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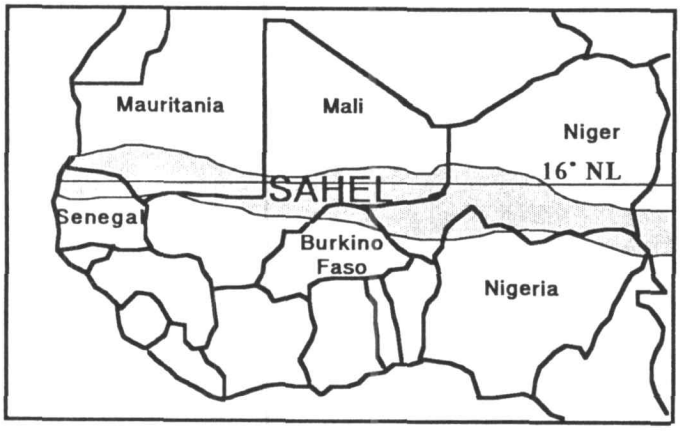
Livestock Production Constraints in the Sahel

R.S. Senock and R.D. Pieper

The Sahel extends over an area of some 2.5 million km^2 on the southern fringe of the Sahara desert and stretches over 5,500 km from the Atlantic Ocean to the Red Sea, in a strip 450 km wide (Le Houerou 1979). The West African Sahel comprises a part of the countries of Mauritania, Senegal, Mali, Burkino Faso, Niger, Nigeria, and Chad (see map).



Livestock production in the central Sahel is largely based on pastoralist systems which are traditionally nomadic and transhumant. The major broad ethnic groups involved are the Twareg and WoDaabe Fulani, who practice animal husbandry in small-scale family groupings. Herd composition is typically a multi-species mix of cattle, sheep, goats, camels, and donkeys. The relative proportion of each species and the various breeds involved are dependent upon milk production characteristics such as seasonality, length of lactation, and perceived quality of the milk produced.

The supply of animal products in West Africa thus occurs as a result of the complex interrelationships composed of ecological, socio-economic and cultural-political factors. The relative degree of influence that each factor exhibits at any particular time is in constant flux and obstructs a simple classification of animal production factors.

Authors are graduate student and professor, Department of Animal and Range Sciences, New Mexico State University, Las Cruces 88003. Current address of Senock is Dept. of Range Sciences, Texas A&M University, College Station 77843.

Forage Resources

Quantity and quality of livestock feed supply are the most important factors in animal production. Three features of the natural rangelands in the Sahel are important in relation to the forage resource base: species composition, biomass quantity, and seasonal nutritive quality.

Species Composition

Sahelian rangelands are composed almost entirely of annual grasses which exhibit large variation in forage production over wide areas, both within and between years (Le Houerou 1979). Annual grass ranges may be very productive in years with average or above precipitation. They are less affected by heavy grazing, but exhibit higher yearly variability than perennial rangelands. The lack of forage species diversity and the relative contributions of different forages at different times of the year have nutritional implications for domestic livestock grazing natural rangelands (Holechek 1984). Except for limited interdunal areas where soil water content is slightly higher, occurrence of perennial grass and forb species is very low. Louis et al. (1983) found the frequency of occurrence of perennial grass species to be only 3% over the entire Nigerien pastoral zone. Species composition data from three consecutive years of multiple exclosure monitoring in central Niger showed the frequency of forb species never to be greater than 3 to 5% (Wylie et al. 1983). The forb species that do occur are annuals of small stature which contribute little to the animal feed base. Woody species typically cover less than 5% of the soil surface, but contribute significantly to livestock diets during the long, dry season period (Otsyina and McKell 1985). Animal diets for a large part of the year are limited to annual grasses and browse species.

Biomass Quantity

Superimposed on the annual rangelands is the regional

climate. Temporal and spatial variation within the annual precipitation pattern results in large fluctuations of available herbage. Between 1980 and 1985, forage production at one site in Niger varied from 25 to 1,000 kg/ha. Severe droughts occur on average every 10 to 15 years, and precipitation is significantly deficient one year in five (De Leeuw and De Hann 1983).

