

Agropastoral herding practices and grazing behaviour of cattle in the subhumid zone of Nigeria

Wolfgang Bayer¹

Subhumid Zone Programme, ILCA, PMB 2248, Kaduna, Nigeria

¹Present address: Nordufer 11
D-1000 Berlin 65
Federal Republic of Germany

Summary

STUDIES OF *grazing behaviour of cattle kept by settled Fulani agropastoralists in central Nigeria revealed the use of a wide range of grazing resources, including crop residues, browse and various distinct types of natural range.*

Herded cattle spent less time grazing than did free-ranging cattle. During the relatively short daily herding period, the cattle showed a high level of grazing activity with very little resting time. Use of diverse grazing resources in proximity to cropped land demands tight animal control which, together with competition for labour between herding and cropping, resulted in the short grazing time, particularly in the late wet season, and probably contributed to the low productivity of the cattle. Transhumant cattle kept in the study areas in the dry season were herded longer each day and were in better condition than the settled herds, which suggests that the transhumant herds are more productive.

Development efforts should concentrate on maintaining the present flexibility and diversity of grazing resource use. Small legume pastures for strategic use can be incorporated into both settled and transhumant pastoral systems. They can be used as an additional grazing resource and could also allow longer grazing periods, which might increase the productivity of the cattle.

Introduction

Livestock development planners in tropical Africa often regard sedentarisation of pastoralists as a prerequisite for any form of improvement in animal production and of the welfare of the pastoralists (Swift, 1982), and tend to consider livestock husbandry in isolation from cropping. However, one of the great strengths of pastoral production systems in subhumid areas is that they permit spatial integration of cropping and livestock keeping, which, at a certain level of external inputs, allows more food to be produced per unit area than either enterprise alone (Bayer and Otchere, 1984).

Based on a study of herding practices and cattle grazing behaviour, this paper examines the consequences for cattle husbandry of livestock–crop integration as practised in an agropastoral production system in the subhumid zone of Nigeria, and discusses implications for livestock development. The study was a component of the research being conducted by the ILCA Subhumid Zone Programme into traditional livestock production systems with a view to developing innovations that build upon the existing systems.

Location and methods of investigation

A study of the grazing activity of cattle kept by settled Fulani agropastoralists was carried out in Abet and Kurmin Biri, in central Nigeria. Both areas receive on average 1100 to 1300 mm of rainfall annually, of which more than 95% falls between April and October. However, there are differences in land use between the two areas. In Abet, a farming area with higher human and cattle population densities, pastoralists have settled spontaneously amidst crop farmers and comprise approximately 10% of the agriculturally active population. In Kurmin Biri, designated as a grazing reserve, pastoral settlement is government assisted. In the reserve there are some enclaves of indigenous farmers and the pastoralists do some cropping themselves. Most of the pastoralists have settled close to the edge of the reserve and include neighbouring farming areas in their grazing orbits.

Both case study areas are in the Guinea savannah zone. The dominant grass species are *Andropogon*, *Hyperrhenia*, *Setaria* and annual *Pennisetum* on more fertile soils and *Loudetia* spp. and *Ctenium* spp. on poorer soils. The major indigenous woody species are *Terminalia*, *Combretum*, *Isobertia* and *Ficus*.

In both study areas the resident cattle are kept almost exclusively by settled Fulani agropastoralists. Transhumant pastoralists who spend the wet season further north bring their herds into the study areas for dry-season grazing. Some characteristics of the intensive study areas and environs are given in Table 1.

Table 1. Characteristics of case study areas in the Nigerian subhumid zone.

	Abet (9°40'N, 8°10'E) ^a		Kurmin Biri (10°5'N, 8°E)	
	Aerial survey area	Intensive case study area	Aerial survey area	Intensive case study area
People/km ²	70	70	12	
Cultivation density(%)	24	25	15	5
Fallow(%)	33	n.k. ^b	15	n.k.
Cattle density (head/km ²)				
Wet season	22.7	25	4.2	5
Dry season	37.4	40	17.3	10
Mean herd size	47.8	49	51.4	53

^aCoordinates refer to central points of intensive case study areas (60 km² each) within aerial survey areas (2500 km² each).

