Paper 7: Traditional small ruminant production in the subhumid zone of Nigeria

W. Bayer
Animal Scientist
ILCA Subhumid Zone Programme

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Abstract

In Nigeria, small ruminants contribute an estimated 35% to the total meat supply; they are more important in the north than in the south, and more important in rural than in urban areas. Population estimates suggest there are roughly 1 million head of sheep and 7 million goats in the subhumid zone of Nigeria. In livestock units, this represents 3% and 16% respectively of total ruminants in the zone. The major breed of sheep is the Yankasa; the West African Dwarf is the major goat breed.

Sheep are kept predominantly by Fulani pastoralists, who manage them fairly extensively. Goats are kept mainly by crop farmers, whose management practices include housing overnight and tethering by day during the wet season, some cut-and-carry feeding shortly before harvesting their food grain crops, and allowing them to roam freely in the dry season.

In sheep flocks kept by Fulani, fertility of ewes is approximately 120%, twinning rate is 12%, and lamb mortality up to 3 months is 25%. Based on limited weight data, a productivity index has been calculated of 0.327 kg lamb/kg ewe per year, assuming a weaning age of 90 days, and 0.490 kg for an assumed 180-day weaning age. The major problems in sheep keeping are a high rate of adult mortality, liver fluke infections, and lameness during the wet season.

In goat flocks kept by farmers, twins and triplets account for almost 40% of total births, but overall fertility is low (below 100%). Most of the kids are born in the period June-September; this means that conception takes place before tethering begins, and suggests negative effects of tethering on fertility. Mortality rates are low: 22% for kids and 14.4% for adults. Calculations of productivity indices for 90 and 180 days weaning age are 0.259 kg and 0.437 kg kid/kg doe respectively. Low fertility and weight losses during the second half of the wet season are the major problems in goat keeping.

The reasons given by farmers for sales reveal that goats perform an important function by providing money for household needs as well as for farm inputs, such as fertilizer. Partial payment for communal farming is also a significant reason for goat slaughter.

It is recommended that browse gardens for goats and a veterinary package for sheep and goats be tested as interventions.

Introduction

The importance of small ruminants for meat production in the tropics is well recognized (e.g. Williamson and Payne, 1978; de Haas and Horst, 1979). Adu and Ngere (1979) found that 11% of the meat supplied from slaughter-houses in Nigeria comes from sheep, and they state that the importance of sheep is greater if rural unregistered slaughters are taken into account. Brinkmann and Adu (1977) estimate that goats contribute about 20% of Nigerian meat supply. This means that about 35% of total meat supply comes from small ruminants. Nevertheless, large differences exist between regions as well as between the countryside and city. According to Sarniguet et al (quoted in Grell, 1976), in rural areas of northern Nigeria the contribution of small ruminant meat to total meat consumed is three times that of beef; but in the cities small ruminants contribute only a quarter as much as cattle to total meat consumption. In the rural areas of southern Nigeria, beef and small ruminant meat are equally important, whereas in urban areas beef consumption is more than eight times as great as the consumption of small ruminant meat.

General indicators of small ruminant production in the zone

Sheep and goat numbers

Census figures for sheep and goats are as approximate and unreliable as those for cattle. Adu and Ngere (1979) estimate a population of 7.2 to 8.2 million sheep in Nigeria. ILCA (1979a) gives a figure of 7.6 million sheep and 22 million goats. Brinkmann and Adu (1977) estimate about 29 million goats and that the number of sheep, i.e. approximately 9 million, equals the number of cattle. The numerical ratio between sheep and goats in Nigeria would thus be 1 to 3. This ratio contrasts with neighbouring countries such as Ghana, Togo and Ivory Coast, where sheep slightly outnumber goats (ILCA, 1979a).

Within Nigeria, livestock density in the subhumid zone is lower than in the semi-arid and humid zones. Bourn and Milligan (1983) estimate that there are approximately 4.2 million head of cattle in the subhumid zone of the country. Milligan (personal communication) concluded from aerial surveys that cattle outnumber sheep by 5 to 1 in Fulani herds; this figure would suggest 0.8 million sheep. A recent survey of 100 Fulani households near Kachia revealed a ratio of 4 to 1 between cattle and sheep (Nweke, personal communication). Although arable farmers in the subhumid zone also keep sheep, they have considerably fewer than the Fulani. Allowing for these, it is estimated that there are approximately 1.1 million head of sheep in Nigeria's subhumid zone.

