
Supplementary paper 2: Agro-pastoral herding practices and the grazing behaviour of cattle

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Abstract

A study of grazing behaviour of herded cattle kept by settled Fulani pastoralists showed that a wide range of different feed resources are utilized, particularly during the dry season. Sorghum and millet residue grazing accounted for 12.6% of annual grazing time in Abet, a farming area, and for 6.6% in Kurmin Biri, a grazing reserve. It peaked in December with 65% of monthly grazing time in Abet and 50% in Kurmin Biri. Browsing accounted for 11.2% of annual grazing time in Kurmin Biri and 1.4% in Abet, with a peak in the late wet season, when browsing was 30% of monthly grazing time in March in Kurmin Biri and 8% in April in Abet.

Natural herbaceous vegetation was not differentiated in this study but includes fallow land, upland range, low-lying areas (*fadama*) and regrowth after burning an fallow and upland range. *Fadama* and regrowth after burning are utilized during the dry season, whereas fallow fields are preferred grazing during the early wet season.

Both herding and grazing time are however very short, with little more than 6 hours grazing per day on average over the year and only 5 hours per day during the late wet season. Compared with free grazing animals, short herding time changes the diurnal pattern of grazing. When the day was divided into 2-hour periods the level of grazing was constantly high, above 70% for most of the year and around 50% in May, the transition period between wet and dry season. Walking accounted for most of the remaining time, with little time spent on resting and ruminating during the herding day. Resting and ruminating account for almost half the time during daytime in the case of free-grazing animals.

Reasons for short herding and grazing times are discussed, and their implications for animal production are examined in view of the spatial and operational integration of farming and cattle herding and the possibilities of using different grazing resources.

Introduction

Grazing behaviour and grazing time of free-grazing cattle have been extensively researched. From the literature, Arnold and Dudzinski (1978) compiled data on the grazing time of beef and dairy cattle in the temperate and tropical zones. Much less, however, is known about the

grazing behaviour and grazing time of herded cattle. Early work (e.g. Smith, 1961) merely stresses that restricted grazing and walking range distances have negative effects on cattle performance. In recent years, more detailed studies of herded cattle have been made. Van Raay and de Leeuw (1974) pointed out that a wide range of different feed resources are used by pastoralists' herds in the semi-arid zone of Nigeria, particularly during the dry season.

This paper presents results of a study of grazing behaviour and forage resource utilization by herded cattle in the subhumid zone of Nigeria. The study was carried out over 2 years in Abet, a farming area, and over 1 year in Kurmin Biri, a government grazing reserve. Observations were made of the time when the herd left and returned to the camp (*ruga*) and predominant herd activities during the time out of confinement. These were classified into: walking, resting, watering, and grazing. Grazing was further subdivided into: grazing of natural range, browsing, and crop residue grazing. During the course of the study, it was decided to include grazing of burnt areas as an additional subdivision.

Utilization of feed resources

As shown in van Raay and de Leeuw's study, pastoralists' cattle used a variety of grazing resources (Table 1). Grazing time on crop residues was about twice as long in the farming area as in the grazing reserve, whereas browsing accounted for eight times the grazing time in the latter than in the former area. In this study, crop residues included only sorghum and millet, but subsequent more detailed work on crop residue utilization in the farming area revealed that rice and soybean residues are also grazed to a considerable extent. Important browse species were *Azelia africana*, bamboo, *Khaya senegalensis*, *Adenolichos paniculatus* and *Mucuna* spp.

