Does Sahelian Pastoral Development Include Range Management?

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The Society for Range Management conducted a symposium on international rangeland resources development during the 1985 annual meeting in Salt Lake City. In discussions with participants I often heard that we, as technical experts, had failed sociologically. We have the technology, I was told, but our Extension techniques are ineffective, and as a result, we are unable to get our technology across to the people. While this may be true in many cases, I wish to present another argument, at least for Sahelian pastoral economies: "We have failed to present economically viable technical alternatives to local herders." My analysis indicates that Sahelian peoples have not made any gross technical errors and that the problems they face are much more difficult than we have yet admitted. Range scientists must first specify production systems for the Sahel that either have higher productivities for the people that already live there or increase the human carrying capacity of the Sahel. Sociological or managerial causes for project failures should only be invoked once we are certain that the project did indeed offer such an improved production system.

The Pastoral Strategy

Pastoralism has provided a living for Sahelian peoples for centuries in the form of meat and dairy products. This production is consumed and traded for complementary food stuffs. Like other subsistence production systems, pastoralism displays considerable geographic variation and defies facile generalization. Several characteristics of pastoralism that appear to buffer the production system from environmental perturbations such as annual variation in forage production, severe droughts, epidemics, etc., are discussed below.

Mobility is perhaps the most obvious component of the pastoral strategy and is largely driven by seasonal and annual variation in forage quantity and quality (Breman et al. 1978). Rains advance to the north in the summer and produce a flush of annual forage growth that we can imagine as a spotty green wave moving north. At the leading edge of the wave forage quality is high, but behind the wave as forage growth continues its quality declines. When the rains cease 6 to 9 weeks later, small quantities of moderate quality forage remain in the north with greater amounts of very low quality forage in the south (Breman and deWit, 1983). Low-lying areas in the south provide some green regrowth later in the dry season. Local topography can modify this scheme. Water, crop residues, and markets alter the value of the forage resource to pastoralists. Mobility allows the herds and their owners to exploit these distant resources. Moreover, impaired mobility has led to disaster. Clanet (1977) found that Gorane herders in Chad who sedentarised in response to the 70's drought lost many more animals than those who maintained their mobility.

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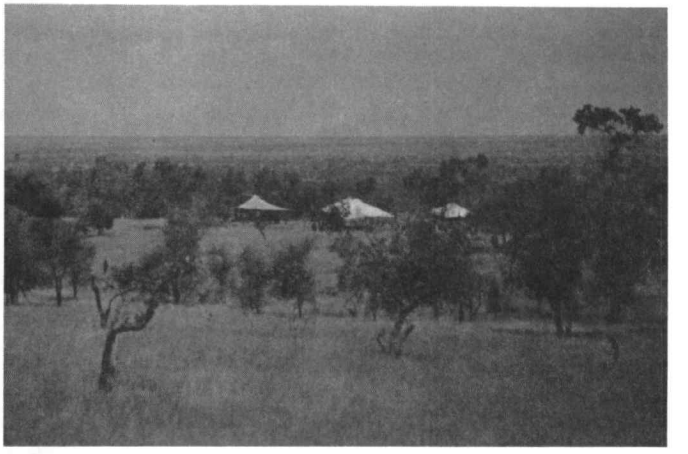


Moor tents in south-central Mauritania. Mobility is an essential component of the pastoral strategy that is increasingly difficult to maintain.

Herding several different species is another buffering mechanism. Mixed herds provide a more even production of milk over the annual cycle (Dahl and Hjort 1976). The sale of sheep and goats provides cash without compromising the reproductive capacity of the large ruminant herd. However, small ruminants are less robust than cattle or camels and are

Twareg herders with expatriate technical advisor and cattle near Abalak, Niger. Livestock populations support relatively large herder populations, providing a livelihood but reducing capital accumulation necessary for development.

therefore riskier to raise. Different species of animal have different herding and watering requirements and therefore mixed herds can increase labor demands.

Milk and animals are often traded for grain to supplement the dairy diet of the household. These market interactions lower the minimum number of animals required to support a household (Dahl and Hjort 1976).

