Paper 6: Traditional cattle production in the subhumid zone of Nigeria

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Abstract

The sizes, structures, general management and productivity of herds under pastoral conditions in the Kaduna Plains of Nigeria are briefly described. Herd sizes averaged 45.9 head, 64.4% of which were females. Calvings and conceptions were bimodally distributed. Age at first calving, calving percentage and calving intervals averaged 60 months, 48% and 25 months respectively. Calf liveweight and mortality to 1 year of age averaged 103 kg and 22.4% respectively. After adjusting for length of calving intervals, milk for humans and calves averaged 112 and 169 litres/cow/year respectively. The productivity of Bunaji cattle under sedentary pastoral management is thus well below genetic potential.

Introduction

The Bunaji breed constitutes about 51% of the estimated 9.3 million cattle in Nigeria (Lamorde and Franti, 1975). Studies were initiated by ILCA's Subhumid Zone Programme to determine the constraints on improving the productivity of this breed.

Bunaji herds in the case study areas are routinely penned at night, released after milking each morning and herded to the grazing ground. Unweaned calves are tied in order from youngest to oldest to a rope called the dangwali, situated near the enclosure for the adults. Throughout the growing season animals are penned to prevent them from damaging crops, and to ensure that they are not stolen. The enclosure is often a single strand of barbed wire. During the dry season, once crops have been harvested, adult animals are often tied in open fields in pairs, according to age.

Breeding is not controlled, allowing cows to become pregnant throughout the year and spreading the income from milk sales. Calves usually wean themselves when the dam ceases milking but pastoralists resort to artificial weaning when the dam is in an advanced stage of pregnancy and the previous calf is still suckling. This is done by smearing the dung of young calves on the dam's teats every day until the calf stops sucking. Bulls not wanted for breeding are not castrated unless they are troublesome, and in any case not until they are 2 or more years of age. Castration is performed in crude surgical operations, or by stretching the scrotum between two light poles and crushing the spermatic cords with an iron bar.

The daily morning milking is begun by allowing the calf to suckle for about a minute to initiate the flow of milk. The calf is then tethered to the near side foreleg of its dam while the hind legs of the dam are held to prevent the cow from kicking whoever milks her. Milking is usually done by men or boys. The quantity of milk extracted from each cow depends on the milker's experience, discretion and the cow's stage of lactation. After milking, the cow and calf are released and the calf suckles the remainder of the milk. Since cows will not let down in the absence of their calves, milking stops when a calf is lost.

After the milking, the pastoralists put out kanwa, a local mineral supplement that is high in calcium (23.7%) and also contains a little phosphorous (0.6%). Kanwa is a traditional trade item brought from northeastern Nigeria and often erroneously called potash.

Materials and methods

Data were collected over a 4-year period for some 30 herds in the Abet, Kurmin Biri, Kaduna and Madauchi areas of central Nigeria. The Kaduna and Madauchi herds are located in pert-urban locations near Kaduna city and Zonkwa town, and were included in the study to provide a contrast with the rural sites of Abet and Kurmin Biri.

Initial records of age and number of calves dropped by breeding females in each herd were obtained by questioning the owners. Age was verified or modified after the animals' teeth were examined. As calves were born into the herd, date of birth, birthweight and dam number were recorded. The initial herd calving percentage was estimated as follows:

$$\text{Calving percentage} = \frac{\text{Total number of calves dropped}}{\text{Total number of cow years}} \times 100$$

Cow years were augmented by adding one third of the total for weaned heifers. This was done because an earlier survey had shown that one third of weaned heifers were capable of calving. Calving percentage was updated monthly by the same formula, in which cow months were divided by 12 to give cow years.

Calves were weighed at weekly intervals until weaned. Calves weighing more than 100 kg were measured around the heart girth and the scapulo-ischial length to estimate weight by the Ross (1958) formula. Adult animals in the ILCA research herd were weighed periodically using a weigh bridge. The amount of milk extracted for human consumption was recorded daily. The milk equivalent for calf growth to 180 days postpartum was estimated by the following formula (Drewry et al, 1959; and Montsma, 1960; 1962):

$$\text{Milk equivalent} = (120\text{d wt} - \text{birth wt}) \times 11.65 + (180\text{ wt} - 120\text{d wt}) \times 8.55$$

A milk production index was then calculated:

$$\text{Milk production index} = \frac{\text{Annual extracted milk} + \text{milk equivalent}}{\text{Calving interval}} \times 365$$

Owners were interviewed from mid-February 1984 to mid-April 1984 to determine which cows were pregnant and the approximate stage of each pregnancy. Ninety-five calving intervals were estimated in this way and added to the intervals already recorded over the previous 3 years.

Based on rainfall data recorded by ILCA since 1980 in the study area, the months of the year were grouped into four subseasons:

Subseasons Months

Dry	December-February
Early wet	March-May
Peak wet	June-August
Late wet	September-November

Data on birth weights, growth rate, milk offtake, calf survival and calving intervals were analysed by Harvey's least squares fixed model procedures (Harvey, 1972). The model included effects of season, year, sex of calf, location, and owner. Interactions between year and season were incorporated in the model. Parity of the calf at birth was not known and was therefore not considered in the analysis. Unequal and disproportionate subclass numbers gave unbalanced factorial designs for which conventional analysis of variance techniques were not applicable. The factors used in the model are evident when the results are presented for each character analysed. The residual mean square was used as the error term to test the significance of all differences evaluated. Linear contrasts of least squares means were computed to determine differences between groups.

Results and discussion

Herd size and structure

Herd size data were obtained from three study locations and are shown in Table 1.

Table 1. Herd sizes at different locations, 1979.

Location	N	Herd size		Mean	SD±
		Maximum	Minimum		
Abet	11	61	13	38	16.2
Kurmin Biri	12	96	16	48.6	27.0
Madauchi	11	135	25	50.8	29.8
All herds mean	34	-	-	45.9	24.9

The results of a survey involving 1560 head of cattle grouped into age and sex glasses in 34 herds at Kurmin Biri (583), Abet (418) and Madauchi (559) are summarized in Figures 1, 2, 3 and 4. Females averaged 64% of the herds in the three different locations.

Herds in Abet contained a low number of males, and no males older than 8 years were observed. In Kurmin Biri there were a few males older than 8 but under 10 years. These were steers. At Madauchi, there were more older males, again mostly steers. The percentage of steers in the herds were 3.9, 3.1 and 7.5% in Kurmin Biri, Abet and Madauchi respectively.

Reproductive performance

Age at first calving, length of calving interval and length of productive life of the cow are the most important factors in the productivity of breeding herds.

Data summarized in Table 2 suggest that the average age at first calving is about 60 months. This agrees with data obtained from Bunaji herds on the Jos Plateau (Pullan, 1979; Synge, 1980). Average age at first calving of Bunaji females on government farms at Kabomo and Birnin Kudu in northern Nigeria was about 42 months (Wheat and Broadhurst, 1968; Wheat et al, 1972). At the National Veterinary Research Institute at Vom, age at first calving in Bunaji averaged 37 months (Ologun, 1980).

Figure 1. Composition of pastoralists' herds in Kurmin Biri.