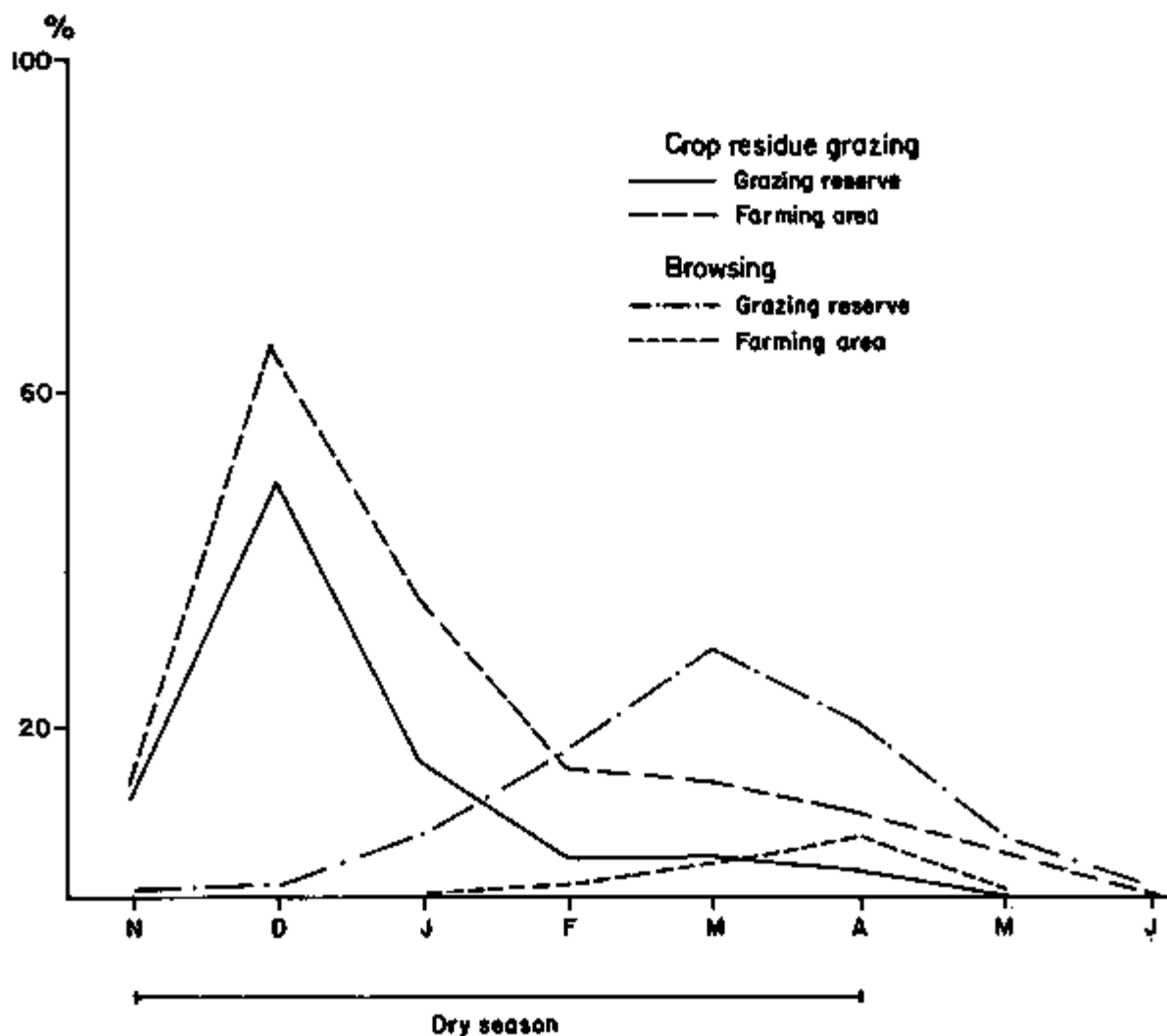
Both crop residue grazing and browsing were highly seasonal. A peak in crop residue grazing occurred in December after grain harvest, when it accounted for 65% of total grazing time in the farming area and 50% of total grazing time in the reserve. Browsing peaked in March, when it accounted for 8% of grazing time in the farming area and 30% in the reserve (Figure 1).

Table 1. Contribution (%) of different grazing resources to total grazing time.