When rainfall is sufficient for seed germination, these annual grass species have short, rapid growth cycles and can pass through the vegetative stage to seed production in less than a month. An example of this rapid growth occurred at one study site dominated by two species, *Cenchrus biflorus* and *Aristada mutabilis.* Rainfall events of 10 and 15 mm in the last week of July resulted in a major germination event on August 1. Plants passed rapidly through subsequent phenological stages until seed production occurred at the end of August. Rate of biomass increase over this period was approximately 36 kg/ha/-day. Following maturation of grasses and end of the effective precipitation period, available standing biomass decreased 15 to 20% due to seed shatter, leaf drop and decomposition as a result of late noneffective rainfall events. Similar patterns of herbaceous development and sharp late season decreases have been reported for areas of Mali.

Nutritive Quality

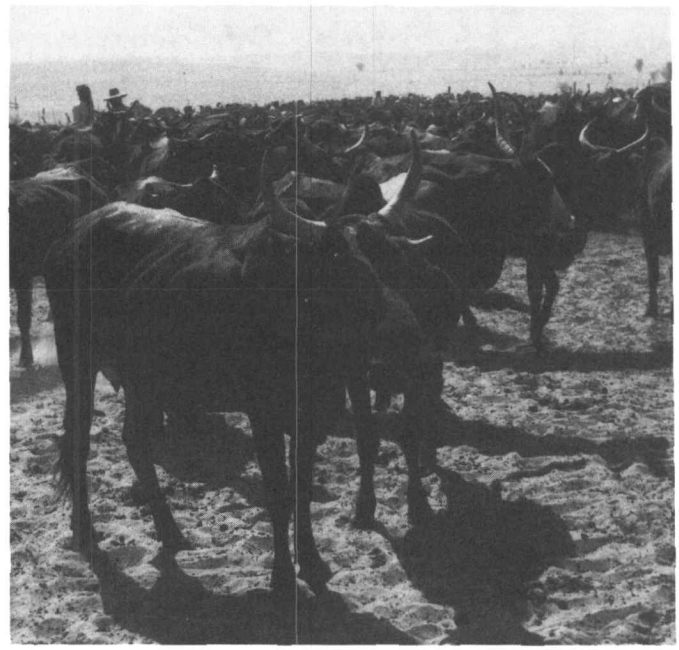
Animal nutrition and growth studies have indicated that livestock production in the Sahel is generally not limited by the amount of dry matter (DM) available, but by the level of available crude protein (CP). Forty-two percent of recorded variation in cattle weight gain was due to CP intake and only 2% of the variation was accounted for by DM intake, while CP and DM intake together accounted for 56% of variation in gain (ILCA 1983).

The short growing cycle of annual grasses in the Sahel means high forage quality is limited to the actual growing season and a short period following the ends of the rains. During the early part of the wet season, herbage of most upland areas contains adequate levels of protein, energy and phosphorus. As the season progresses digestible protein, phosphorus and vitamin A content begin to decline rapidly. Chemical analysis of the major dominant annuals in Niger showed that crude protein content decreased an average of nearly 70% between the rainy and dry seasons. In contrast, average crude protein content of the dominant tree and shrub species during the dry season was 15% (Louis et al. 1983). One evergreen species, *Maerua crassifolia* Forsk., had a dry season crude protein content of 25%.

Livestock Production

Factors affecting productivity of a pastoral herd are length of time needed to achieve reproductive maturity, reproductive performance of the cow, quantity and length of lactation, and time taken to reach adequate slaughter weight. Age at first calving lies between four and six years, depending on race of cattle and location. After the cow has reached reproductive age, long calving intervals further reduce reproductive efficiency of the herd.