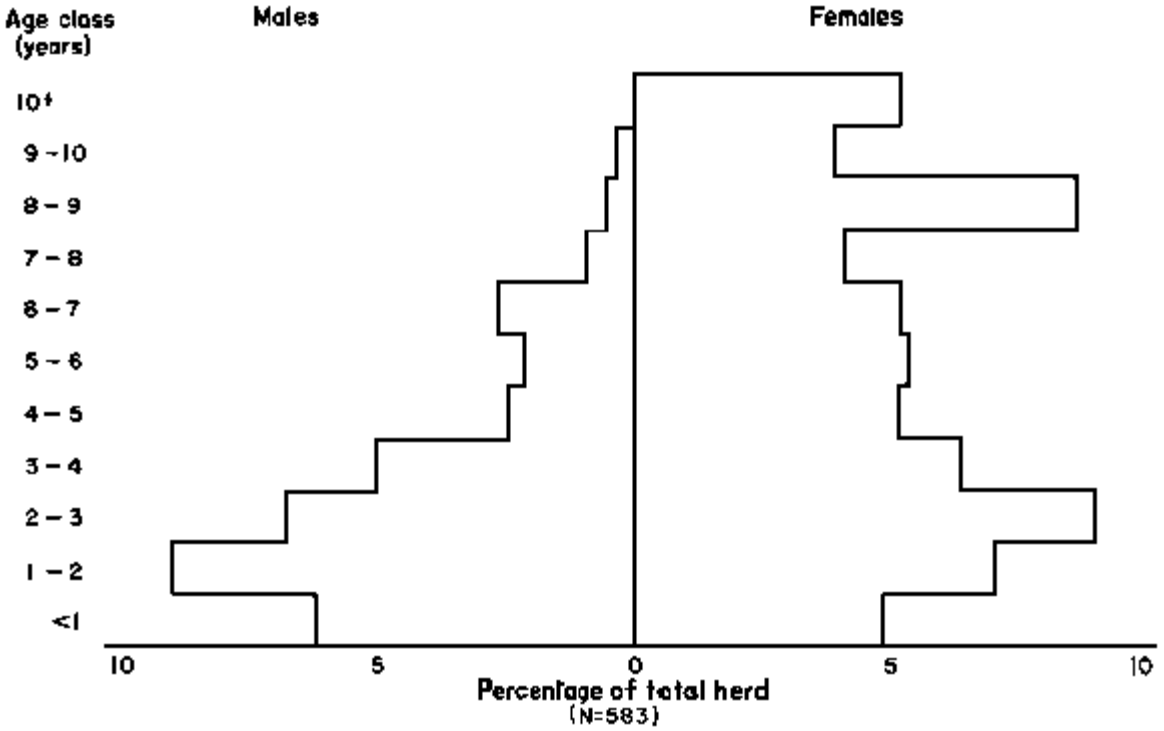


Figure 2. Composition of pastoralists' herds in Abet.

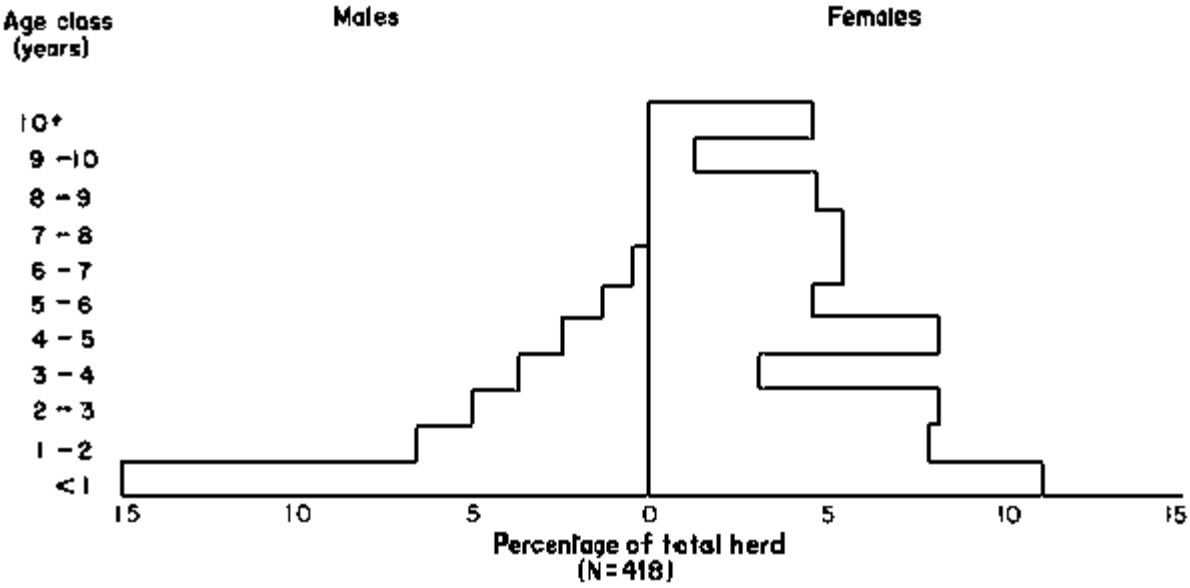


Figure 3. Composition of pastoralists' herds in Madauchi.

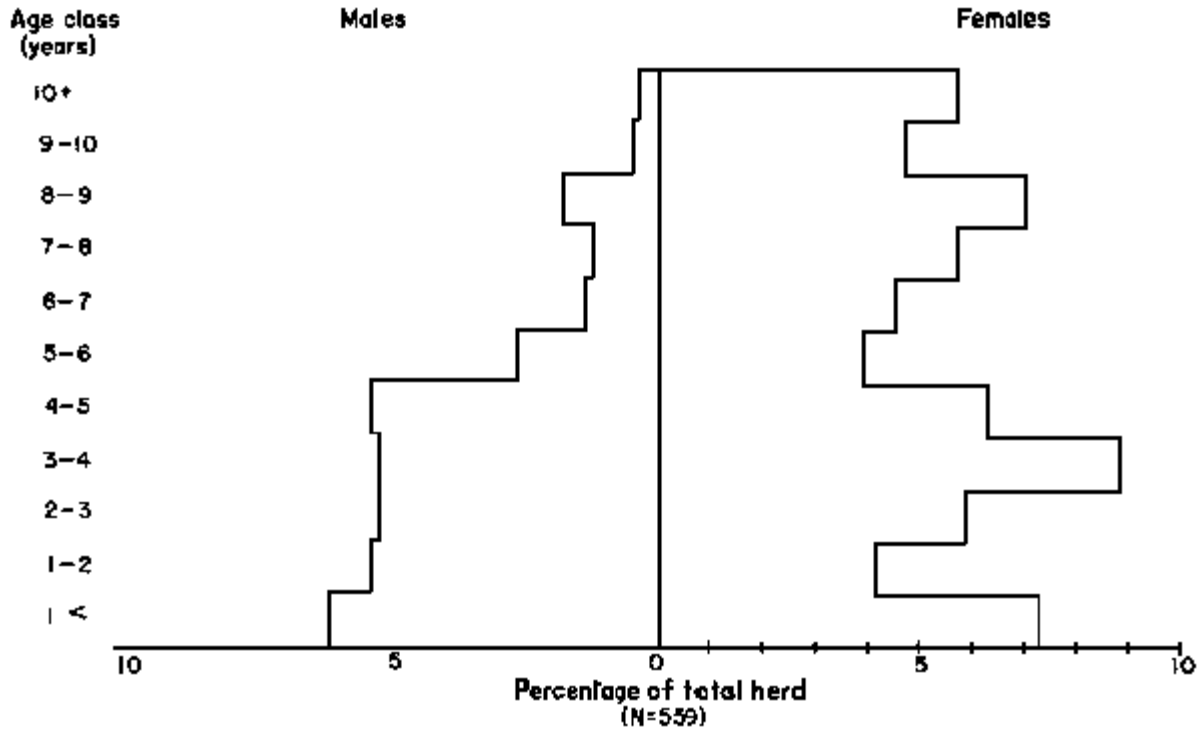
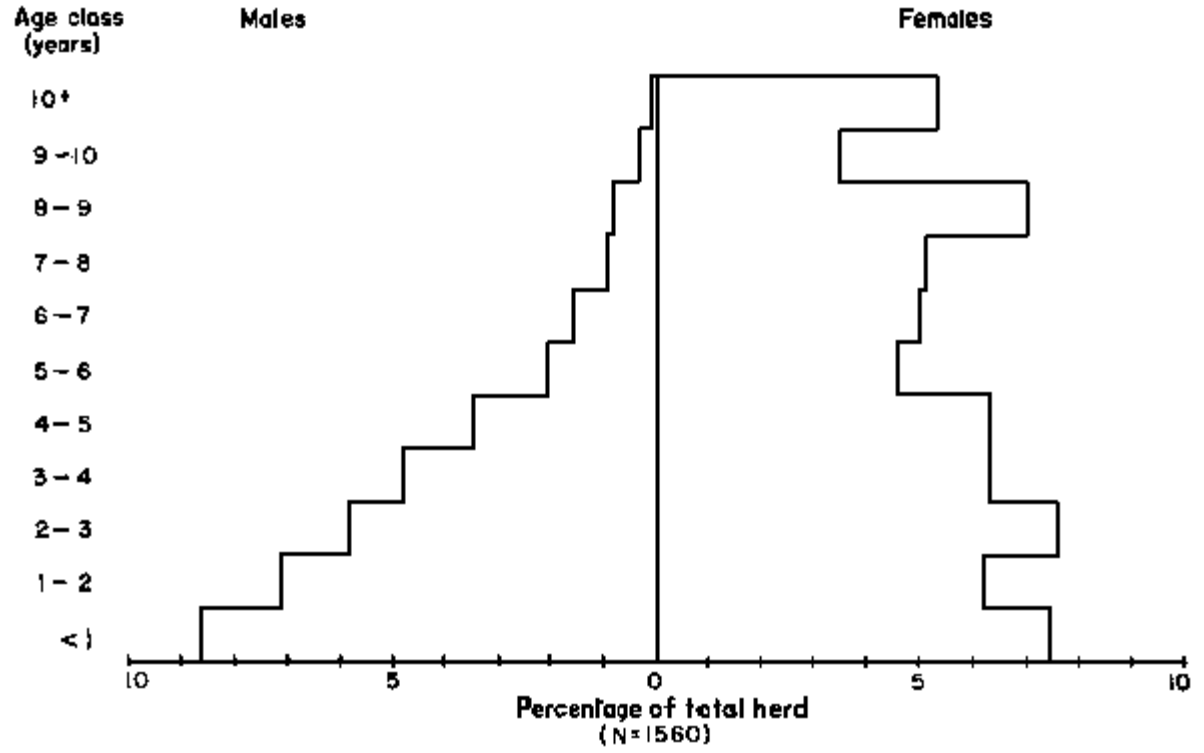