Study area	Farming area (Abet)	Grazing reserve (Kurmin Biri)
Crop residues	12.6	6.6
Browse	1.4	11.2
Naturally occurring herbaceous layer	86.0	82.2
Average grazing time hours/day)	6.1	6.2

Crop residues provided good-quality forage during the early dry season. Faecal nitrogen in December (the height of crop residue grazing) in the farming area was found to be 1.55%, corresponding to 9.7% crude protein, whereas by the late dry season it had dropped to 0.6% (Powell, personal communication). If faecal nitrogen falls below 1.3% animals respond to non-protein nitrogen supplements such as urea, indicating nitrogen deficiency in the diet (Winks and Lainge, 1972).

Figure 1. Crop residue grazing and browsing as percentage of total grazing time in different months of the year.



In both study areas, more than 80% of total grazing time was spent on natural range (Table 1). During the second year of study, when regrowth on burnt areas was included as a distinct resource within natural range, the cattle in the farming area spent 19.3% of their total dry-season grazing time and 8.5% of their total wet-season grazing time on regrowth, which may contain more than 8% crude protein (Blair-Rains, 1978). The wet-season regrowth grazing was in the 2-month period before heavy rains began. Over the entire year, 13% of total grazing time was spent on recently burnt areas. In the case of cattle in the grazing reserve, corresponding figures were 22% of dry-season grazing, 7.9% of wet-season grazing, and 14.1% of total annual grazing.

Low-lying seasonally inundated (*fadama*) areas contributed primarily to dry-season grazing. The contribution of fallow grazing was greatest during the early wet season. However, observations did not permit a detailed analysis of upland, *fadama* and fallow land grazing times.

Herding and grazing time

The cattle were herded for an average of 8.4 hours per day in the farming area and 8.8 hours per day in the reserve. The longest time out of confinement was recorded in April (period of scattered rains in the early wet season), when the monthly average was 10.8 hours per day in both study areas, and the shortest time in September (late wet season) with 6.9 and 7.5 hours per day in the farming area and reserve respectively. Walking accounted for about one quarter of herding time, whereas resting and watering together represented only 5% of total time out of confinement, with little difference between study areas (Table 2). Actual grazing

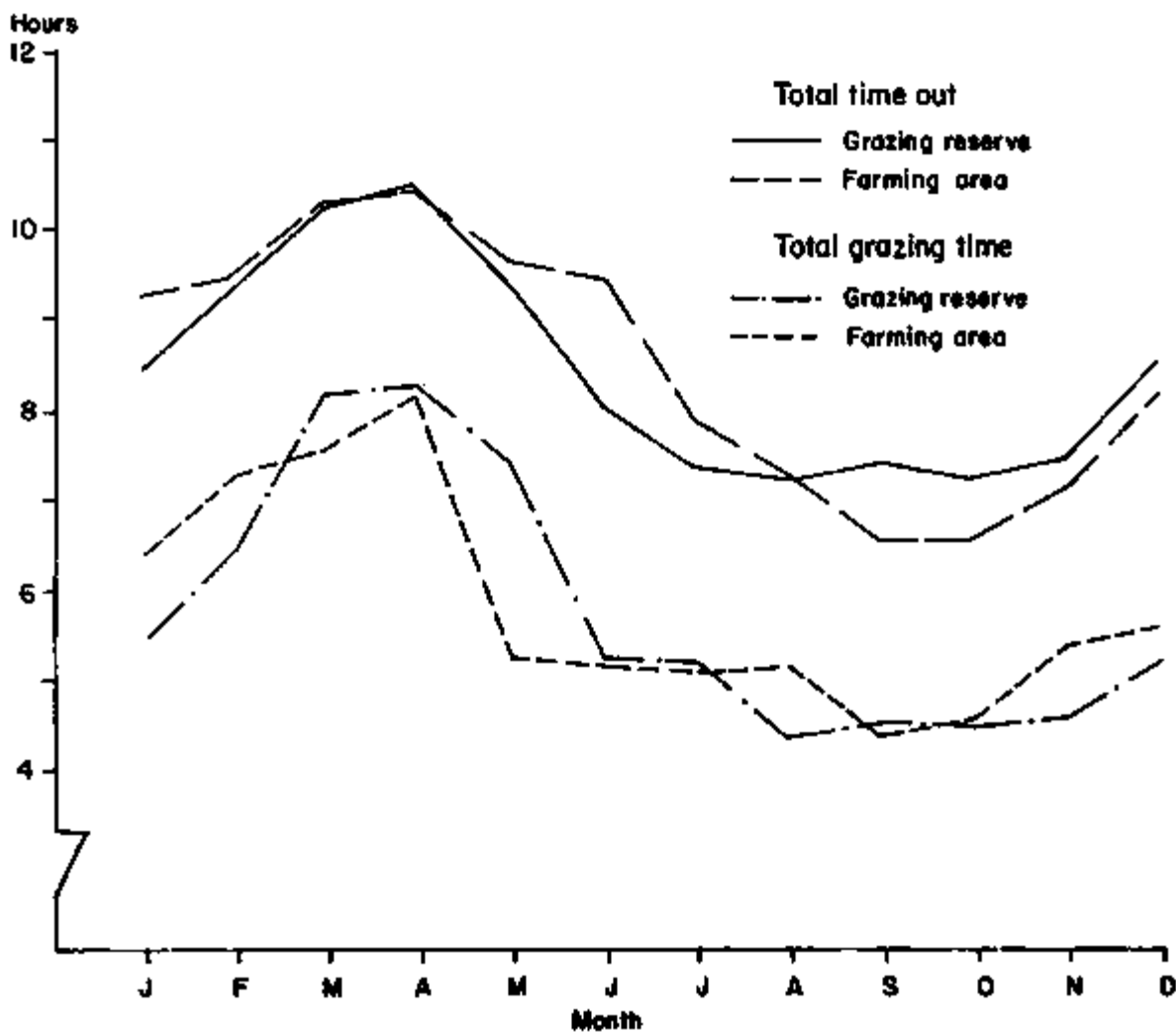
time constituted roughly 70% of time out of confinement in both areas.