^bNot known.

Sources: Milligan et al (1979); Waters-Bayer and Taylor-Powell (1984a).

The study was conducted in Kurmin Biri during 1980 and in Abet during 1980–81. Observations made by enumerators who followed the herds included the times at which each herd left and returned to the camp, and predominant herd activities during the time out of the camp. These were classified into walking, resting, watering and grazing. Grazing was subdivided into grazing

of natural range, browsing, and grazing on crop residues. During the course of the study it was decided to include grazing of burnt areas as an additional subdivision of grazing activities.

Results and discussion

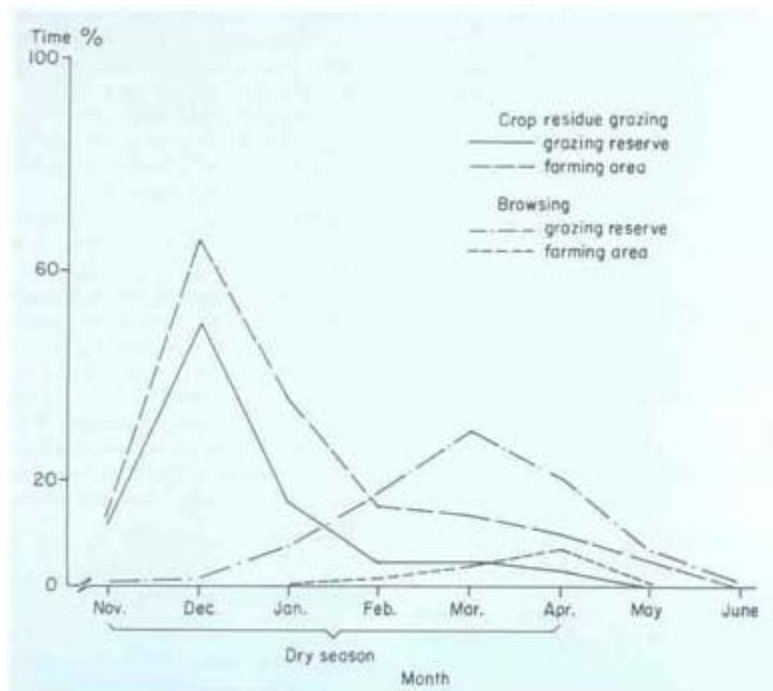
The agropastoralists' cattle in the study areas grazed a wide variety of feed resources (Table 2). Cattle in the farming area (Abet) spent twice as much time grazing crop residues as those in the reserve (Kurmin Biri), whereas the cattle in the reserve spent eight times as much time browsing as those in the farming area, reflecting the relative availability of crop residues and browse in the two areas. In this study, only sorghum and millet residues were considered, but subsequent more detailed work on crop residue utilisation in the farming area revealed that rice and soya bean residues were also grazed to a considerable extent (Powell, 1984). The most important browse species were *Azelia africana*, bamboo, *Khaya senegalensis*, *Adenolichos paniculatum* and *Mucuna* spp.

Table 2. Contribution (%) of different grazing resources to total grazing time.

	Abet (farming area)	Kurmin Biri (grazing reserve)
Crop residues	12.6	6.6
Browse	1.4	11.2
Natural range	86.0	82.2
Average grazing time (h/day)	6.1	6.2

Both crop residue grazing and browsing were highly seasonal. Crop residue grazing was most intensive in December immediately after grain harvest, when it accounted for 65 % of the total grazing time in the farming area and 50% in the grazing reserve. Browsing peaked in the late dry season, accounting for 30% of the grazing time in March in the reserve and 8% of the grazing time in April in the farming area (Figure 1).

Figure 1. Crop residue grazing and browsing as percentage of total grazing time, November to June.



Crop residues provided good quality forage during the early dry season (Powell, 1984). At the height of crop residue grazing in December, faecal nitrogen concentration of cattle in the farming area was 1.55%, whereas in the late dry season it had dropped to 0.6% (Powell, personal communication). If faecal nitrogen content falls below 1.3%, animals respond to non-protein nitrogen supplements such as urea, indicating nitrogen deficiency in the diet (Winks and Laing, 1972). The peak in crop residue grazing coincided with a conception peak in the cattle (Otchere, 1984).