Figure 4. Composition of pastoralists' herds in Kurmin Biri, Abet and Madauchi.



Only a few of the females in this survey had produced more than four calves (Table 2). With an estimated age at first-lying of about 5 years and a calving interval of about 25 months, cows with four calves would be about 11 years old.

Since breeding is uncontrolled, it was expected that heifers were breeding too young. Only eight heifers born since ILCA started recording births in 1979 had calved for the first time when this analysis was made. This subgroup averaged 43 months at calving. That uncontrolled breeding does not necessarily lead to premature breeding is also bores out by the results of Wilson and Clarke (1975).

Table 2. Number of cows reported by producers to have given birth to different numbers of calves in three study locations.

Number of permanent incisors (age of cow)	Number of cows[a/] giving birth to number of calves						
	0	1	2	3	4	5	6+
1 pair (over 24 months)[b/]	28						
2 pairs (over 30 months)	73						
3 pairs (over 39 months)	53	8					
4 pairs (over 48 months)	38	74	85	90	76	19	19
Total	192	82	85	90	76	19	19
% of overall total	35.5	14.3	14.8	15.7	13.3	3.3	3.3

[a/] Total number of cows= 563 from 32 herds.

[b/] According to Wilson and Clarke (1975).

Calving intervals

The mean calving interval for 236 records from 1979 to 1981 was 757.3 days. None of the environmental effects included in the model had a significant effect on calving interval.

Least squares means of calving intervals are shown in Table 3. The mean for calvings which occurred in 1979 was below the overall mean, while that of 1980 was 28.9 days longer. The interval for calvings that occurred in the dry season was 110 days longer. Although the intervals of these calvings was not significant at the 5% level, with more data they' may prove to be the result of poor nutrition.

Calving intervals for herds in Abet and Madauchi were below the overall mean, while these in Kurmin Biri were about 31 days longer.

Table 3. Estimated least squares means for calving interval (days) in Bunaji herds.

Variable	No. of records	Mean
Overall	236	757.3 (25.2)[a/]
Year of calving		
1979	49	730.0 (24.3)
1980	76	786.2 (26.2)
1981	111	755.7 (25.2)
Season of calving		
Dry	28	867.3 (28.9)
Early wet	93	767.2 (25.6)
Peak wet	36	68.2 (22.7)
Late wet	79	712.5 (23.8)
Sex of calf		
Male	119	765.5 (25.5)
Female	117	749.1 (25.0)
Location of herd		
Kurmin Biri	114	788.6 (26.3)
Abet	96	734.5 (24.5)
Madauchi	26	748.8 (25.0)

[a/] Figures in parenthesis are calving intervals in months.

Pullan (1979) estimated a calving interval of about 27 months in Bunaji cows in pastoralists' herds on the Jos Plateau. Bunaji cows in government herds have averaged about 14 months (Wheat and Broadhurst, 1968; Wheat et al, 1972). The long calving intervals recorded by ILCA are probably associated with lactation stress, since milking and calf suckling are continued as long as possible. Cows suckle their calves and are milked by hand as long as even a very small amount of milk is produced. Offtakes as low as 250 ml/cow/day are not uncommon.

Calving percentage

From the calving intervals reported above, calving percentage was estimated to average about 48.2%. This figure is close to the mean of 47% obtained by dividing the total number of calves by the total number of cow years. The mean calving percentage observed in this study was higher than that observed in traditional herds on the Jos Plateau (Pullan, 1979; Synge, 1980).