Table 2. Herd activities as per cent of total annual time out of camp.

Activity	Study area:	
	Farming area	Grazing reserve
Walking	20.6	25.5
Resting	4.6	2.5
Watering	1.7	1.5
Grazing	73.1	70.5
Average time out of camp (hours/day)	8.8	8.4

Herding and grazing time varied according to season. Longest herding time was recorded in April and shortest in September (Figure 2). Actual grazing time was little more than 5 hours per day in the wet season, reached 8 hours per day in the late dry season, and averaged only about 6 hours per day over the year as a whole. The general annual pattern of daily grazing time longer in the dry than the wet season, with a peak when the first scattered rains fall - agrees well with the patterns of free-ranging domestic ruminants in similar climates (Smith, 1959; Wilson, 1961). However, the absolute daily grazing times of the herded cattle are very low compared with free-ranging animals.

Figure 2. Herding time (total time out) and grazing time of cattle in a farming area (Abet) and a grazing reserve (Kurmin Biri).



In the review by Arnold and Dudzinski (1978) of grazing studies in tropical and temperate areas, the average grazing time of beef cattle came to 9.5 hours/day; only 10% of the over 100 references indicated less than 7 hours/day and only 2% less than 6 hours/day. Stobbs (1974) found grazing times of up to 14 hours/day by dairy cattle in southern Queensland, Australia. Smith (1959) found similarly long grazing times by Zebu cattle in Zimbabwe when pasture quality was low. Moreover, night grazing by indigenous African cattle in pastures for 24 hours/day accounted for up to 25% of total grazing time (Haggar, 1968).

Restricted grazing

Effects of restricted grazing time on animal productivity have not been extensively researched. In Zimbabwe, Smith (1961) compared grazing behaviour and liveweight development of cattle allowed on pasture for 7 hours, 11 hours and 24 hours/day. The animals in the 7 hour treatment partly compensated for the shorter grazing day by deferring resting and ruminating until they were confined and by increasing feed intake per grazing hour. Nevertheless, they gained less or lost more weight than animals in the 11-hour and 24-hour treatments in the dry season, when pasture quantity and quality were low. Over the entire trial period of 16 months, liveweight gains per animal in the 7-hour treatment were only half those in the 11-hour and 24-hour treatments (37 versus 73 kg). These data suggest that short grazing time may be a factor contributing to the low productivity of pastoralists' cattle in the study areas.