In both study areas, more than 80% of the total time spent grazing was spent on natural range (Table 2). During the second year of study, when regrowth on burnt areas was included as a distinct feed resource within the natural range, cattle spent 19.3% and 22% of total dry-season grazing time on regrowth after burning in the farming area and in the reserve, respectively. Regrowth after burning may contain more than 8% crude protein during the dry season, compared with only 1 to 2% in unburnt natural range vegetation (Blair Rains, 1978). However, it yields only 0.1 to 0.2 t/ha, compared with 1.5 to 2.5 t/ha from unburnt natural range (Mohamed-Saleem, 1984a).

Herding and grazing time

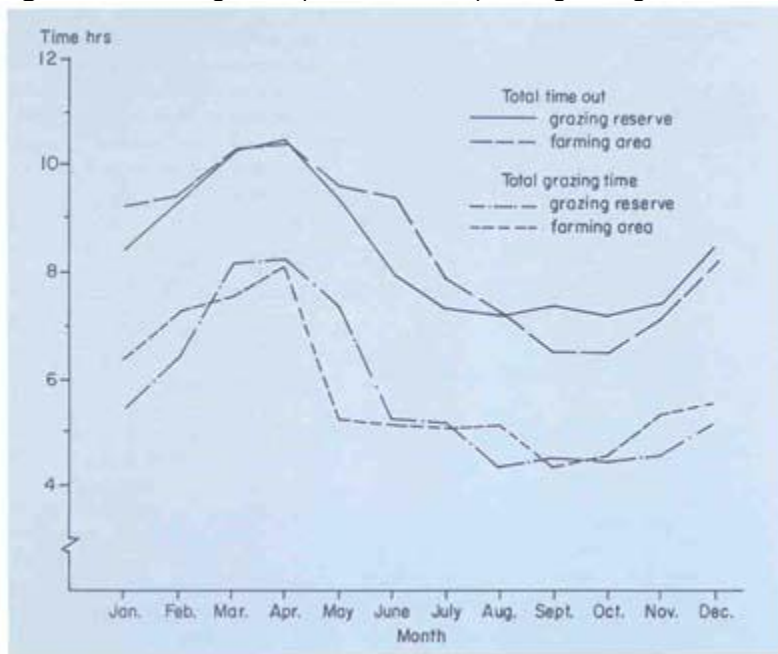
Averaged over the whole year, the cattle were herded for about 8.5 hours per day in the farming area and slightly less than 9 hours per day in the grazing reserve (Table 3). Walking accounted for about one quarter of herding time, whereas resting and watering together represented only 5% of total time out of camp, with little difference between the two study areas. In both areas, actual grazing time accounted for approximately 75% of the time out of the camp (Table 3).

Table 3. Herd activities as percentage of total annual time out of camp.

	Abet	Kurmin Biri
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 (h/day)	8.8	8.4

Herding and grazing times varied according to season. The longest herding time was recorded in April and the shortest in September (Figure 2). Actual grazing time was little more than 5 hours per day in the wet season, peaked at 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 in the wet season, with a peak when the first scattered rains fall—agrees well with the pattern of free-ranging domestic ruminants in similar climates (Smith, 1959; Wilson, 1961). However, the absolute daily grazing times of the herded cattle were very short compared with those of free-ranging animals.