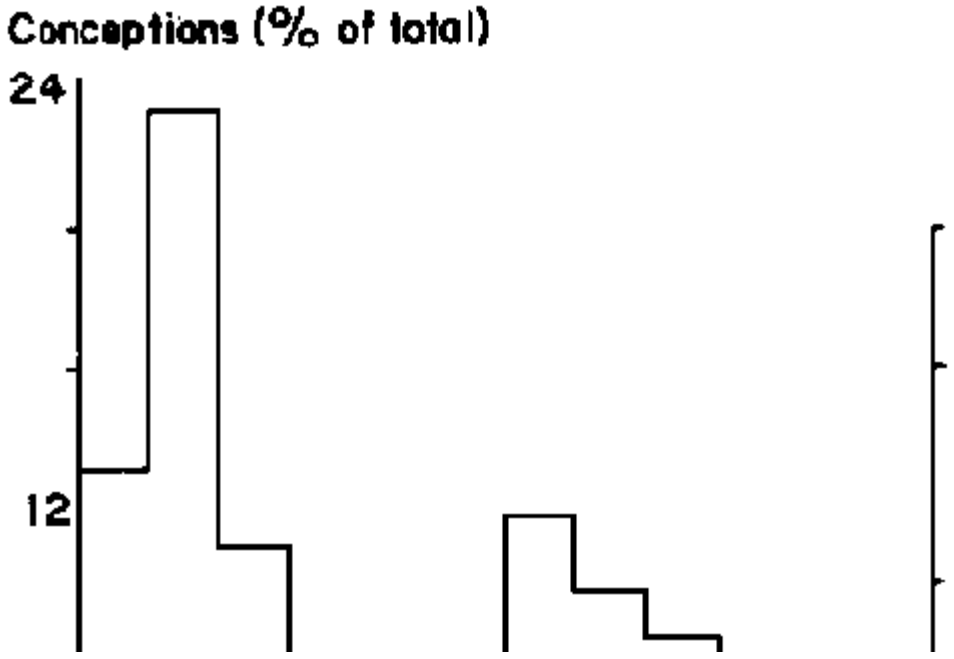
Seasonal effects

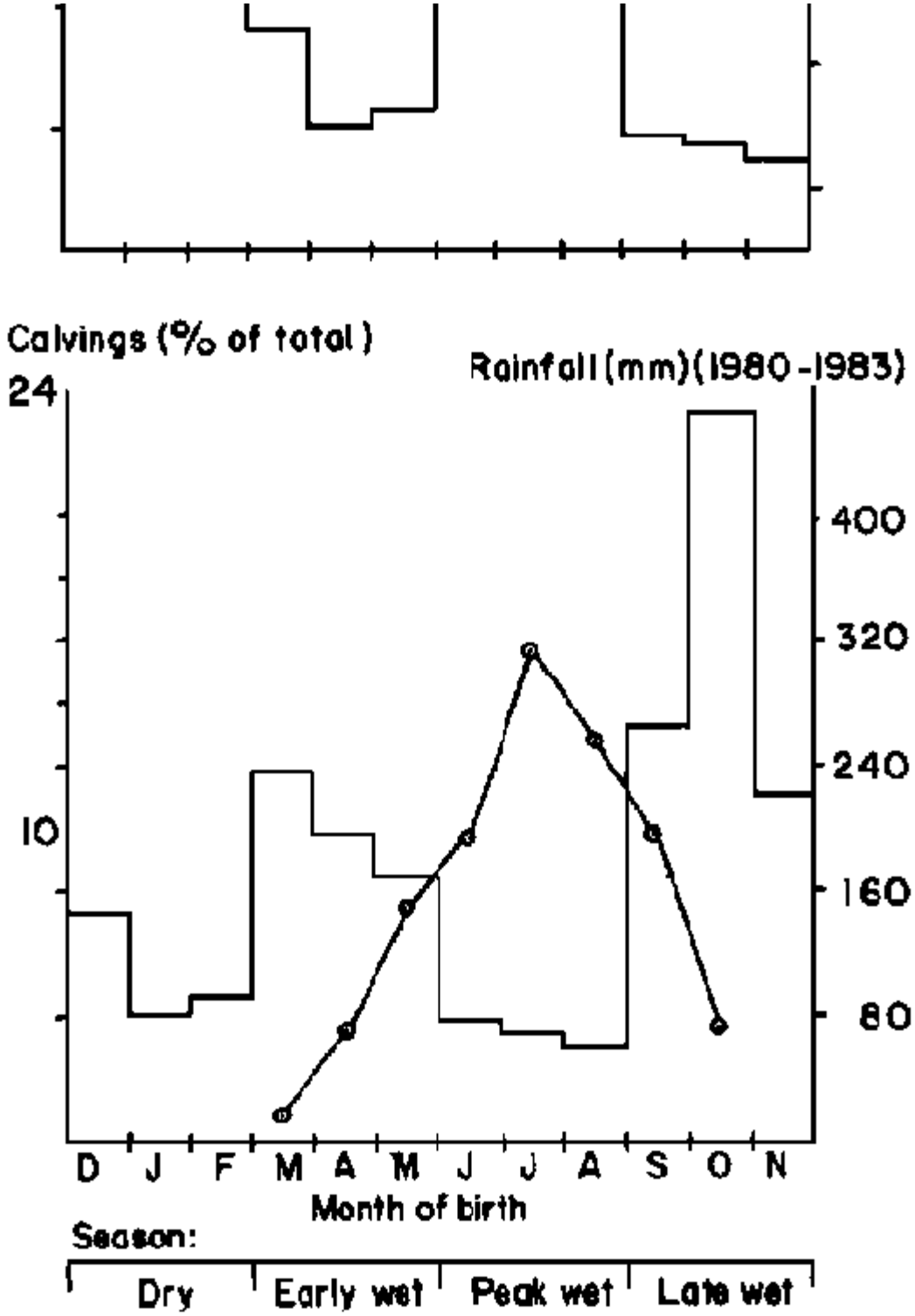
Whereas high correlations (r = 0.82) between annual rainfall and calving have been found elsewhere (Butterworth, 1983), in the present study very low correlations were found between annual rainfall and calving or conception.

Several research workers have demonstrated that uncontrolled breeding leads to seasonally uniform calving (Menendez et al, 1978; Pena and Plasse, 1971; Butterworth, 1983). The present study revealed two calving peaks (Figure 5), an early wet-season peak between March and May and a late wet-season peak between September and November. Similar observations have been made on the Jos Plateau (Lamorde and Franti, 1975; Pullan, 1979; Synge, 1980). Zakari et al (1981) reported fewer oestrous cycles in Bunaji cows during the dry and pre-rainy seasons, when behavioural signs of oestrus were poorly manifested and lasted for only a short period. During the rainy and pre-dry seasons, however, the duration of oestrus and behavioural signs of heat were much more pronounced.

These findings are related to the nutrition of the animals, since the periods when forage quality is low coincide with the periods of suppressed oestrus and mating behaviour.

Figure 5. Monthly distribution of rainfall, births and conceptions.





The present study found that about 74% of conceptions occurred during the dry months from November to February; the remainder occurred during the only and peak wet-season months from March to August.

The wet-season peak is caused by improved nutrition and the rising liveweights of the heifers and cows. The reason for the dry-season conception peak is less obvious, but it is probably related to crop residue grazing. Cattle spent about 200 minutes each day on crop residues in December, and about 60 minutes in January and February. The chemical composition of the major crop residues (sorghum and millet) and the time spent grazing them indicate that residues are a major source of nutrients during this period (Paper 14).

From February to April, cattle spent over 60 minutes a day (about 12% of their total grazing time) browsing, and this must be an important part of their diet (Le Houérou, 1980; Dicko-Touré, 1980; Toutain, 1980). Leguminous browse plants are rich in phosphorus (Kapu, 1975; Agishi, 1984). As noted above, kanwa, a local mineral supplement, is fed to animals during the dry season. Although it has been analysed (Table 4), its effect on oestrous activity in the dry season is unclear. Its phosphorus content is higher than that of local native pasture, but its high calcium to phosphorus ratio could cause a nutritional imbalance. It is possible that the cumulative effects of crop residue grazing, browsing and the mineral supplement could cause the higher conception rate during this period.

Table 4. Principal elements in kanwa cattle salt.

Na (%)	K (%)	Ca (%)	P (%)	Mg (ppm)	Fe (ppm)	Mn (ppm)	Cu (ppm)	Co (ppm)	Zn (ppm)
1.5	4.7	23.7	0.6	848.7	774.7	407.2	44.2	23.6	176.0

Calf growth

The data set used to assess calf growth contained 322 records and covered the period 1979-1982. Weaning weights were included. The results are presented in Table 5.

Table 5. Least squares means of calf liveweight (kg) from birth to 1 year.