Some reasons given by pastoralists for this relatively short grazing time were: increasing danger of worm infestation in early morning during the wet season; negative effect of wet-season dew on feed intake by cattle; difficulty of controlling animals with satiated appetite; and competition for labour between herding and cropping. Night grazing is avoided for fear of predators and thieves.

The arguments concerning control of satiated animals and labour competition deserve particular attention in the context of livestock-crop integration. Ethological studies show that towards the end of a grazing period some animals still feed, although probably more selectively, while others begin to ruminate or wander idly (Arnold and Dudzinski, 1978). A herd which ceases to behave uniformly becomes more difficult to handle. The practice of grazing fallow and uncultivated fields adjacent to cropped land and grazing crop residues adjacent to unharvested crops demands tight herd control if crop damage is to be avoided. Cessation of herding before animal appetite is satisfied and behaviour begins to diversify reduces the danger of crop damage. Whereas young boys can handle herds in the dry season, it is necessary for older youths or adult men to accompany the cattle when grazing control is critical during the wet season and early crop residue grazing period. However, these people are also needed for land preparation, weeding and harvesting of their own fields. It is unlikely that the cattle can eat their fill during the short grazing time found in Nigeria. Fulani cattle allowed on pasture for 11 hours grazed for 7.5 hours daily in the wet season (Haggar, 1968).

Transhumant versus settled pastoralism

Transhumant herders, who use the study areas only in the dry season, leave camp each morning 1.5 - 2 hours earlier than the settled Fulani and, subtracting a mid-morning break in the camp for 0.5 - 1 hour, herd their cattle for about 1 hour/day longer. Those herders who bring cattle into the study areas during grain harvest herd their animals for up to 3 hours/day longer than do the settled Fulani in that period.

Reports from semi-arid savannas (Hoper, 1958; Barral, 1967; Riesman, 1977; Fricke, 1979) indicate that night grazing of cattle is practised by some transhumant groups. There is little information on productivity comparisons of these different pastoral systems. Wilson and Clarke (1976) found in Sudan that productivity was higher in nomadic than in settled cattle

herds, yet recent work in Mali (Wilson, 1982) showed no significant difference in productivity indices between a transhumant and a settled cattle-keeping system. Van Raay and de Leeuw (1974) compared grazing strategies of nomadic and settled pastoralists in the semi-arid savanna of Nigeria, which has higher human and cattle population densities than in the subhumid savanna. The nomadic cattle were longer out of camp and generally grazed longer, but walked up to 30 km per day compared with a maximum of 14 km by settled herds. The settled Fulani were able to provide their cattle with a more varied and steady fodder supply within more confined areas, i.e. requiring less energy expenditures by cattle and herders. By virtue of their closer association with cropping systems, settled Fulani appeared to have an advantage over nomads in terms of access to valuable grazing resources such as crop residues and fadamas.

In the study areas of the subhumid zone crop residue and fadama grazing is more abundant, relative to cattle density, than in the semi-arid zone and transhumant herds appear to have easy access to these resources. Camping and grazing of transhumant herds on farmland in the dry season is welcomed by the farmers, who appreciate the manure and the fact that the herds leave the area again before crop damage becomes possible. Transhumant pastoralists moving into these farming areas only seasonally are by no means disadvantaged and may even gain from their ability to utilize a wider ecological range of grazing resources than settled pastoralists; transhumant cattle are therefore likely to be more productive.