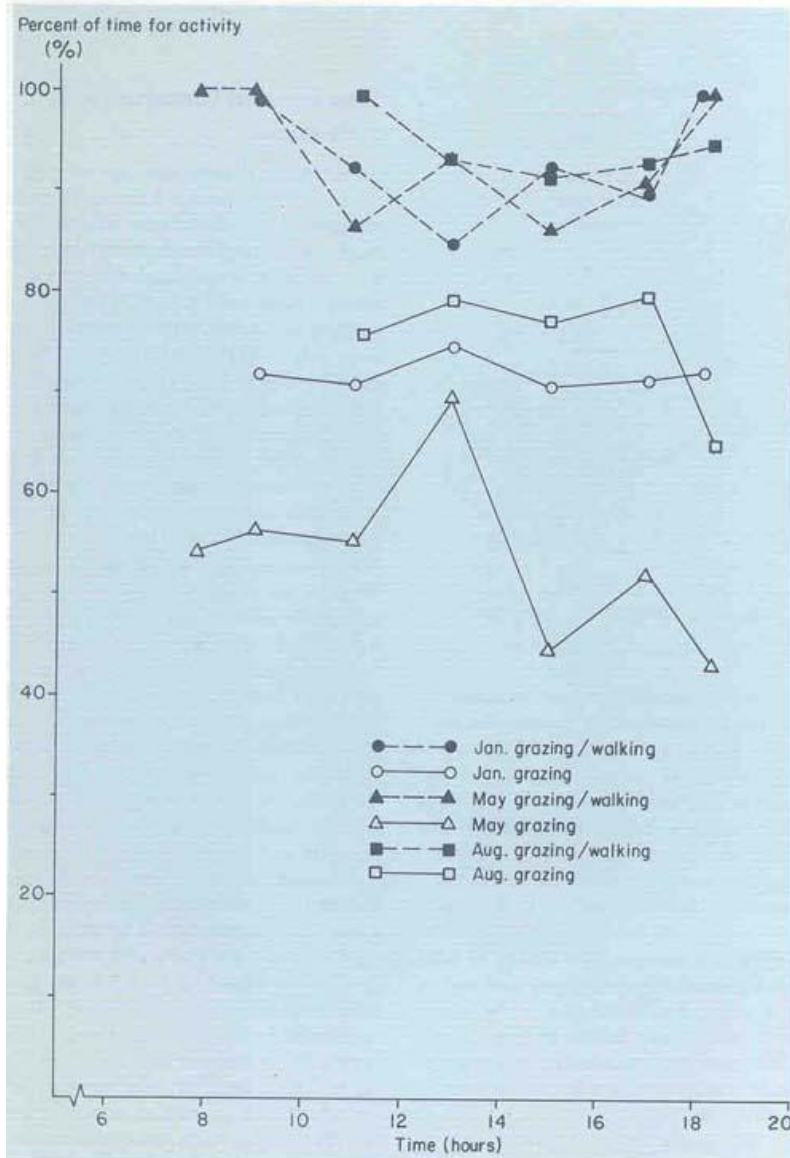
Figure 2. Herding time (total time out) and grazing time of cattle in Abet and Kurmin Biri.



A review of more than 100 grazing studies in tropical and temperate areas (Arnold and Dudzinski, 1978) gave an average grazing time for beef cattle of 9.5 hours per day. Only 10% of the references indicated grazing periods of less than 7 hours per day, and only 2% gave a figure of less than 6 hours per day. Stobbs (1974) found grazing periods of up to 14 hours per day for grazing cattle in southern Queensland, Australia, and Smith (1959) found similarly long grazing periods for zebu cattle in Zimbabwe when pasture quality was low.

The impression that time spent grazing is restricted by the present herding practices is supported by the diurnal pattern of grazing activity. Free-ranging animals show a peak of grazing activity in the early morning, another in the late afternoon and substantial grazing activity during the night (Smith, 1959; Wilson, 1961; Arnold and Dudzinski, 1978). The grazing periods are separated by resting and ruminating periods. Night grazing can account for up to 25% of total daily grazing time in free-ranging indigenous African cattle (Smith, 1959; Haggard, 1968). In contrast, the herded cattle studied maintained a high level of grazing activity throughout the herding day, and most of the non-grazing time was occupied by walking (Figure 3).

Figure 3. Diurnal grazing activity pattern of agropastoral cattle herds.



Footnote: The beginning and end of each line indicates the beginning and end of the herding day

The present practices of the settled Fulani prevent grazing in the early morning and at night. As a result, the activity pattern during the herding period was one of more or less continuous

grazing. This agrees with the findings of Smith (1961), who reported that animals that were allowed on pasture for 7 hours per day grazed almost continuously and deferred resting and ruminating until they were confined at night. However, animals allowed on pasture for 11 hours (Smith, 1961) or 12 hours (Lewis, 1978) exhibited a normal grazing pattern.