Variable	No. of records	Age (days)[a/]				
		Birth	30	90	180	365
Overall mean	322	19.4	28.4	43.6	60.2	103.6
Year of calving						
1979	58	19.3	27.7ab	41.9ab	56.9a	104.4b
1980	87	19.2	27.1a	40.1a	52.0a	94.2a
1981	102	19.0	28.6ab	44.0b	63.4b	106.4b
1982	75	19.8	30.2b	48.6c	68.4c	109.4b
Season of calving						
Dry	52	19.1	27.0	39.8a	61.0ab	101.1ab
Early wet	110	19.4	28.7	44.8a	63.7b	97.1a
Peak wet	31	19.2	29.2	47.0b	58.6ab	104.4a
Late wet	129	19.7	28.8	42.9ab	57.4a	111.8b
Sex of calf						
Male	166	19.9a	29.0	44.8a	60.7	105.5
Female	156	18.8b	27.9	42.4b	59.6	101.7
Milk offtake						
Dam not milked	45	19.2	27.5a	44.1	61.3	107.3a
Dam milked	277	19.5	29.3b	43.1	50.0	99.9b

[a/] Main effects with different superscripts within a column are significantly different ($P<0.05$).

Overall mean birth weight was 19.4 kg. It was lower than that reported for Bunaji calves under improved management in northern Nigeria (Wheat and Broadhurst, 1968; Wheat et al, 1972; Ologun, 1980; Alaku, 1982). Season of birth had no effect on birth weight, which is at variance with reports by Wheat and Broadhurst (1968), Wheat et al (1972), Alaku (1982), but which agrees with Ologun (1980).

Male calves were 5.9% heavier (P<0.01) than females. The observation confirms earlier reports on Bunaji calves in Nigeria (Wheat and Broadhurst, 1968; Wheat et al, 1972; Ologun, 1980). However, Alaku (1982) observed no difference in the birth weights of male and female calves in northern Nigeria.

Year effects on the liveweight of calves up to 180 and 365 days were highly significant (P<0.001). Calves born in 1980, the year with the most irregular rainfall pattern of the 4 years studied, were 31.5 and 15.2% lighter (P<0.001) by 180 and 365 days than were calves born in 1982, the best year. Calves born in 1981 were also significantly heavier (P<0.001) than the 1980 calves.

By 180 days of age, calves born in the early wet season were significantly heavier (P<0.01) than calves born in the late wet season, but differences in the weight of calves born in the other seasons were not significant. By 365 days of age, calves born in the late wet season were 15.1% heavier than those born early in the wet season (P<0.001). Calves born late in the wet season were 10.6% heavier than those born in the dry season (P<0.01).

Male calves were 5.4% heavier than females (P<0.05) by 90 days of age. However, by 180 and 365 days of age, male calves were only 1.8 and 3.7% heavier respectively than females. That the differences in weight between the two sexes reduced with age indicates that there was no preferential milking of the dams of male or female calves. The similarity in early growth rates is at variance with reports in the literature (Montsma 1960; Wheat and Broadhurst, 1968; Wheat et al, 1972; Gregory et al, 1979; Ologun, 1980).

The overall weaning weight averaged 112.1 kg at an age of 411.2 days (13.7 months). Differences between years were highly significant (P<0.01) but seasonal effects were not significant (P>0.05). Weaned males were heavier by 7.7 kg (7.7%) than females (P<0.05). The effect of nutrition is again demonstrated by the acceleration and deceleration in the rates of weight gain during the wet and dry seasons.

Table 6 shows the least squares means of weight for age of calves at the different locations. Linear contrasts showed that birth weights of calves born in Abet were significantly higher (P<0.05) than those of Kurmin Biri. Although Abet calves were consistently heavier at all ages, the difference after birth was not significant (P>0.05).

Table 6. Effect of herd location on calf growth.

Location	No. of records	Age (days)[a/]				
		Birth	30	90	180	365
Kurmin Biri	157	19.7b	28.5b	45.3b	65.7b	103.9b
Abet	114	20.9c	29.1b	47.4bc	67.9b	108.0b
Madauchi	37	17.4a	20.2a	29.1a	43.2a	84.2a
Kaduna	14	19.4ab	35.8c	52.7c	63.8b	118.3b
Overall mean	322	19.4	28.4	43.6	60.2	103.6

[a/] Means with different superscripts within the same column are significantly different (P<0.05).

Calves born in Kurmin Biri and Abet were highly significantly heavier (P<0.01) than those born in Madauchi at all ages. Differences in birth weights of calves at Madauchi and Kaduna were not significant (P<0.05), but after that Madauchi calves were highly significantly lighter (P<0.01) than Kaduna calves up to 1 year of age. The poor performance of Madauchi calves may be partly attributed to low milk consumption (see Table 12) and partly to disease.

Pastoralists sometimes do not milk certain cows that are poor milk producers. Calves from dams that were not milked were 7.4% heavier (P<0.05) at 1 year than those from dams that were. Dams that were not milked constituted about 16.2% of the population of all dams.

Calf viability

Data on 723 calves born between 1979 and 1982 were used to determine calf viability. The mean mortality rate to 1 year of age was 22.4%; 8.2% died before 90 days, and a further 9% before they were 180 days old. These rates were consistent with Umoh and Jagun (1981) and Umoh (1982), who reported an average Bunaji calf mortality of 6.0% up to 90 days under NAPRI conditions at Shika, while average mortality from 6 to 12 months was 5.2%. In the present study, over 50% of the deaths occurred by 120 days. Jagun (1980) noted that about 50% of the deaths occurred during the first 30 days of life. He attributed these deaths to calf scours, calf pneumonia, navel ill and physiological starvation. The causes of deaths in the present study were not determined because of the difficulty of obtaining carcasses for postmortem examination.

Effect of year of calving was significant (P<0.05) only at 120 days. Mortality in calves born in 1980 was consistently higher (about 30%) up to 1 year. Calves born in 1981 had the highest survival rate, followed by those born in 1982 and 1979. The causes of these annual differences were not determined

Table 7. Least squares means of calf viability (%) to 365 days, by location of herd.

Location	No. of records	Age (days)[a/]			Average mortality
		90	180	360	
Kurmin Biri	298	96.9	90.8	88.5b	11.5
Abet	264	94.6	86.1	80.6b	19.4
Madauchi	129	94.9	79.5	70.0a	30.0
Kaduna	32	80.7	74.8	71.5ac	28.5

[a/] Means with different superscripts within a column are significantly different (P<0.05).

Calves born in the dry season had better (but non-significant: P>0.05) survival rates than those born in the other seasons. By 1 year calf mortality averaged about 14% in animals born during the dry season compared with those born in the early and peak wet seasons (24%) and in the late wet season (28%). Calves born in the dry season averaged 12.5% mortality up to 6 months, and only 1.4% between 6 and 12 months. Mortality rates for animals born in other seasons were higher at all stages up to 1 year of age.

The survival rate observed in this study agrees generally with data collected under similar management conditions, but the seasonal pattern of mortality is quite different (Pullan, 1979; Wilson and Clarke, 1975). In other studies, mortality was usually higher in the dry season when the nutrition of calves and dams was poor, whereas in the ILCA study survival was better in calves born in the dry season.

The sex of the calf had no effect (P>0.05) on survival rates. This finding agrees with Jagun (1980), who reported a mortality rate of 16.1% in calves up to 1 year old at NAPRI, Shika, with sex having no effect on the pattern of mortality.

The importance of environmental effects on pre-weaning viability is shown in Table 8. Calf mortality up to 1 year was lowest (11.5%) in Kurmin Biri, followed by Abet (19.4%). It was highest (30%) in Madauchi, followed by Kaduna (28.5%). Mortality to 6 months followed the same pattern, except that the figure for Kaduna was higher than that for Madauchi. However,

Table 8 shows that from 7 months to 1 year mortality was lowest in Kurmin Biri (2.3%), followed by Kaduna (3.3%); it was highest in Madauchi (9.5%), followed by Abet (5.5%) (Table 8).