Herding and farming

The present systems of livestock-crop integration in the subhumid zone, whether involving settled or transhumant herds, are characterized by high labour inputs for animal control in order to make optimal use of space in farming areas. The restricted grazing time when pastoralism and cropping are spatially integrated is a constraint on animal productivity. However, partial compensation is gained through the herded animals' access to better quality feed on fallow and harvested land. Segregation of cattle keeping from cropping would sacrifice the better utilization of land resources possible within the present production systems and would lower the total animal and crop yields per unit area.

If the pastoralists could establish fenced pastures, at least selected productive animals could be allowed longer grazing times without extra labour requirements for herding. Such a combination of improved forage and a longer grazing day should bring substantial improvements in animal productivity. Expressed in terms of liveweight gain of the selected animals, increases of about 30 kg per head and year may be expected, calculated on the basis of Smith's (1961) data from Zimbabwe and the preliminary results of ILCA's fodder bank grazing experiments.

Diurnal grazing activity of herded cattle

The grazing studies in Abet and Kurmin Biri also presented an opportunity to examine the diurnal activity patterns of herded cattle. The diurnal grazing activity pattern of non-herded cattle in the tropics as well as in temperate zones has been well documented (e.g. Smith, 1959; Wilson, 1961; Arnold and Dudzinski, 1978). The general pattern includes a peak in grazing activity in the early morning, another in the late afternoon, and substantial grazing activity at night. Climatic factors, particularly high ambient temperatures, influence this general pattern, especially in the case of exotic cattle in the tropics. For example, Breinholz et al (1981) found in Ibadan, Nigeria, that almost 60% of the grazing time of Friesian cattle was during the night hours, whereas only 25% of the grazing time of indigenous African cattle was at night (Smith, 1959; Haggard, 1968) .

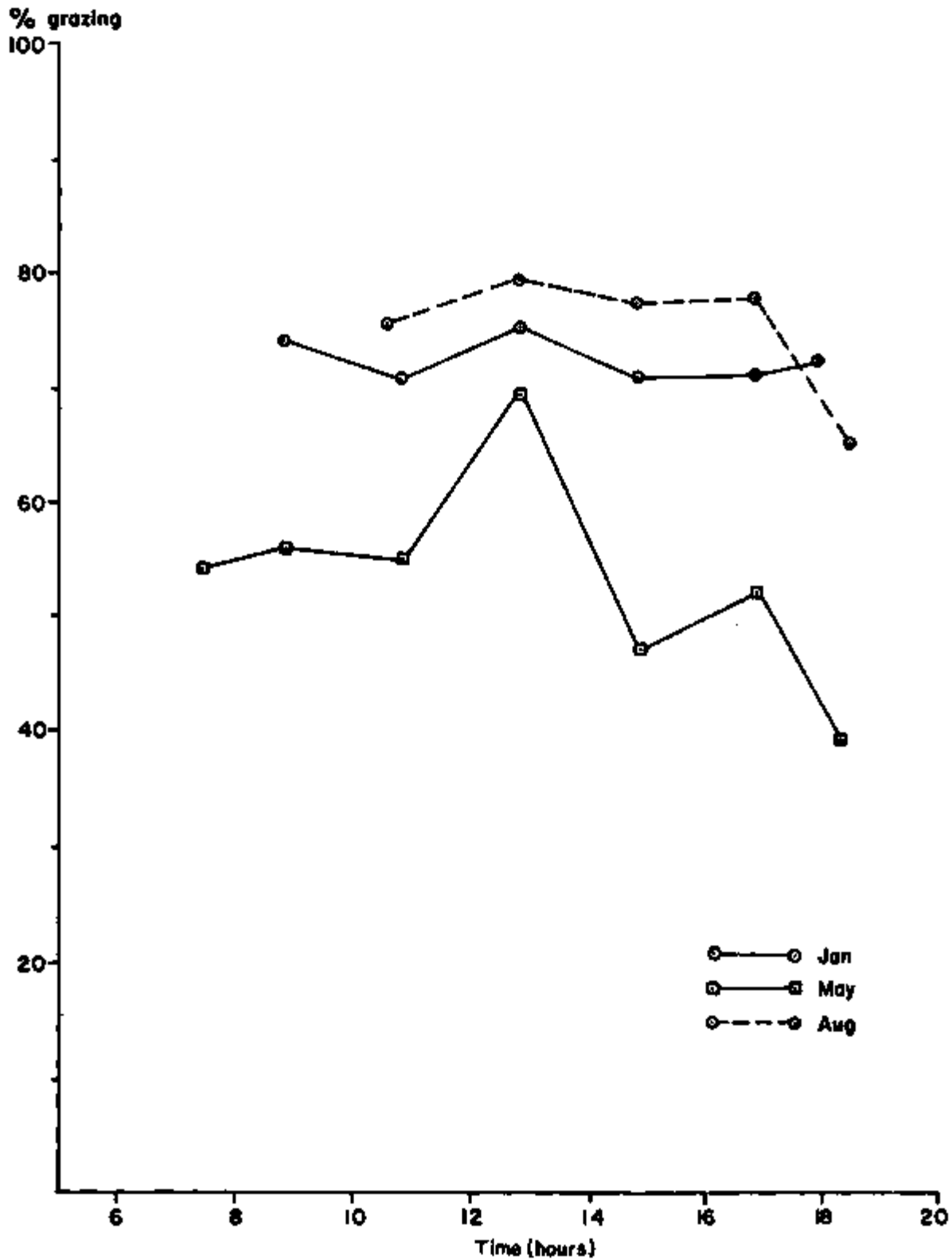
Management practices also affect grazing behaviour of cattle. For instance, a peak in grazing activity occurs immediately after a new strip of pasture has been allocated (Hancock, 1953).