In the absence of more precise data, the present goat population in the subhumid zone of Nigeria can only be estimated roughly. If

Fulani pastoralists represent 5 to 7% of the total population active in agriculture, and average herd size is 50 cattle, then the 4.2 million cattle in the zone must be kept by 84 000 pastoral households, and there must be about 1.6 million crop farming households in the zone. If 90% of the farmers keep goats and average flock size is 5, as revealed by ground surveys in the ILCA case study areas, then the zone's goat population must be about 7 million head.

If the above-mentioned small ruminant and cattle populations are converted into livestock units (LU), then sheep would represent about 3% of the total, goats 16% and cattle 80% (1 head of cattle = 1 LU; 1 sheep or goat = 0.1 LU; Williamson and Payne, 1978). For Nigeria as a whole, 75% of the ruminant livestock units are cattle, 18% goats and 7% sheep. These calculations must, of course, be treated with great caution, since the data base is far from firm. However, it appears realistic to state that small ruminants, particularly sheep, are less important relative to cattle in the subhumid zone of the country than they are in Nigeria as a whole.

A survey of agriculture in the central part of the zone (Blair Rains, 1978) provides more information about the distribution of sheep and goats. Whereas goats were kept in 99 of the 100 villages in the sample, village sheep keeping is not quite so widespread: it is absent or rare around the Jos Plateau and in the southern part of the zone (Figure 1).

Breeds

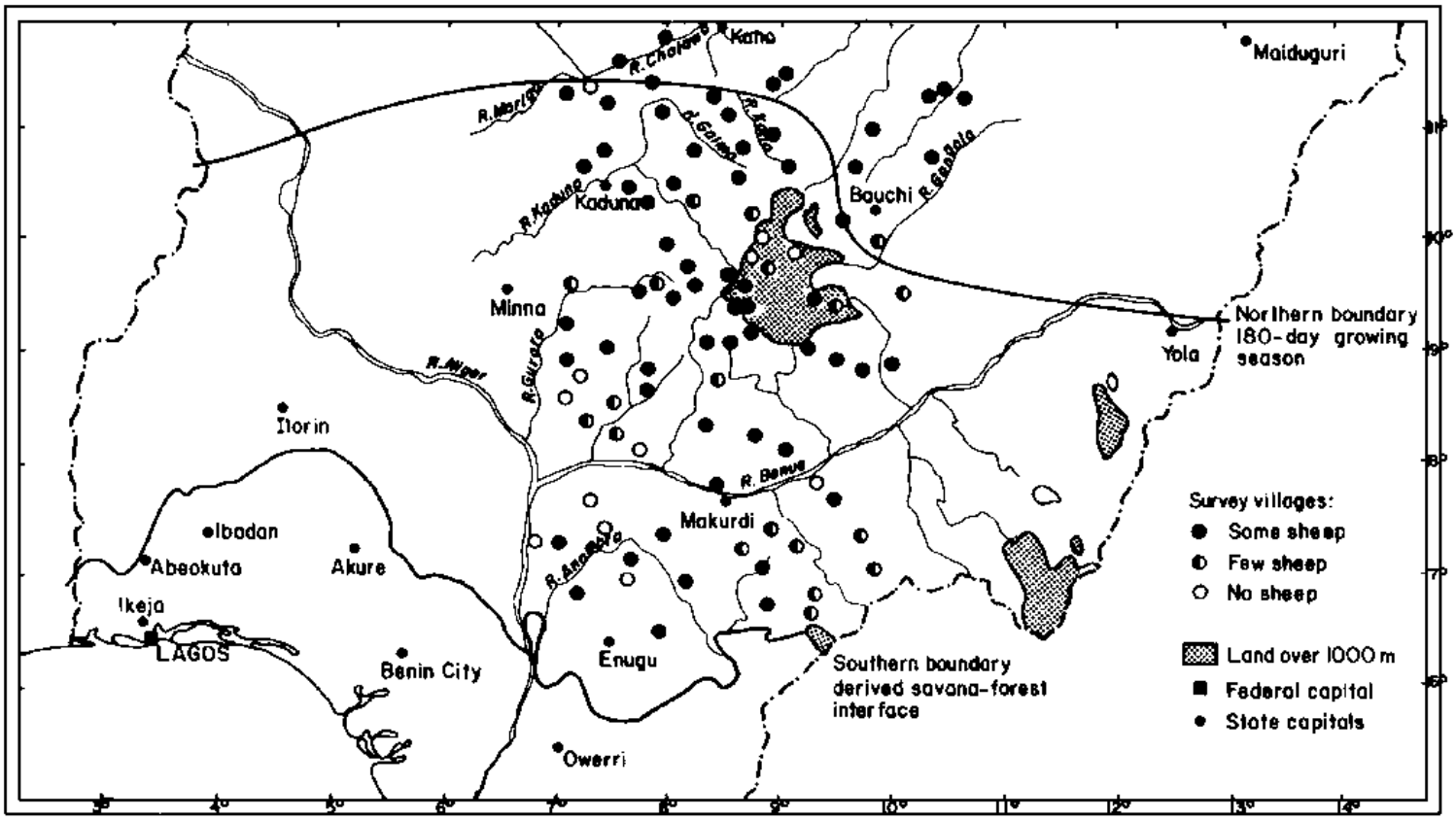
According to the classification by Adu and Ngere (1979), the predominant type of sheep in the subhumid zone is the Yankasa, which, according to ILCA's classification, corresponds with the Djallonke savanna type (ILCA, 1979b). In cities and towns, as well as in the transhumant flocks of the countryside, the Sahelian breeds of sheep (Uda and Balami) occur most frequently. The Uda are predominant near Kontagora, where large flocks can be seen in the dry season. Where the Sahelian and Yankasa types occur together, crossbreeding is common.