Milk yield

The Bunaji has been recognized in Nigeria and other parts of West Africa as a good dual-purpose animal. Hartley and Baker (1935) quote yields of 1082 kg of milk with over 7.5% butterfat in 305 days. Hill (1956) reported milk yields of 2475 kg over the same period from Bunaji cows at the University of Ibadan farm. ILCA (1978) showed the Bunaji to be above average in major production parameters like calving interval, milk production and growth. These data were, however, obtained under research station rather than pastoral conditions.

Table 9 shows least squares means of milk taken off for human consumption, based on 585 cow records. Overall mean offtake was 108.3 litres over the 180-day period.

Table 8. Least squares means of calf viability (%) to 365 days.

Source	No. of records	Age (days)[a/]						Mean Mortality
		30	90	120	180	300	365	
Overall mean	723	97.0	91.8	87.5	82.8	80.5	77.6	22.4
Year of calving								
1979	108	100.0	98.1	92.3	83.7	80.9	77.6	22.4
1980	152	93.4	86.4	79.5	76.1	72.9	70.0	30.0
1981	174	97.8	90.0	89.1	85.1	84.1	82.5	17.5
1982	289	95.6	92.5	89.1	86.4	83.8	80.3	19.7
Season of calving								
Dry	152	99.8	95.2	92.9	87.5	86.8	86.1	13.9
Early wet	264	98.0	92.8	87.7	83.1	80.3	76.1	23.9
Peak wet	61	94.7	89.2	85.1	81.4	79.9	76.3	23.7
Late wet	246	95.0	89.8	84.4	79.2	74.8	71.9	28.1
Sex of calf								
Male	383	96.9	91.3	87.9	81.5	79.1	76.2	23.8
Female	340	96.8	92.2	87.2	84.2	81.8	79.0	21.0

[a/] Main effects with different superscripts within a column are significantly different ($P<0.05$).

Mean offtake during 1981 was significantly higher ($P<0.01$) than for the other 3 years. Offtakes for 1979, 1980 and 1982 were below the overall mean. Offtake for lactations starting in the late wet season was significantly lower than for those that started in the other seasons ($P<0.01$).

Similarly, offtake from lactations which started in the dry season was significantly lower than offtake from lactations that started in the early or peak wet seasons ($P<0.05$). There were no differences in the offtake for lactations that started in the early or peak wet seasons ($P<0.05$). Interactions between year and season had very significant effects on milk offtake from calving up to 120 days postpartum ($P<0.01$). Differences in the amount of milk taken for human consumption varied significantly ($P<0.05$) for the different locations at 30 and 120 days after calving (Table 10). However, total offtake was not significantly different. As suspected from the growth and viability data, the sex of a calf did not significantly influence the amount of milk extracted ($P<0.05$).

Table 9. Milk offtake (litres) for human consumption from Bunaji cows.

Variable	No. of records	Days postpartum[a/]			
		30	90	180	Total
Overall mean	585	15.6	20.6	17.2	108.3
Year of calving					
1979	82	12.0a	20.4a	16.0ab	101.1a
1980	119	14.3a	17.3a	16.7a	97.0a
1981	139	20.1b	25.0b	21.1b	131.8b
1982	245	16.0a	19.9a	14.9a	103.4a
Season of calving					
Dry	125	13.2a	16.2a	21.3c	104.0b
Early wet	210	12.8a	25.3b	20.3bc	124.3c
Peak wet	66	24.3b	25.9b	15.1ab	129.0c
late wet	183	12.1a	15.2a	12.0a	76.3a
Sex of calf					
Male	315	16.2	20.7	16.5	108.5
Female	270	14.9	20.6	17.8	108.1

[a/] Main effects with different superscripts within a column are significantly different (P<0.05).

Table 10. Milk offtake (Litres) for human consumption at three different locations.

Location	No. of records	Days postpartum[a/]			
		30	90	180	Total
Kurmin Biri	250	15.7b	19.6	14.0	103.2
Abet	209	9.2a	21.5	17.4	107.8
Madauchi	100	20.0c	19.9	16.0	108.3
Kaduna	26	17.5bc	21.5	21.2	113.9
Overall mean	585	15.6	20.6	17.2	108.3

[a/] Main effects with different superscripts within a column are significantly different (P<0.05).

Estimated milk consumed by calves

Table 11 shows least squares means of estimated milk consumed by Bunaji calves up to 180 days postpartum. The overall mean averaged 442.3 litres or 2.5 litres per calf per day. Analysis of variance showed that the year during which the lactation started had significant effects (P<0.05) on milk consumed by the calf, except at 90 and 180 days after calving. Total milk consumed by calves in 1981 and 1982 was significantly greater (P<0.05) than in 1979 and 1980.

Table 11. Least squares means of estimated milk consumed (milk equivalent) by Bunaji calves (litres).

Variable	No. of records	Days after calving[a/]		
		90	180	Total

Overall mean		585	75.9	53.0	442.3
Year of calving					
	1979	82	67.8	51.3	427.5a
	1980	119	71.7	49.4	379.8b
	1981	139	85.1	59.8	477.0b
	1982	245	79.2	51.6	485.0b
Season of calving					
	Dry	126	72.2c	72.2c	446.3b
	Early wet	210	92.1b	57.6b	480.4b
	Peak wet	66	68.6a	29.0a	421.0a
	Late wet	183	70.9a	53.3b	421.8a
Sex of calf					
	Male	315	75.5	49.9	442.6
	Female	270	76.4	56.2	439.3

[a/] Main effects with different superscripts within a column are significantly different (P<0.05).

Season of calving had a significant effect (P<0.05) on milk consumed by calves at 90, 120 and 180 days postpartum. Early wet-season calves consumed significantly more milk (P<0.05) than those born in other seasons. The reason for the low amount of milk consumed by calves born in the peak wet season is not apparent but may be related to the nutrition of their dams.

Bayer and Otchere (1982) pointed out that grazing time of animals in pastoral herds was shorter during the cropping season, and that this may well affect their productivity.

Table 12 shows the quantity of milk consumed by Bunaji calves according to the location of the herd. Analysis of variance showed that location had significant effects on the amount of milk calves consumed (P<0.05) from birth to 150 days of age. Madauchi calves consumed significantly less milk (P<0.05) than those in all other locations, while Kaduna calves consumed significantly more (P<0.05).

Table 12. Least squares means of milk consumed by Bunaji calves (litres) up to 180 days of age in different locations.

Location	No. of records	Days after calving[a/]				
		30	90	120	180	Total
Kurmin Biri	250	117.6b	76.3b	59.4b	54.4	462.3
Abet	209	116.6b	95.0b	59.2b	56.9	486.7
Madauchi	100	67.1a	42.8a	40.1a	48.1	293.1
Kaduna	26	183.3c	89.7b	40.0a	52.7	527.4
Overall mean	585	121.1	75.9	49.7	53.0	442.3

[a/] Column means with different superscripts are significantly different (P<0.05).

By 90 days postpartum, cows that had calved in the early wet and late wet seasons were under nutritional stress and milk production was falling. Thus, calves born in the peak or late wet season had 4.8 and 4.6% less milk respectively than the overall mean. They also suffered from the lower feed intake of their dams due to the shorter grazing day (Bayer and Otchere, 1982).

Estimated total milk produced

Table 13 shows estimated least squares means of total milk produced, without allowing for calving intervals. The overall mean was 550.3 litres up to 180 days after calving. Total milk produced in 1979 was marginally below the mean, while milk produced in 1980 was 13.3% below. The totals produced in 1981 and 1982 were respectively 10.6 and 6.9% higher than the overall mean.