The effects of restricted grazing time on animal productivity have not been extensively researched. In Zimbabwe, Smith (1961) compared liveweight gains of cattle allowed on pasture for 7, 11 and 24 hours per day. The animals in the 7-hour treatment gained less, or lost more, weight than those in the 11- and 24-hour treatments in the dry season, when pasture quality and quantity were low. Over the 16-month trial period, liveweight gains per animal in the 7-hour treatment were only half those in the 11- and 24-hour treatments (37 vs 73 kg). Over a 10-month trial period in Uganda, steers that were allowed to graze at night gained 13 kg (30%) more than those yarded overnight (Joplin, 1960). In Tanzania, heifers allowed to graze overnight were 25 to 110 kg heavier at 120 weeks of age than those allowed to graze only during the day (Kyomo et al, 1972).

These findings suggest that the short grazing times observed in this study contribute to the low productivity of the cattle of settled pastoralists in the study areas, where calving rate was 49%, calves gained 0.2 to 0.3 kg liveweight per day and calf mortality up to 1 year of age was 30% (Otchere, 1984). It is unlikely that the herded cattle can eat their fill during the short grazing time (5 hours/day) in the wet season. Grazing time would probably be longer and feed intake higher if the animals were herded for a longer period at this time of year, as suggested by Haggard's (1968) findings that Fulani cattle allowed on pasture for 11 hours per day in the wet season grazed for 7.5 hours.

Some reasons given by pastoralists for short herding time were:

- Higher risk of worm infestation in the early morning during the wet season;
- Negative effect of wet-season dew on feed intake of cattle;
- Difficulty in controlling animals with satiated appetite; and
- Competition for labour between herding and cropping.

Night grazing was avoided for fear of predators and thieves.

Herding and farming

Spatial integration of pastoral production and cropping permits more intensive use of land than cropping or livestock husbandry alone and also benefits both sectors. Crop residues and fallow lands offer better forage than natural range, and the open, park-like nature of cultivated land facilitates herding (Powell and Waters-Bayer, 1984). Furthermore, proximity to cultivators offers pastoralists relatively easy access to markets for purchasing consumer goods and for selling livestock products. The crop farmers benefit from the ready availability of meat and milk products, but the major advantage is the availability of manure for their fields.

The main disadvantage of integrating pastoral production and cropping for the pastoralists is that animals must be closely supervised to avoid crop damage. Thus, two of the reasons given for the short herding time deserve particular attention: the difficulty of controlling animals with satiated appetite and the competition for labour between herding and cropping.

Ethological studies show that towards the end of a grazing period some animals still feed while others begin to ruminate or wander idly (Arnold and Dudzinski, 1978). A herd that ceases to behave uniformly becomes more difficult to handle. The practice of grazing fallow and uncultivated fields adjacent to unharvested fields demands tight herd control if crop damage is to be avoided. Cessation of herding before the animals' appetites are fully satiated, and hence before behaviour begins to diverge, reduces the difficulty of herding. Whereas young boys can handle the herds in the dry season, older youths or adult men must 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.

The present systems of livestock–crop integration in the subhumid zone are characterised by high labour requirements for animal control in order to make optimal use of land in farming areas. The short grazing time when pastoralism and cropping are spatially integrated may be a constraint on animal productivity, but is partly compensated for by the access to better quality feed on fallow and harvested land. Spatial segregation of cattle-keeping and cropping, as proposed in the original plans for grazing reserves in Nigeria, would sacrifice the better utilisation of land possible within the present integrated systems and would lower the total combined yield of animal and crop products per unit area.

Transhumant versus settled pastoralism

Transhumant herders who use the study areas in the dry season leave camp each morning 1.5 to 2 hours earlier than the settled Fulani and, subtracting a mid-morning break of half to 1 hour, herd their cattle for about 1 hour more per day. Those pastoralists who bring cattle into the study areas only during grain harvest herd their animals for up to 3 hours more per day than do the settled Fulani during that time. Reports from semi-arid savannah areas (e.g. Hopen, 1958; Barral, 1967) indicate that some transhumant pastoralists also allow their cattle to graze at night, but this was not observed in the study areas.