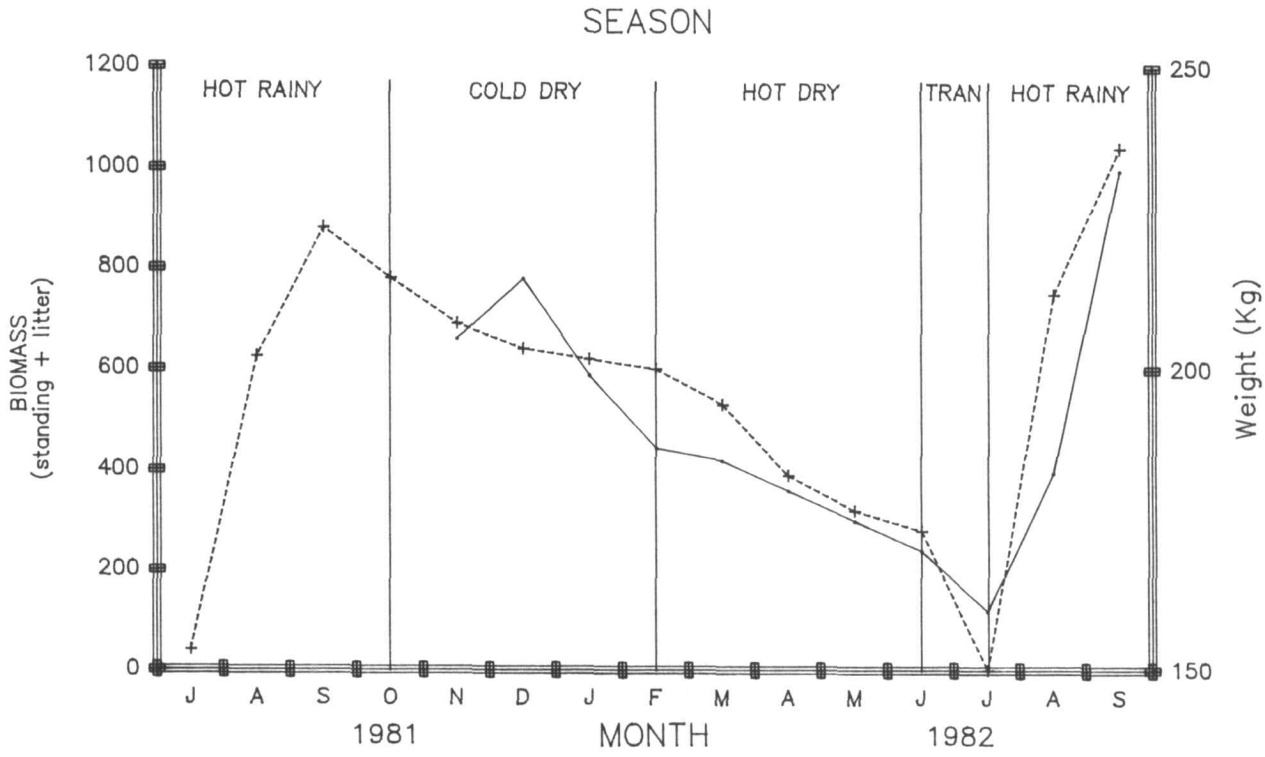
Consideration of calving intervals on a seasonal basis, however, reveals two distinct time values of 12 and 24 months. This phenomenon is typical of the Sahelian region where, as a result of restricted forage availability, cows conceive primarily during the rainy season. Animals failing to conceive in the first rainy season after parturition generally do not conceive until the following rainy season (Wilson 1985).



Herd of Bororo cattle penned for watering at the government Ibecetene Ranch, Niger

During this period of low milk production there is competition between humans and calves for the milk supply. Weight gains in calves having access to the total milk produced were nearly two times greater (.47 kg/day) than those where approximately half the yield was removed for human consumption (.28 kg/day).

