. Livestock production systems have been devised by various groups in each climatic zone. Many of these rely on traditional knowledge and an intimate relationship between the herder and the herd. In the face of burgeoning populations and a greater demand for meat, milk and other animal products there is pressure to increase productivity and output from arid rangelands.

This paper reviews the recent history of pastoral production systems and considers the prospects for successful management interventions in the light of the constraints under which they operate and the effect of the shift, in almost all of the world's pastoral regions, to a cash or market economy.

The difference between livestock production and pastoral development is also discussed and the implications elaborated.

Livestock Production versus Pastoral Development

There has been a general and continued misconception about livestock production and pastoral development when it comes to management intervention in the arid pastoral zone. The confusion in the termi-

Table 1. Classification of arid zone regions for the purpose of estimating pastoral land areas

	Growing period (days)	Annual rainfall* (mm)	Land Use
Arid land/deserts	0-74	0-250	Nomadic grazing
Semi-arid land/rangelands	75-119	250-400	Semi-nomadic settlements; marginal for agriculture
Sub-humid	>120	>400	Settled agriculture

*In the tropical areas these upper limits will be higher because the rainy season is in summer and rainfall effectiveness is lower.

nologies, that has since translated into policy formulation and project implementation, especially in Africa, originated from the concept of commercial livestock production as practiced in temperate ranching operations.

Livestock production is first and foremost geared towards the improvement of livestock and livestock products and their availability for market consumption. Livestock production is characterized by the establishment of production units complete with:

- disease control,
- water development,
- extension and marketing services in pastoral areas to supply the larger domestic economy,
- the encouragement of pastoral communities to sell off immature stock for fattening in the wetter parts of the country,
- the strengthening of and support to livestock marketing services such as purchasing, quarantining and transportation of immatures produced in rangeland areas, and
- the increase in off take through establishment of companies, cooperatives and group ranches.

Livestock production programs, as advocated by conventional range management and implemented in the past, were bound to fail, primarily due to the narrow technical approaches which neglected the social, cultural and ecological peculiarities of arid zone livestock systems (Squires *et al.*, 1992). They focused narrowly on animals and rangelands in isolation rather than as part of a larger system of herders, people and institutions (Swift, 1988; de Haan, 1990). Their basic shortcoming was the inability to take into account the complexities and development potentials and constraints of traditional pastoral organizations and production systems.

Pastoral development, by contrast, addresses this larger framework. It involves, in addition to livestock production, the recognition and genuine support of a pastoral entity within a wider national development program. Pastoral management involves people; sustainable pastoral development involves the empowerment of people. As such, pastoral development integrates the anthropological aspects, cultural and sociological beliefs and practices of the peo-

ple into a comprehensive management plan. Pastoral production systems should be first recognized as ecosystems in which there is a strong interdependence among humans, livestock and land resources.

Livestock Production is an Activity on Residual Lands

Unlike agricultural systems in the wetter regions, pastoral systems are characterized by a true collaboration with nature rather than a control over nature. Heathcote (1983) has shown that livestock raising lies at the outer end of the economic rent ($ per ha) spectrum, i.e., where the return per ha is lowest (Fig. 1). Within this livestock raising sub-spectrum, commercial ranching more commonly occurs in the moister, more reliable part. Semi-nomadic, transhumant and other more traditional systems, based on migration of livestock and the people who depend on them, occur at the extreme end of this economic rent spectrum, in