Table 13. Least squares means of total milk (litres) produced by Bunaji cows in pastoral herds.

Variable	No. of records	Days postpartum[a/]				
		30	90	120	180	Total
Overall mean	585	136.7	96.6	67.9	70.2	550.7
Year of calving						
1979	82	119.6a	88.2	61.8ab	67.2	528.6
1980	119	125.3a	89.0	51.9a	66.1	477.1
1981	139	155.8b	110.0	77.0bc	81.0	608.8
1982	245	146.2b	99.1	80.9b	66.6	588.5
Season of calving						
Dry	126	123.1	88.4a	71.7b	93.5d	550.3
Early wet	210	134.0	117.4b	82.9b	77.9c	604.6
Peak wet	66	156.2	94.5ab	68.2b	44.1a	550.0
Late wet	183	133.7	86.0a	48.7a	65.2b	497.8
Sex of calf						
Male	315	140.1	96.1	64.2a	66.4a	551.0
Female	270	133.3	97.0	71.6b	74.0b	550.3

[a/] Main effects with different superscripts within a column are significantly different ($P<0.05$).

Season of calving had no effect on milk produced during the first month, but differences in subsequent months were significant ($P<0.05$). Total milk produced for lactations that started in the dry and peak wet seasons were the same as the overall mean. Total milk produced in lactations which began in the late wet season was 9.5% lower than average, whereas lactations beginning in the early wet season produced a total amount of milk 9.9% higher than the overall average. Again, the above pattern may be a reflection of the shorter grazing pattern (Bayer and Otchere, 1982).

Milk production index

A total of 236 cow records including calving intervals, milk offtake and calf viability data to 180 days postpartum were used to estimate milk production indices. Least squares analysis of variance for this data subset are shown in Tables 14 and 15.

Table 14. Least squares means of estimated milk production index for Bunaji cows in pastoral herds.

Variable	No. of records	Milk for humans	Milk for calves	Milk production index
Overall mean	236	111.5	169.2	280.7
Year of calving				

	1979	49	110.9	174.6	285.5
	1980	76	107.6	140.8	248.4
	1981	111	115.9	192.3	308.2
Season of calving					
	Dry	28	111.7	152.5	264.2
	Early wet	93	114.7	184.3	299.0
	Peak wet	36	123.0	170.7	293.7
	Late wet	79	96.5	169.4	266.0
Sex of calf					
	Male	119	115.3	157.0	272.3
	Female	117	107.6	181.5	289.1

[a/] None of the main effects within a column-in the table were significantly different (P>0.05).

Table 15. Least squares means of milk production indices for Kurmin Biri, Abet and Madauchi (litres).

Location	No. of records	Milk for humans	Milk for calves[a/]	Total milk[a/]
Kurmin Biri	114	131.4	228.5a	359.8a
Abet	96	101.8	217.5a	319.3a
Madauchi	26	102.2	61.7b	163.0b

[a/] Means with different superscripts within a column are significantly different (P<0.05).

Lactation length averaged 411.2 days or 13.7 months while calving interval averaged 757.3 days or 25.2 months. Consequently, in this study the milk production index was calculated on a 365-day basis.

The overall means for human milk offtake and milk consumed by the calf were 111.5 and 169.2 litres/cow/365 days respectively. Thus the estimated total amount of milk produced by the average Bunaji cow was 280.7 litres per year. Neither year nor season of calving had any effects (P>0.05) on the indices. Allowing for calving intervals, the total amount of milk produced in 1981 was thus 9.8% higher and that of 1979 was marginally above the overall mean. Lactations that started in the dry or late wet seasons were below the overall mean, whereas those that began in the early and peak wet seasons were 6.5 and 4.6% above. No significant differences were detected between Kurmin Biri and Abet in all of the three indices, but Kurmin Biri was consistently higher in all cases. Kurmin Biri and Abet were significantly superior (P<0.05) to Madauchi in all the indices. Owners in Kurmin Biri differed significantly (P<0.001; P<0.05; and P<0.01) in the amount of milk taken for human consumption as well as in total milk production. There were no differences between owners at Abet or Madauchi (P>0. 05) .

Cow viability

The data set from which cow viability results were obtained had 582 records and covered the period 1979 to 1982 (Table 16). The year of calving had a significant effect (P<0.05) on the viability of cows. Cow viability was significantly lower (P<0.01) in 1980 than in the other 3 years. Differences between 1979, 1981 and 1982 were not significant. Herd location had no effect on cow mortality (P>0.05). However, differences between owners in Kurmin Biri were very highly significant (P<0.001), whereas differences between owners in Abet were significant

(P<0.05). There were no differences between owners in Madauchi and Kaduna (P>0.05).

The season of calving had no significant effect (P>0.05) on cow viability. The interaction of year and season was also not significant (P>0.05). Overall cow mortality averaged 6.2%.

Table 16. Least squares means of cow viability in pastoral herds.

Variable	No. of records	% Mean[a/]	Mean mortality[a/]
Overall	582	93.8	6.2
Year of calving			
1979	74	95.6b	4.1
1980	103	85.1a	14.9
1981	135	97.0b	3.0
1982	270	97.1b	2.9
Season of calving			
Dry	129	93.9	6.3
Early wet	233	93.4	6.6
Peak wet	46	95.0	5.0
Late wet	184	92.8	7.2
Sex of the calf			
Male	311	92.6	7.4
Female	271	95.0	5.0
Owners within location			
Kurmin Biri	235	91.7	8.3a
Abet	197	94.4	5.6b
Madauchi	118	94.1	5.9
Kaduna	32	95.0	5.0

[a/] Means of a main effect with different superscripts within a column are significantly different (P<0.05).

Cattle offtake

Certain constraints make it difficult to estimate cattle offtake accurately. Muslims are forbidden to eat animals not slaughtered according to Islamic rites. Provided the disease is not thought to be enzootic, animals are therefore slaughtered and consumed on the prognosis of death, making postmortems impossible.

Overall offtake of all adult animals averaged 12.2% over the period July 1980 - June 1982. Cow sales averaged 10.6% of all cows, or 4.5% of all adult cattle. The sale of adult males averaged 14.4% of all adult males or 7.7% of all adult cattle. These figures are higher than those reported from other locations in Nigeria and elsewhere in Africa. Okaiyeto (1980) reported a rate of 7.1% in a questionnaire survey in three villages around Zaria. Fricke (1978), using registered slaughter data, estimated offtake in Nigeria at about 6.8% from 1969 to 1974. When he made allowances of 25% and 50% for non-registered slaughters, mean offtakes of 8.2 and 9.5% respectively were obtained. Reasons given by owners in the present study for the sale of their animals included the following: the animal was terminally sick; money was needed for going on pilgrimage, for food, clothing and marriage expenses. Cows were sold mainly because of old age and breeding problems.

Although it was very difficult to get pastoralists to weigh their animals, the mean weight of 395

cows averaged 268 kg. Wheat et al (1972) reported that mature Bunaji females at Shika weighed 350 kg, whereas the mature females in this study were about 85 kg lighter.

In this study, it was observed that during the 1980/81 dry season (November to April), cows lost about 16% of their liveweight. During the 1982/83 dry season animals having no access to a Stylosanthes fodder bank lost 18.9 and 23.6% of their liveweights respectively.