Mbororo herder watering cattle in central Niger, West Africa.

Dahl and Hjort (1976) estimated that a minimum of 10 to 13 cattle were required to nutritionally support one adult during the yearly cycle. Traditional pastoralism had mechanisms to maintain the appropriate animal to human ratio. Pastoral population growth rates have been less than those of similar farming peoples (Swift 1977). Imbalances caused by the loss of animals or the absence of labor were corrected by an elaborate system of loans of both animals and labor from within the larger social group (Helland 1978, Hjort 1976).

Surveys show that cattle productivities are variable but low compared to Western standards, with low calving rates (60%), older ages of first calving (4 yrs.), and high calf mortality (35%) (Shapiro 1979). Production per hectare differs little from rates in similar ecological zones, but production per man-hour is quite low (Breman and deWit 1983). Internal rates of return are probably higher than any other rural investment alternative, especially for small sums of capital. Therefore, cash surpluses are often invested in animals (Horowitz 1972, Frantz 1975, Van Raay 1975, Swift 1979).

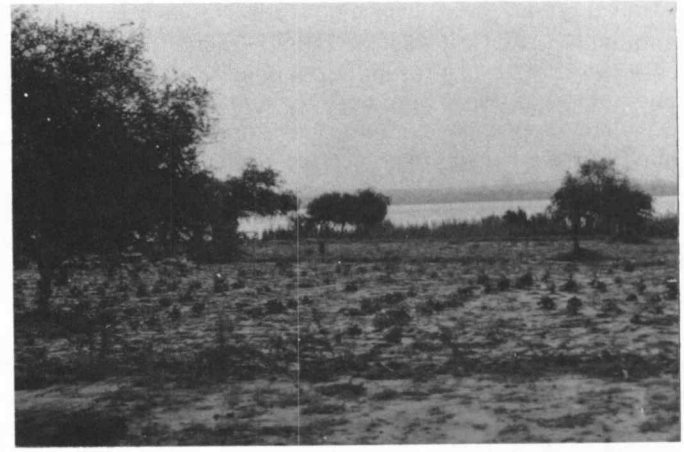
Dimensions of Change

Prior to colonization, access to pastoral resources was controlled at the tribal level (Swift 1979). Subjugation of the local powers by European armies had several effects. First, it opened the range to all comers. Second, it expanded the resource base by allowing the exploitation of zones that previously had served as buffers between southern farmers and the northern herders. Third, the elimination of slavery drastically reduced the availability of labor, leading to changes in the composition of herds and the efficacy of mobility as a strategy (Bernus 1977, Bellot and Bellot-Couderc 1979).

The initiation of annual vaccination campaigns against both human and livestock diseases removed one of the major constraints on both populations. Human populations were estimated to have increased 2-3 fold between 1914 and 1968 while cattle increased 4-5 fold (Gallais 1977).

New water points expanded the exploitable area and changed the season of use. Areas that previously had been used only during the wet season became usable during the dry season (Bernus 1975). Second, water point development undermined whatever remained of local control of rangeland by the controlled access to water and as a result encouraged the immigration of foreign herds. Third, the boreholes reduced the dry season labor constraint imposed by traditional wells and encouraged herders to congregate around the well head.

The expansion of cropping had drastic effects on the forage resource base. The 50's and 60's were generally quite wet in the Sahel. Cropping peoples expanded northward into regions previously used only by herders (Bellot and Bellot-Couderc 1979). More importantly, cropping expanded into critical dry season pastures further south, such as the Senegal



Drought refugee dry season gardens near a seasonal lake at Tabalak, Niger. Refugee herders, squeezed out of the livestock economy by drought contribute to the expansion of cropping into former dry season pastures.

River valley, the inland Delta of the Niger, and inundated areas throughout the savanna (Swift 1979, Van Raay 1975, Sabry 1972). These incursions, fueled by population growth and commercialization in southern regions, reduced access to a very critical forage resource.