The annual cycle of cattle weight changes occurs in a pattern which is directly related to forage availability and quality (see Figure). Animals gain weight during the rainy season but begin to decline rapidly for two months as animals adjust to the lower quality forage. Increasing temperatures and "Harmettan" winds during the early dry period also place a physiological stress on animals. During the four-month hot season, weight losses are relatively low (.2 kg/day). This situation changes during a short transitional period when weight losses may be 1 kg/day or greater. This period of weight loss during the late dry season coincides with the period of extremely limited forage availability and a time of physiological stress due to climatic factors. The initial storms that occur during the early rainy period results in a sharp drop in



Annual cycle of biomass availability and monthly weight changes in heifers as determined from grazing trails conducted at the Ibeceten Centre de Multiplication, Niger, 1981–1982. Dashed line is plant biomass; solid line is heifer weights (from Wylie et al. 1983).

temperature that commonly forces the animals to initiate shivering for several hours, thus utilizing already depleted energy stores. During the growing season, a period of "compensatory gain" occurs until animals regain the transitional period weight losses in less than one month. Total dry season weight losses (20 to 30% of body weight) are regained in less than two months. Similar annual patterns of weight changes have also been reported for adult cattle in a Malian agropastoral system, while weight changes for younger male cattle (3 permanent incisors) was even greater at up to 44% of body weight (ILCA 1982).

Herds in the Sahel travel 10–25 km per day (Dicko and Sangare 1985). This high energy expenditure during the late dry period when energy values of herbaceous forage are extremely low coupled with reduced grazing times due to distance travelled to water can result in severe tissue degradation.

Improved Productivity

The situation of varying animal forage and seasonal nutrient deficiencies make an adjustable feeding program a necessary part of any improved range livestock production system. Increasing quality of dry season forage intake is a crucial factor in any effort to increase livestock production.

Conventional methods of adjusting feed intake during the dry season have concentrated on developing organized grazing schemes or reducing livestock numbers. These methods have had only limited success, and generally are not applicable in every situation or even warranted in terms of production benefits. If the sole forage is annual grasses, even well-managed pastures often do not yield sufficient supplies of protein for good reproductive performance or growth patterns. Grazing schemes often proposed for annual rangelands have been designed for managing perennial grasslands. Such systems seek to achieve different objectives from the aspect of plant functioning (Ratliff 1986). Management strategies and options (centripetal grazing, control of animal numbers, etc.) often proposed in an attempt to improve or stabilize productivity in the Sahel appear technically feasible (De Leeuw and De Haan 1983, Peyre 1970), but do not address the main problem of low forage quality. In addition, they require a relatively high degree of organized management and control. Strategies requiring radical departures from traditional use patterns are typically not easily accepted by mobile pastoralists. Possible alternative interventions based on supplemental strategies include: feeding of high protein supplements such as cottonseed, use of forage reserves as partial supplements and vitamin A supplements in oral or injectable form (Pase et al. 1985).

Compensating for variability of range feed by use of supplemental feeds may offer a more practical method of management than adjusting animal livestock numbers or trying to implement a controlled grazing pattern. However, the economic situation of many Sahelian countries and indigenous livestock herders prohibit widescale application and utilization of costly manufactured or imported supplemental feeds. Given the limited availability and

high cost of purchased supplements, any improvements in livestock feed resources are most likely to be based on development of appropriate techniques to introduce high quality, locally produced supplemental feeds into livestock diets (ILCA 1983). The use of a simple methodology utilizing native species and local production practices where possible would be more applicable than developing capital intensive techniques.

Herbaceous production at the end of the rainy season in 1985 following severe drought in 1984 in central Niger. Major annual grass species is Cenchrus biflorus.

Several native plant species have significant potential for development as livestock supplemental feeds within the local economies. Shrub species within the family Capparidaceae are considered the most valuable in terms of nutrient qualities and browse potential (Le Houerou 1979) and are highly palatable to domesticated and wild herbivores. Preliminary field trials in Niger have indicated *Maerua crassifolia* Forsk., in particular, shows promise for use in revegetating rangelands. Observations on its drought tolerance, resistance to excessive browsing, and high potential production show it to be a highly desirable part of the Sahelian rangelands (Breman 1982). The high crude protein content of *Maerua* (24.8%) is three times that of most grasses during the rainy season and about eight times that of the grasses at the beginning of the dry season. A three-fold decrease in the acid detergent fiber value (13.6%) combined with a comparable lignin content (5.4%) to other browse species results in a digestible protein value of 19.5%. This can be favorably compared with most crop or industrial by-products which are scarce, expensive and not widely available in Niger (Louis and Pase 1985).