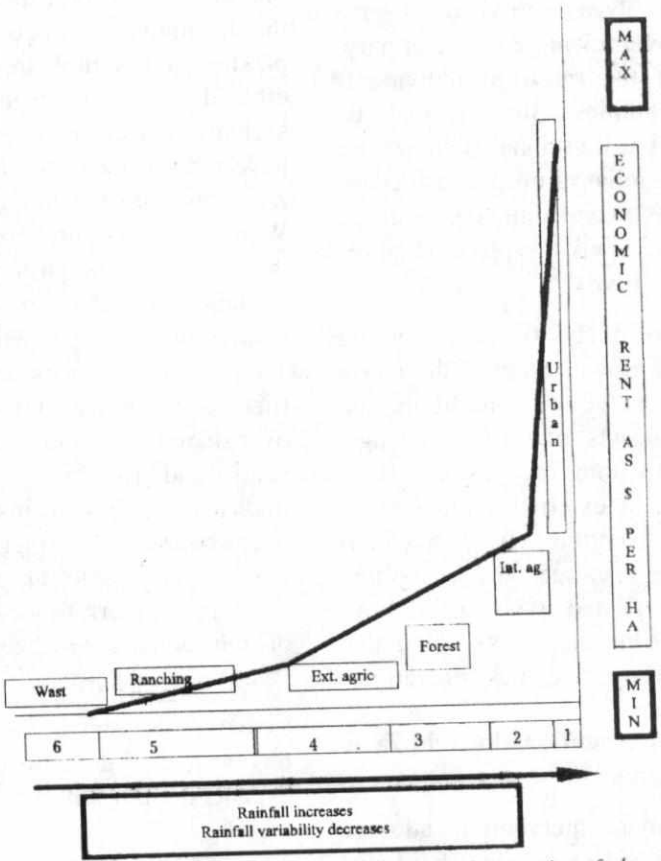

Fig. 1. Rangeland livestock production occurs principally on the margins of deserts and wastelands where economic rent ($ ha^{-1}) is low and rainfall is sparse and highly variable (After Heathcote, 1983, redrawn)
Key to zones: Urban/industrial, Intensive agriculture, Forest, Extensive Dryland agriculture, Ranching, Wasteland/desert.

the most marginal country (see also Squires and Sidahmed, 1997).

Many of the problems facing livestock producers are common to groups at both ends of the spectrum, but it is useful to distinguish between those systems which are essentially traditional with a high degree of reliance on subsistence and those where there is a dependence on a favorable return on capital invested. The reason for this is that management interventions, apart from application of traditional technologies by the herders themselves or provision of services by the government, e.g., veterinary, may be out of the reach of individuals or pastoralist families. But this may be changing; even the traditional societies are moving to more reliance on the cash economy (Blench, 1998) and some convergence of the systems is taking place (Squires and Sidahmed, 1998).

The future is likely to see increasing emphasis on the globalization of the world economy, the breakdown of tradition, and the potential impacts of climate change. Pressures from within the pastoral communities and from external sources (e.g., International conventions), will see conservation of the resource base (including biodiversity issues), and assume greater importance. In some instances this will impinge negatively on range/livestock operations.

Management Interventions in Arid Zone Livestock Systems

The management interventions adopted may be those aimed at reducing herd size while maintaining output of animal product, or producing better quality products at lower prices or indeed implementing land rehabilitation measures at the behest of governments, or in order for the livestock production to stay viable.

Viewed from a political, social and economic angle, major constraints to pastoral development (as defined above) are all interrelated but essentially revolve, in one form or another, around shortage of or restricted access to land and water resources.

Access to land and water, particularly in the dry season, is crucial for the sustainability of pastoral production. While pressure on pastoral land is hardly recent, the accumulated effects of decades of expanding agriculture are now being exacerbated by rapid advance of commercial agriculture such as irrigation schemes that have monopolized the more mesic grazing zones and are expanding into drier areas. Wherever year-round crops are introduced, they impinge on pastoral system by excluding livestock from grazing lands and restricting animal passage to other pastures. They are also sources of tensions and conflicts between pastoralists and cultivators over shared exploitation of land. In addition, year-round crop does not accommodate the traditional arrangements often made between herders and farmers, whereby animals graze crop stubble during the dry season, allowing farmers to benefit from a share of the organic fertilizer.

The identification of other constraints to livestock raising in the world's arid zones has been well documented. The key ones, expanded from those of Sidahmed (1992), are:

Biophysical

- climate
- other environmental factors.

Socio-political

- policy issues
- land tenure
- religion and customs
- gender issues (role of women in pastoral systems)
- economic factors
  - — trade
  - — various subsidies
  - — lack of markets
  - — lack of capital

Technical

- lack of appropriate information
- animal nutrition
- animal genetics
- inappropriate animal husbandry practices
- diseases and pests
- predation and competition

From this list, it is appropriate to highlight those which have the potential to be affected by management interventions. Many of the following can make a significant difference to success or failure of both subsistence and quasi-commercial ranching operations in the arid zone:

Technical interventions

- the location of water points (capacity and spacing, etc.)
- frequency of watering (once daily, once in three days)
- nutrition and diet supplements (non-protein nitrogen, salt and urea)
- planting of fodder trees/shrubs and provision of fodder banks
- sowing of improved pastures
- breeding (controlled mating, ratio of males/females)
- genetic improvement
- exploiting the adaptability of native breeds
- improved animal husbandry (weaning, mortality rates)
- improved grazing management
- development of drought strategy (drought feeding), policy shifts, subsidies, etc.; restocking policy
- manipulating fire frequency
- agro-pastoral integration - crop/livestock systems