The imposition of taxes payable only in currency and the increasing material desires of herders caused herd compositions to shift away from more adapted animals, such as camels and goats, toward the more commercially interesting species of sheep and cattle (Swift 1977). Monetarization also led to the concentration of animals in fewer hands. As the cash economy grew, it became possible to purchase herds with money gained through employment or commerce (Hjort 1976, Dahl and Hjort 1976). Such investment was particularly favorable during the drought of the early 70's when animals became available at very low prices. These new herd owners, who frequently had traditions in cropping, not livestock (Frantz 1975) did not engage in the traditional readjustment mechanisms and often lacked the expertise to manage their herds.

These shocks to the pastoral system coupled with drought may have led to an excess of animals with respect to the

resource base. They may also have led to an insufficient number and an unequal distribution of animals with respect to the human population. The extent to which any of these scenarios accurately describes the situation in any given region can only be determined on a case-by-case basis. For example, an examination of forage production and animal and human populations in central Niger (Milligan 1982a, 1982b) show that while sufficient forage exists in all but the very worst years, the ratio of animals to humans is considerably lower than the limit suggested by Dahl and Hjort (1976). If all households had sufficient animals, the carrying capacity of the zone would be exceeded.

Development Options

At least three lines of action might be considered with respect to the welfare of pastoral peoples in the Sahel.

1. Do nothing in the rural sector.

By the mechanisms discussed above, ownership of animals would be increasingly concentrated in a few hands. Animal productivity per human would necessarily increase and therefore a surplus of wealth could be accumulated and later invested. Herd compositions might shift away from the subsistence dairy herd structure. Production per head might increase as more milk goes to calves rather than people.

What will become of the people who would be squeezed off the land? Emigration from the countryside is a well-established process and in many cases, it contributes to the rural economy through wages sent back to the villages. Increased investment in industrialization might therefore improve rural welfare as well.

The resource base might be more abused by a few wealthy owners than by many poorer herders. Large herd owners who entered the system commercially could mine the resources and later convert the herds to capital for other investments, such as trucks, urban land, and construction.

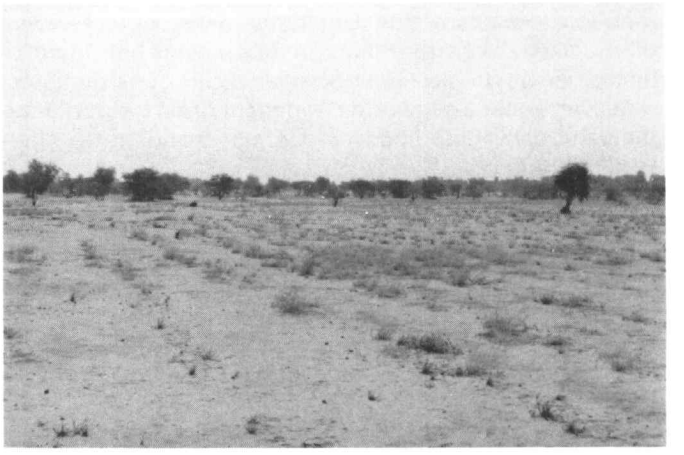
2. Redistribute the animals.

Redistribution of animals is unlikely, since many of the large herd owners are related to the governments or other powerful institutions. Furthermore, concentration of wealth is symptomatic, not causative. Redistribution alone would not prevent re-concentration during the next drought.

3. Increase both efficiency of production and buffering capacity.

"Efficiency" describes strategies to increase animal production, while "buffering capacity" describes those designed to mitigate the effects of a perturbation. It is difficult to determine which of these two categories is more important. The steady increase in animal numbers can increase a herder's survival in a drought. Deferral of short-term gains in order to invest in some other type of "insurance policy", especially an unproven one, could be counterproductive.

Attempts to increase efficiency or buffering capacity should be based on thorough studies of the existing production system, not just on resource inventories or cursory determinations of limiting factors. No one factor can be solely designated as the factor limiting annual production. To design more productive systems, we must know the long-term response of the animal herd to changes at any point in the annual cycle. This approach suggests that we study and model the production system rather than strive to determine



Micro water catchments on a crusted soil in central Niger. Range improvements are very costly, deal with only small areas and are subject to the same annual variation in production that plagues surrounding ranges.

that elusive single factor that limits animal production.