Less is known about the effect of herding on diurnal grazing pattern. The Fulani practice of confining the cattle overnight and well into the morning excludes both: night grazing and the early morning grazing peak found in free-ranging cattle.

As shown in Figure 3, the diurnal feeding activity pattern of herded cattle differed markedly from that of non-herded cattle in that grazing continued throughout most of the day. This corresponds with a report from Smith (1961) that animals restricted to a grazing day of 7 hours grazed almost continuously while on pasture.

Although the White Fulani cattle, with their white hair and dark pigmented skin, are well adapted to high radiation, it is likely that even they suffer from heat stress during midday grazing, particularly in February and March when midday temperatures above 35°C are common. The short herding time and shortage of feed forces the animals to graze more or less continuously, thus preventing them from seeking shade and rest, as described by Lewis (1978). Utilization of fenced pastures for night grazing may be a means of alleviating this problem to some extent.

Figure 3. Diurnal grazing pattern of herded cattle.



Analysis of diurnal cattle activity reveals that another problem expressed by the Fulani in the case study areas - insufficient water for stock in the dry season - is not very severe. The cattle are watered at least once daily throughout the year. During the dry season, watering frequency is increased, and thrice daily watering is not uncommon. In this respect, management of stock in the subhumid savanna differs markedly from management in semi-arid or arid tropical areas, where animals are led to water only every second or even third day (King, 1983).

Summary and conclusions

1. Herded cattle in the subhumid zone use a variety of different feed resources including crop residues, browse, low-lying seasonally inundated areas and fallow land. Crop residues are more important in a farming area whereas browse is used to a greater extent in a grazing reserve.
2. Utilization of these different resources demands control of animal movements combined with flexibility, which can be achieved only through the practice of herding. The need to herd, together with labour competition between cattle husbandry and cropping activities, leads to short grazing times for agropastoralists' herds, particularly in the late wet season.
3. The short herding times lead to a change in the diurnal grazing activity pattern of cattle to one of almost continuous grazing throughout the time out of confinement, even during the hottest time of the year.
4. It is suggested that short grazing time and reduced feed intake during the hot midday in the dry season contribute to the low level of cattle productivity.
5. It is further suggested that the use of fenced pasture for night grazing would enable cattle to extend grazing time and avoid stressful midday grazing, thus increasing feed intake, without sacrificing the flexibility- and utilization of different grazing resources during the day as practised in the present agropastoral system.

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