Non-technical interventions

- poverty alleviation
- provision of rural credit
- improved marketing of off-take
- better technical advice (improved research and extension)
- empowerment of local people
- recognition of the role of women
- improved education for children to enhance their prospects for 'off-farm' employment

Many of these technologies have been implemented separately or in an integrated manner through some development programs in arid regions. Strategies to increase forage production and to create fodder reserves through rangeland improvement programs (seeding range species, planting fod-

der trees and shrubs in conjunction with water spreading and soil moisture conservation techniques; utilization of marginal lands for self-regenerating pastures, including fodder legumes in crop rotations) are part of land use policies in many countries. Improved land husbandry is being promoted in response to the National Action Plans to Combat Desertification and/or protect biodiversity. The role of women in livestock production systems and in stabilizing rural households and the rural economy has received much greater attention than in the past (Naimir-Fuller, 1994).

To reverse the deterioration in the vast rangeland areas, many countries have commenced programs and established projects for studying approaches and technologies required to conserve and improve this important natural resource. Information generated from the implementation of the various programs and projects indicate considerable opportunities to increase production per unit of land or livestock. Valuable experience has also been gathered on the methods to increase and to conserve the long-term productivity of the grazing lands. A suitable socio-economic framework needs to be worked out in order to scale up these project results to the wider area. This is the major stumbling block and is why the participatory approach has supplanted the more traditional methods of research and extension (Andrew and Fargher, 1998).

In an edited volume which summarizes the experience of the International Fund for Agricultural Development (IFAD) in participatory development (Lineberry, 1987) it is suggested that:

> "the increased emphasis on global structural adjustments, on the environment, and on the human dimension of development is significant, yet, if the true concern is with people, a thorough review of current conceptual approaches is in order".

It is becoming more clear that the conceptual approach, which will lead to the best outcomes, is one which sees pastoral development within the broader system context (Remenyi, 1987; Waters-Bayer and Bayer, 1995). Pastoral development works best when it begins at the household level. Direct involvement by the people is critical and self-help is the key to success. The key to any progress clearly must be implemented by the herder. The scene in many pastoral regions is one of harsh climate, scarce water and hardy livestock grazing the degraded rangelands. The central figure in the management of these resources should be the pastoralist, who is the primary user. Ideally, the pastoralist should be the key decision-maker in utilization and conservation of the land, but rapid social changes brought about during the past few decades have placed such decision making in the hands of government functionaries and large-scale livestock owners and traders.

Management Aids

The important question at this stage is "Are there any measures which are not yet available which would make a big difference to the way pastoral societies perform?". If the answer is yes, as we believe it to be, then we must first define the specific needs. This is best done by asking the right questions to the end users. All

too often researchers answer questions that no one is asking.

Pastoral societies have developed coping mechanisms that help them to survive. Increasingly, more reliance is placed on capturing this local knowledge and incorporating it into the management system. Some of this knowledge is qualitative but nonetheless, sound. Conventional models, which rely on quantitative data, find it difficult to cope with this traditional knowledge. New methods have been sought which can combine qualitative, semi-quantitative, quantitative and multi-state (yes/no) information into decision support systems (DSS). But we need more than data, we need expertise — data may be accurate but valueless. Expert systems and DSS are aids to help managers make decisions (Squires, 1998). The power of the computer now allows the synthesis of information in a way which was impossible a few years ago. But we also need to ask "how does this technology help solve the problem"?

Technological developments should supplement conventional wisdom and local knowledge. Of the whole menu of technologies developed to improve pastoral production, hardly any, other than disease control, has been adopted by the traditional pastoral communities. Participation by traditional pastoralists has been negligible in technology development or technology transfer programs. However, in Australia there has been widespread adoption of computer-based technologies to provide real time information on weather (including drought prediction), livestock markets and economic trends. Modern day ranchers can download satellite imagery, which gives information on such characteristics as the greenness index (derived from an analysis of NDVI on NOAA satellite imagery) and other information from the Internet, which can aid in their management.

Of course, technology alone does not solve problems, but a partnership between people and technology often solve them (Andrew and Fargher, 1998). Participation has undoubted advantages, but there are a number of constraints working against it as well (Alamgir, 1989).

A new paradigm for rangeland management, based on disequilibrium assumptions, has now come to the fore (Behnke *et al.*,1993; Sidahmed, 1996). It is recognized that complex social, cultural, technical and political matters interact in a quite complex way with the long term climatic variability to produce outcomes that are difficult to predict. The ability of DSS to capture and use the traditional knowledge of the local population in almost any form (hard data, qualitative information or multi-state) and combine it with data from other sources is the biggest single advantage these tools have. Decision support systems have considerable relevance to marginal pastoral lands. Efforts should be made to develop them (Stuth and Lyons, 1993).