Even in the absence of complete studies, some points seem clear. The maintenance of regular vaccination campaigns is basic to any other intervention. If investment in the production system is always at risk because of disease, then such investments will never occur. Therefore vaccination campaigns and research on tropical livestock diseases must be continued.

It is generally assumed that cattle production will respond to improved diet quality. Forage quality varies considerably with season and location. Dry season forage quality is usually low and leads to some degree of weight loss on all ranges, except those in the northern Sahel. Selective grazing in some environments reduces but does not eliminate weight loss (Breman and deWit 1983). When the rains begin, standing dead forage decomposes and becomes unpalatable or perhaps even toxic (Denis et al. 1979). Intake declines and rapid weight loss ensues.

It is standard practice to improve the quality of the animal's diet whenever the crude protein declines below the maintenance requirement. However, this strategy may not be cost-effective. First, while liveweight changes are often the only data available, the critical management parameters are calving rate and calf mortality. We must know how nutrition affects bull performance, conception by the cow, and survival of the calf, rather than its effects on meat production per se. Second the animals have probably developed mechanisms such as compensatory growth and lower basal metabolism to cope with poor quality dry season diets and may be quite able to cope with dry season weight losses.

This conception of the animal production cycle suggests that nutritional innovations to increase efficiency should complement rather than compensate for the seasons by:

1. maximizing production per head during the wet season, and
2. maximizing head per hectare during the dry season.

How to maximize production per head during the wet season

a. Increase dispersal of animals during the wet season.

Unfortunately, there is little latitude for opening new wet season pastures in the Sahel. A more even utilization of existing ranges could be encouraged by the construction of temporary watering holes or catchment basins with capacities calculated according to the forage production on surrounding ranges.

b. Extend the duration of the high quality diet period by intensifying crop production. Herders already herd their animals into harvested grain fields to graze the crop residues and occasional regrowth in the fields. A major problem is incursion into unharvested fields. Better fencing techniques might allow a more timely use of harvested fields. As cropping intensifies, the possibilities for the integration of livestock and cropping will certainly multiply. The cultivation of forage crops seems unlikely, unless the price of meat or milk climbs to such an extent that the herder becomes willing to pay for feed.

Dry season water well near Gadabedji, Niger. The scope for cost-effective technical improvement of subsistence livestock economies is extremely limited.

c. Supplement the animals with nitrogen during the late wet season. To my knowledge, no research has been conducted in the Sahel on the effect of late wet season supplemental feeding on animal performance. Data from Mauritania suggest that holding crude protein levels at 6% rather the usual 3% during the last third of the wet season would produce 26 additional kilograms of liveweight on a yearling steer. Such feeding might increase conception rates in cows. The ease of supplemental feeding relative to other proposals makes it easy to extend.

How can we maximize head per area during the dry season?

As one moves south away from the desert, the dry season forage quality declines except in low-lying areas. Selective grazing becomes less effective at compensating for poor forage quality. At some point the higher foraging costs of selective grazing may render it unattractive. Data from Mauritania show no increase in liveweight loss with decreasing dry season herbage allowances, as long as 300 kg of dry matter remained per hectare. Furthermore, the higher the herbage allowance, the faster the rate of dry matter disappearance from the pasture. These results indicate that where the dry season forage quality is low, a strategy of concentrating animals and moving them through a series of small pastures could increase the number of animals supported per hectare with little influence on their per head performance. The animals would certainly lose weight during this time, but liveweight loss is an unavoidable cost of living in such an environment. However, even if it were shown that this grazing pattern did indeed increase forage conversion efficiency, an analysis of the labor and material inputs required might very well show that the pattern is not worth establishing.

Centripetal grazing, tested by Klein (1981) in Niger, is a grazing pattern that does increase forage conversion efficiency during the dry season. This system conserves forage near a water point for use during the late dry season and includes daily watering of the animals, thereby greatly reducing stress and permitting higher stocking rates. Yet even this grazing strategy may not survive an economic feasability study in which the increment of increased animal production must pay for the fencing of the waterpoint and the loss of dry season mobility that such investment implies.