Conclusions

ILCA's study of the productivity of traditionally managed Bunaji cattle has revealed the following average production parameters:

1. Herd size: 45.9 head
   - Females: 64.4% of herd
   - Breeding females: 42.8% of herd
2. Reproductive performance:
   - Age at first calving: 60 months
   - Calving interval: 757.3 days (25.2 months)
   - Calving %: 48.2%
   - Birth weight: 19.4 kg
   - 180-day weight: 60.2 kg
   - 365-day weight: 103.6 kg
   - Weaning weight: 112.1 kg
   - Adult cow weight: 268 kg
3. Mortality:
   - Calf mortality, 90 days: 8.2%
   - Calf mortality, 365 days: 22.4%
   - Adult mortality: 6.2%
4. Offtake:
   - Cow offtake rate: 10.6%
   - Bull offtake rate: 14.4%
5. Milk production to 180 days postpartum:
   - Human offtake: 108 litres
   - Consumed by calf 442.3 litres
   - Total: 550.3 litres
   - Average (whole herd basis):
   - Human offtake: 111.5 litres/cow/365 days
   - Consumed by calf: 169.2 litres/cow/365 days
   - Total: 280.7 litres/cow/365 days

The generally low performance of traditionally managed Bunaji cattle compared to the breed's demonstrated productivity on government farms and research stations can be ascribed to poor nutrition during the late dry season. This confirms the conclusion of the 1979 ILCA/NAPRI symposium. The study provides important baseline data on herd performance, against which the effects of any interventions can be measured. It has also revealed seasonal and locational differences in performance that should be the subject of further research.

References

Agishi, E.L.C. 1984. Nigerian indigenous legumes and their forage value. In: Proceedings of the Ninth Annual Conference of the Nigerian Society of Animal Production, Nsukka.

Alaku, O. 1982. Effect of season on birth, weaning and 12-month weights and calving frequency in indigenous cattle of the subhumid region of northeast Nigeria. J. Anim. Sci. 55 (Suppl.1): 173.

Bayer, W. and Otchere, E.O. 1982. Grazing time of White Fulani cattle kept by pastoralists an the Kaduna Plains. Paper presented at the National Beef Conference, Kaduna.

Butterworth, M.H. 1983. Seasonality of calving amongst unimproved cattle in Swaziland. Trop. Agric. (Trin.) 60: 218-220.

Dicko-Toure, M. 1980. The contribution of browse to cattle fodder in the sedentary system of the Office du Niger. In: Le Houérou, H.N. (ed) Browse in Africa: The current state of knowledge. ILCA, Addis Ababa.

Drewry, K.J., Brown, C.J. and Honea, R.S. 1959. Relations factors associated with mothering ability in beef cattle. J. Anim. Sci. 18: 1209.

Fricke, W. 1978. Cattle husbandry in Nigeria. A study of its ecological conditions and social-geographical differentiations. Department of Geography, University of Heidelberg, West Germany.

Gregory, K.E., Smith, G.M., Cundiff, L.V., Koch, R.M. and Laster, D.B. 1979. Characterization of biological types of cattle Cycle III: I. Birth and weaning traits. J. Anim. Sci. 48: 271.

Hartley, K. and Baker, D.W.H. 1935. An unusual variation in the butterfat content of milk. J. Dairy Res. 6: 353.

Harvey, W.R. 1972. Program write-up for least squares and maximum likelihood general program. Mimeo, Ohio State University, Columbus.

Hill, D.H. 1956. Observations on the performance of a dairy herd of White Fulani (Bunaji) cattle at University College, Ibadan, under conditions of moderate exposure to infection from trypanosomiasis IBED Technical Report, Inter-African Bureau for Epizootic Diseases, Muguga, Nigeria.

ILCA. 1978. Evaluation of the productivities of Maure and Peul cattle breeds at the Sahelian Station. Niono. Mali. Monograph No. 1. Addis Ababa.

Jagun, A.G. 1980. Calf mortality in Shika farm during 1975-1979. NAPRI Seminars 2: 100-110.

Kapu, M.M. 1975. The natural forages of northern Nigeria 1: Nitrogen and mineral composition of grasses and browse from the Northern Guinea Savanna and standing hays from the different savanna zones. Nig. J. Anim. Prod. 2: 235-246.

Lamorde, A. and Franti, C.E. 1975. Nomadism and cattle production in Nigeria. Proceedings of the first Annual Conference of the Nigerian Society of Animal Production, Enugu. pp. 14-17.

Le Houérou, H.N. 1980. Chemical composition and nutritive value of browse in West Africa. In: Le Houérou, H.N. (ed.) Browse in Africa: The current state of knowledge. ILCA, Addis Ababa.

Menendez, A., Guerra, D., Dora, J. and Perez, M.L. 1978. Influencia de la epoca del ano sobre la presentacion de partos en la vacas Cebu en condiciones de Cuba. Mem. As. Lat. Am. Prod. Anim. 13: 176-177.

Montsma, G. 1960. Observations on milk yield, and calf growth and conversion rate, on three types of cattle in Ghana. Trop. Agric. (Trin.) 37: 293-302.

Montsma, G. 1962. Observations on milk yield and calf growth and conversion rate, on three types of cattle in Ghana: Effects of plane of nutrition. Trop Agric. (Trin.) 39: 123-129.

Okaiyeto, P.O. 1980. A descriptive study of the major economic activities of the settled pastoral Fulani in three Zaria villages of Kaduna State. Unpublished M.Sc. thesis. Ahmadu Bello University, Zaria, Nigeria.

Ologun, A.G. 1980. Seasonal and breed variations in birth weight and age at first calving of exotic, local and crossbred cattle in a tropical environment. J. Anim. Sci. 51 (Suppl. 1): 153.

Pena, N. and Plasse, D. 1971. Distribution of calving over the year in Brahman cattle and its relationship with rainfall. III Reun. Lat. Am. Prod. Animal, Bogota, p. 127.

Pullan, N.B. 1979. Productivity of White Fulani cattle on the Jos Plateau, Nigeria I: Herd structures-and reproductive performance. Trop. Anim. Hlth. Prod. 12: 17-24.

Ross, J.G. 1958. The estimation of liveweight of Nigerian cattle from linear body measurements. Bull. Epiz. Dis. Afr. 6: 353-356.

Synge, B. 1980. Factors limiting cattle productivity in highland areas of Nigeria. Centre for Tropical Veterinary Medicine, Easter Bush, Roslin, Midlothian, Scotland.

Toutain, B. 1980. The role of browse plants in animal production in the Sudanian zone of West Africa. In: Le Houerou, H.N. (ed.) Browse in Africa: The current state of knowledge. ILCA. Addis Ababa.

Umoh, J.U. 1982. Relative survival of calves in a University herd in Zaria, Nigeria. Br. Vet. J. 138: 507-514.

Umoh, J.U. and Jagun, A.G. 1981. A case-control study of calf mortality in Zaria. Nig. Vet. J. 10: 31-39.

Wheat, J.D. and Broadhurst J. 1968. Analysis of data an Bunaji cattle in Birnin Kudu and Kabomo, northern Nigeria. Samaru Miscellaneous Paper No. 25. JAR, Ahmadu Bello University, Samaru, Zaria, Nigeria.

Wheat, J.D., de Leeuw, P.N. and Koch, B.A. 1972. Bunaji cattle at Shika Research Station, North Central State, Nigeria. Samaru Miscellaneous Paper No. 41. JAR, Ahmadu Bello University, Zaria, Nigeria.

Wilson, R.T. and Clarke, S.E. 1975. Studies on the livestock of Southern Darfur, Sudan. I: Ecology and livestock resources of the area. Trop. Anim. Hlth. Prod. 7: 165-187.

Zakari, A.Y., Molokwu, E.C.I. and Osori, D.I.K. 1981. Effect of season on the oestrous cycle of cows (Bos indicus) indigenous to northern Nigeria. Vet. Rec. 108: 213-215.