Maerua crassifolia had the second highest seedling survival percentage (53%) out of a total of five different species investigated during establishment of reserve plantations in Niger during the 1984–85 drought years. Useable herbage from a plantation of 208 shrubs per acre could yield (based on harvest information) 66 kg/ha of leaves and 46 kg/ha of buds and small stems on very young stands increasing to 995 kg/ha leaves and 1,543 (kg/ha (air-dry) buds and small stems on mature stands on a sustained basis (Louis and Pase 1985).

Other native species with potential for development in the Sahel are forbs within the family Curcurbitaceae. Within the Nigerien pastoral zone, several species of this family are reported by local herders to be important in maintaining increased levels of milk production in the months following the end of the rainy season and during the early dry season (Maliki 1981). In addition, the local population actively harvests fruits of *Citrullus lanatus* when available to supplement their food diet (Loutan 1982). A concentrated research effort could provide the necessary techniques for successful propagation on a production basis. Extensive research on a production basis has been conducted on Buffalo gourd *(Curcurbita foetidissima)* for several years at the University of Arizona. The strategic use of legumes to improve annual grasslands in California is often a recommendation to improve animal production (Murphy 1986). In general, development of indigenous plants for animal fodder production should pay particular attention to those species which also produce materials for human consumption, both food and fuel wood. Pastoralists seek out and harvest wild foods to supplement the family diet, a practice more prevalent than is generally recognized. This utilization of native plants is important in helping increase the resource upon which people depend for their livelihood.

The development of browse plantations appear to offer possible solutions to problems of livestock feed in the Sahel. They would present obvious advantages over the feeding of concentrates which have an unreliable supply. Intensive research on integrating forage browse plantations into local production systems is presently being carried out as part of the Cooperative Arid Lands Agricultural Research Program (CALAR) in Egypt and Israel.

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Andropogon gayanus: A Valuable Forage Grass for Tropical and Sub-tropical Arid Rangelands

Javed Ahmed

Andropogon gayanus Kunth, gamba grass, a native to east and west Africa, has been introduced for forage/-fodder in South America, northern Australia, and tropical India. It is valued for its productivity, drought resistance, and palatability. In January 1977, a grass plant was found growing inside a thorny shrub, *Caoparis decidua,* at Taunsa, near Dera Ghazi Khan, Pakistan. Average annual rainfall in this area is about 80 mm, most of which occurs during July and August. Occurrence of the plant only under such protective cover and not elsewhere strongly indicates the palatable character of this taxon. Seed of this plant was collected and sown in a germplasm nursery in the Thal desert, near Bakkhar, Pakistan. In 1983, specimens were sent to Royal Botanic Gardens, Kew, for identification. The plant was identified as *Andropogon gayanus* var. *argyrophoeus* Stapf, a new record for Pakistan (Cope 1983, personal communication).

In the germplasm nursery, plants exceeded 1 m in diameter and height at the end of first growing season. (See photo.) The plants remained green and put on new growth until late winter, a value for animal nutrition. In order to test the palatability, harvested forage was fed to cattle and sheep, who relished the forage. However, no comparison was made with other taxa or forages to ascertain relative preference.

Some research and development has been done in Australia and South America to develop this plant as a forage resource. The preliminary observations in Thal have prompted further investigations to highlight its potential for tropical and subtropical arid rangelands.

Andropogon gayanus var. *argyrophoeus* Stapf.

Author was formerly research associate, Colorado State University, Fort Collins, CO 80523. Presently research scientist, Kuwait Institute for Scientific Research, P.O. Box 24885, 13109 Safat, Kuwait.

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