The strategy of tolerating dry season weight losses may not be appropriate for pregnant cattle which often calve in late dry season. Supplemental feeding of these animals during both the late dry season and the last third of the wet season may lead to healthier calves and a higher probability of breeding back the cow during the wet season.

Standard range management and improvement practices do not appear useful in the Sahel. The establishment of range legumes and/or perennial grasses and/or longer cycle annuals could potentially extend the period of high diet quality. However, soil fertility may not be sufficient to support higher forage quality regardless of the species. Furthermore, the conditions under which the planted species will persist and contribute are unknown. Native legumes of excellent quality already exist; we might consider why they are not more prevalent. Finally, most revegetation projects are very expensive, yet their forage production is still subject to the great annual variation in rainfall. Because herds cannot rely on the higher quality forage, there is little incentive to assert ownership of the improved land and assure the management required to maintain the stand.

There are also several reasons for eschewing grazing controls that aim at destocking. First, decreasing stocking rates will not necessarily lead to higher animal productivities (Breman 1982). Grazing controls may also limit mobility and could therefore decrease short-term animal productivity regardless of the stocking rate. The aim of the dry season grazing patterns previously suggested is to increase stocking rates without greater losses in per head productivity by altering the energy expenditures of the animal.

Controlled grazing is often proposed to remedy desertification but may do little to halt the process. In perhaps the only complete before and after study on desertification in the Sahel, the loss of trees and the increased movement of the soil in the Kanem of Chad between 1964 and 1974 has been attributed more to a lack of precipitation and an expansion of cropping than to overgrazing (Gaston and Dulieu 1976).

On the other hand, grazing can lead to degradation. Grazing can change the composition of the grassland, especially by removing perennials (Valenza 1975, Peyre de Fabregues 1971), but this is not necessarily bad. Legumes often increase under grazing while the dominant south sahelian perennial

grass *(Andropogon gayanus)* appears to be a particularly grazing-sensitive plant whose replacement by the more resilient annuals might be viewed as an improvement (Cissé and Breman 1975).

Overgrazing can lead to degradation if animals remove all the herbaceous cover during the dry season and expose the soil to wet season erosion. Much of the Sahel is sandy and is unlikely to be eroded in this fashion. The degradation around water points and on silty sites may be an unavoidable cost of using the entire range to support a relatively dense human population. Attempts to mitigate such degradation may be economically irrational.

Though stocking rates under common use can exceed optimal levels with respect to animal production, the question of fair application and compensation of those who would be forced out of the pastoral economy by grazing controls must be addressed. In a larger sense, the controls may cost more to implement then they will yield in increased animal production.

The Shape of the Future

Let us suppose that we can outline a cost-effective way to increase calving rate and calf survival. What will happen?

If we can show that the method is cost-effective, then herders will probably pay for it. Payment requires that some of the additional animals produced by the interventions be sold at some point to cover the cost.

If the calving rate is increased, the number of animals on the range will increase to the extent that immediate subsistence needs allow a retention of calves. Herders will probably not sell all of the additional animals produced, but will retain more of the female calves in an attempt to increase the size of the cow herd. Many households have an insufficient number of milk cows for subsistence needs. Furthermore, experience has shown that a larger herd is a more effective means of surviving a drought. The ratio of animals sold to those retained will be higher among poorer herders. Thus, in a more productive system one would expect much of the additional production to be sold as long as more herders are poor, increasing both the welfare of the herder and the supply of animals to the market. We would expect more sacrifice areas around water points and perhaps lowered primary production on sandy soils (Breman 1982). However, overpopulation is a very real threat. The expansion of waterpoints has encouraged immigration in the past. If the increase in welfare of herders translates to higher human fertility, then the susceptibility of the system to catastrophe will have been increased, not reduced.

If no alternative to a large herd can be proposed as a survival mechanism, the next drought will produce famine, just as occurred in the early 70's and again in the mid 80's. Many herders will be destitute, food aid will be imported and will further undermine local crop production, some additional increment of fragile land will be irrevocably lost and whatever animals that remain will be purchased by a few wealthy owners.