Few studies reported in the literature compare the productivity of different 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 differences 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 savannah of Nigeria, where human and cattle population densities are higher than in the subhumid savannah. The nomadic cattle were found to spend more time out of the camp and generally grazed longer, but walked up to 30 km per day, compared with a maximum of only 14 km for settled herds. The settled pastoralists were able to provide their cattle with a more varied and steady feed supply within more confined areas, i.e. requiring less energy expenditure by cattle and herders. By virtue of their closer association with cropping systems, the settled Fulani in the semi-arid zone appeared to have an advantage over nomads in terms of access to valuable grazing resources such as crop residues and *fadama* areas (low-lying seasonally inundated areas).

In the subhumid study areas, crop residues and *fadama* grazing are more abundant relative to cattle population than in the semi-arid zone, and transhumant herds appear to have easy access to these resources. Farmers in the zone welcome transhumant pastoralists camping and grazing their herds on farmland during the dry season, because they recognise the value of the manure and because the herds leave the area before any crop damage can occur. Thus, in contrast to the situation in the semi-arid zone, transhumant pastoralists who move seasonally

into these subhumid farming areas are by no means disadvantaged and may even gain from their ability to utilise a wider range of grazing resources than the settled Fulani.

Although the productivity of the transhumant cattle was not studied, they appeared to be in generally better condition than the resident cattle, which suggests that the transhumant herds may be more productive. The transhumant system of production is more likely to disadvantage people than animals, especially if the whole family moves with the herd, since it limits accumulation of household goods, precludes permanent dwellings, and reduces access to health care, schooling and other social amenities. The hardship of movement on the pastoral family was a reason given by Fulani living in the study areas for their decision to settle (Waters-Bayer and Taylor-Powell, 1984b).

Implications for livestock development

Despite low productivity per animal, pastoralism can contribute to relatively high levels of food production per unit area, since it permits multiple use of land. Moreover, spatial integration of cattle-keeping and cropping benefits both the cattle, through crop-residue and fallow-land grazing, and the crops, through manure. The already high degree of flexibility and diversity of grazing resource use in the agropastoral production system in the study areas could be enhanced by the strategic use of an additional grazing resource. Small legume pastures (fodder banks), which are currently being tested by ILCA and some agropastoralists in the area, provide better quality feed in the late dry season than other grazing resources (Mohamed-Saleem, 1984b), and, being fenced, also permit the grazing day to be prolonged, and even allow night grazing, without requiring additional labour.

However, fencing represents a change from the communal grazing practised hitherto. Indigenous pastoralists have started to enclose land in other parts of tropical Africa (Behnke, 1985) and a small number of cases have also been observed by the ILCA research team in Nigeria, where the present system of land rights permits private use.

Estimated on the basis of literature values (Smith, 1961; Joplin, 1960; Kyomo et al, 1972) and preliminary results of grazing experiments in the Kurmin Biri reserve, grazing fodder banks at a stocking density of 4 to 5 head/ha for 2 to 4 hours/day in the late dry season, as a supplement to current feed resources, could increase liveweight gains by 25 to 30 kg/head per year in growing stock and also substantially increase cow and calf viability (Bayer, 1984). Fodder banks can be incorporated into both settled and transhumant pastoral systems, particularly if herd splitting is practised and a milking herd is kept close to the dry-season camp.

In the subhumid zone, settlement of pastoralists alone is unlikely to lead to increases in herd productivity. In fact, if pastoralists settle pasture development will probably be necessary to compensate for the loss of diversity in feed resources. Rather than concentrating on settling pastoralists, development efforts should aim at:

1. Maintaining the present crop–livestock integration and utilisation of diverse feed resources (crop residues, fallow land, *fadama*, browse and upland range, both burnt and unburnt);
2. Permitting seasonal use of different geographic regions, and providing marketing facilities and social services at wet- and dry-season grazing areas so as to improve the welfare of the transhumant pastoralists;

3. Increasing feed diversity and quality through promotion of small improved pastures for strategic use; and
4. Assisting pastoralists to obtain at least temporary rights to use small areas of land for such pasture improvement, ideally in combination with cropping.

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