New Technologies

Scientific research has led to new technologies that will impinge on the livestock industries, even in the arid zone. Some of these technologies may take decades to be adopted, others will find ready acceptance. Bioengineering has the potential to create advances in animal productivity, disease resistance, and adaptability. Satellite technologies for resource inventory and monitoring, and the application of computer

technologies for, among other things, drought forecasting, will make the future different from the past. But, of course, they will not be easily accessed by the small holder in the more remote regions of the arid zone, unless new advances in satellite communications makes this possible; and they will be of little use unless the information is packaged so as to fit within their pastoral development system.

Emerging Issues

The arid zone livestock producer has to cope with many changes, some rapid, some less so. The phenomenon of global climate change (including global warming and shifts in the rainfall belts) promises to have a major effect. Rising populations will see drastic land use changes with rangelands being converted to cropland, especially near the wetter margins. The implementation of the new world order and the globalization of markets, freer trade and other external forces will also impact on the arid zone producer. In fact, most of the changes will be forced from outside.

Questions related to sustainability of resources, reversing land degradation and putting into place anti-desertification measures, as agreed under the International Convention to Combat Desertification and Drought, will see many changes as each signatory country prepares its National Action Plan (NAP). The NAP will also take into account the International Biodiversity Convention and the International Convention on Climate Change.

Research Direction

Answers to questions being asked now and which will be asked in the future will require research. In the first instance, short term, problem-oriented research will be required to give answers to immediate questions. Strategic, long-term research, for example, on genetic engineering, will also be needed. A series of possible "solutions" might be offered and future scenarios devised. The key factor is to define the desired outcomes and to foreshadow the undesirable side effects. Just how will the likely outcomes be influenced by technology and by management interventions? Ironically enough, technology is a people-oriented business. Whatever the technology, it is people who implement it and adopt it, but only if it is relevant to their needs.

Extension and Technology Transfer - A New Paradigm

In the face of continuing degradation in the biophysical and the socio-cultural environments in the arid zones of the world, it is clear that there is need for a new approach to research and extension. There is an urgent need for research to be aimed at inquiry with people to complement that which is currently being conducted on them or for them. This approach must deal with complexity and change, and it must combine action with enquiry. Such research must be trans-disciplinary (rather than multi-disciplinary); it is characterized by a new relationship between the researcher, the livestock owner and others in the broader farming systems context (e.g., livestock marketers, processors).

In the traditional research and extension approach, the researcher conducted research, which was passed on by the extension agent to the herder. Adoption was mostly very low. Later, a systems approach

was advocated and more holistic approach (as opposed to a reductionist one) was used. The new paradigm for research and extension is for the "client" to be a co-researcher. The parties in this scheme are co-learners and together they seek situation improvement. In this scenario the traditional extension agent is no longer required because the client helps to define the problem and arrive at an answer.

Summary and Conclusions

Pastoralism has been essentially based on adaptations (coping strategies) to allow survival in a harsh and highly variable physical environment. Recently, pastoralism has had to face new external pressures that have threatened the viability of the traditional principles and strategies for managing natural resources.

Traditional pastoralism has undergone irreversible modifications for decades as a result of pressures from land shortages caused primarily by population growth, introduction of the cash economy and free markets, changing development priorities and directions, international cross-border restrictions, among many others.

New pressures will emerge. Some areas will have to be retired from grazing, in others, the application of new technologies and research findings will assist the livestock owner to survive. Social and economic frameworks will be developed to accommodate people's aspirations and their new attitudes to schooling of their children, and opportunities for employment outside of traditional livestock production.

The past record of failure of pastoral development in many arid regions can be attributed to attempts to apply inappropriate technologies, inappropriate or incomplete research and lack of appropriate management. In general, pastoralism, as a production system and as way of life, appears to be fighting a losing battle in many countries. This generalized crisis in pastoral development has led to the proposition of a closer linkage between traditional pastoral systems and indigenous knowledge, and modern, scientific technologies, to produce what Roling (1993) termed coupled systems comprising of hard ecosystem (e.g., range science) and soft platform for decision making about that ecosystem (i.e., pastoral organizations). By drawing on the mistakes of the past and putting technology in the context of people's real needs, our thinking is on track to produce some really effective solutions.

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