What alternatives are there to a large herd?

Forage reserves have been suggested to buffer the animals' food supply. However, if the site can produce sufficient forage during a drought year, it is probably suitable for cropping and could be used to produce human food directly. If poorer quality land is reserved, then more of it must be withdrawn from current use. The formation of state ranches in several countries proves that such withdrawals are politically feasible. However, the net effect is to push someone out of pastoral production now, or to concentrate production on the remaining land.

The major problem with animals as a store of capital for use during drought is that, unless the herder sells well in advance of the late dry season, the price of his animals collapses at just the time the price of food is rising. One proposal is the establishment of grain reserves within herder cooperatives to insulate the herders from high grain prices in a drought by selling animals during good years. The creation of this new social institution has many problems.

First, would it be cost-effective? It would require at least some additional labor to oversee sales and purchases of grain. It would require some storage and transportation of grain to the participants since further sedentarization should not be encouraged. These costs must be paid from the increment of additional production afforded by supplementation, etc.

Second, since the actual buffering mechanism has been removed from the household, the question of trust of cooperative officials becomes critical. The elaboration and extension of such a system would require great legal ingenuity.

Summary

This analysis shows an adapted production system squeezed by exogeneous factors and burdened with an increasing human population. The buffering capacity of the system has been largely eliminated and an increasing number of people find themselves destitute after an environmental perturbation. Any new buffering mechanism will require reinvestment that can only come from increased production through improvements in animal health and nutrition, or from alternate sources of employment. The number of technical innovations that are cost-effective and that do not interdict some other important adaptation of the production system are few. The degradation that can be rightfully attributed to overgrazing results more from an excess of people living on too few animals per household than from excessive personal greed.

This analysis is not optimistic about the future of Sahelian herders or the technical options available to them. Conditions peculiar to particular Sahelians regions may alter or nullify parts of this analysis, but overall, I believe this analysis to be realistic. Consequently, a concentration on the sociological aspects of Extension obscures the much greater need for technically efficient and economically justifiable improvements. It is ironic that the Sahel, which immediately attracts our attention as range managers, presents problems that range management is presently unable to address: overpopulation, very low and variable land productivities, and the questionable value of money as wealth. Range management may yet contribute to improving the lives of Sahelian pastoralists, but it will likely do so only as part of a larger pastoral systems approach.

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Mexico $Haylift$—Southern Section Challenges the Society

Recently, farmers and ranchers throughout the United States responded to a challenge to help their own. A haylift to the drought-stricken Southeastern states was the result. The challenge was answered.

Members of the Society for Range Management are now faced with a similar challenge. The current economic "drought" in Mexico, coupled with the exchange rate, has made it practically impossible for a large portion of the Mexico Section to continue their membership.

Accordingly, the Southern Section "passed the hat" at their recent annual meeting and collected $286 to be used to pay the Society portion of the dues for selected members of the Mexico Section. The officers of the Mexico Section can determine who is designated for membership and how the Section dues will be handled.

Now comes the challenge: the **Southern Section challenges the sections** to "meet-or-beat" our contribution to the "haylift."

At a time when the Society is in an aggressive membership drive, it's well to remember our own and meet the challenge to help our "drought-stricken" members in Mexico.

Contributions may be sent to the Denver office, payable to SRM, by sections and/or individuals. Please indicate that it's for Mexico Section "Haylift" and which section to credit for the challenge.

Third International Rangeland Congress New Delhi, India—November, 1988

The meeting date for the 3rd IRC has been postponed one year, from 1987 to 1988. The congress is being reorganized with excellent support from the Government of India. The 1988 date will allow mailing of the first notice and call for papers well ahead at the congress.

The host organization will be the newly formed Rangeland Society of India. The President of the Society is Dr. Punjab Singh, Director of the Grassland Research Institute at Jhansi, a branch of the Indian Council for Agricultural Research. This is a great development of interest in rangeland science in that part of the world.

Please pass this information concerning change in date for the 3rd IRC to all organizations and individuals interested in rangeland management. We can look forward to a most productive and interesting trip to India. See description of the congress in the June 1986 issue of *Rangelands.*