The predominant goat breed in the subhumid zone is the West African Dwarf. However, the Red Sokoto goat can be observed frequently in urban areas as far south as Ilorin. Again, crossbreeding is common, particularly in the northern part of the zone, where Red Sokoto goats are found not only in cities but also in rural areas.

Nutritional status

The fact that sheep under station conditions grow faster and attain heavier weights than those in villages indicates the presence of nutritional constraints under village conditions. However, as Brinkmann and Adu (1977) point out, sheep tend to lose weight much less than cattle during the dry season in the subhumid zone, and goats are even less susceptible to weight losses than sheep. One reason for these differences may be that small ruminants select a diet of better quality from natural fodder resources than cattle do (ILCA, 1979a).

Figure 1. Sheep keeping in land resource survey villages in central Nigeria



Some researchers state that goats are superior to sheep in their ability to select a good diet (ILCA, 1979a; Wilson et al, 1975). However, Squires (1980) found in subtropical Australia that in those cases where there were evident differences between the ability of the two species to select diet, sheep were superior to goats.

Sheep are basically grazers, whereas goats eat a substantial amount of browse (ILCA, 1979a). Variations in the nutritional quality

of browse plants from region to region may lead to the conflicting observations. The higher resolution of selectivity in smaller animals compared with larger ones is attributed by Arnold and Dudzinski (1978) to relative jaw size and to differences in the geometry of lip and tongue movement. ILCA (1979a) suggests that goats may be able to digest low-quality forage better than either cattle or sheep. However, the evidence is conflicting: many reports, the majority of them based on pen trials, do not take into account the possibility that goats are more selective and make no statements about the nutritional quality of plants or plant parts that were not selected (Butterworth, personal communication). Greater selectivity rather than digestive efficiency as such may be a major reason for differences between goats and sheep in their ability to digest fodder. Nevertheless, the superiority of goats and sheep over cattle in diet selection capacities is undisputed. The scope for increasing productivity by improving nutrition is thus likely to be much less in small ruminants, particularly in goats, than in cattle.

Fertility

Generally, sheep and goats mature early. Adu and Ngere (1979) state that the age of sheep at first oestrus is 5 to 8 months for the West African Dwarf breed, 7 to 9 months for Yankasa and about 9.5 months for Uda. Age at first parturition varies considerably. In West African Dwarf sheep, it occurs between 11 and 37 months (Adu and Ngere, 1979), in Mali 50% of the ewes had lambed by 15 months and the mean lambing interval of sheep was found to be 253 days, resulting in 1.4 births per ewe per year (Wilson et al, 1983). Adu and Ngere (1979) give a lambing rate of 110 to 112% for Yankasa and 120% for West African Dwarf sheep. Matthewman (1980) found a lambing rate of 115% in his village survey near Ibadan. Since multiple births are common among small ruminants, the number of lambs born per ewe per year (or kids born per doe) is higher than the lambing or kidding percentages reflect. ILCA (1979a) differentiates between fertility (parturitions per dam per year), prolificacy (average litter size) and fecundity (number of offspring born per dam per year). In Ivory Coast, Ginistry (quoted in ILCA, 1979a) found that fertility was 160% and fecundity 170%.

Kidding intervals are generally found to be similar to lambing intervals; age at first kidding also differs little from age at first lambing. Vohradsky and Sada (quoted in ILCA, 1979a) observed a kidding interval of 285 days on Nungua Research Station in Ghana. In Mali, a mean kidding interval of 265 days was found in village flocks, whereas Otchere and Nimo (1976) calculated 254 days in Ghana under research station conditions. Matthewman (1980) and Putt et al (1980) consider three parturitions in 2 years as the maximum in both sheep and goats in Nigeria.

The average litter size is usually greater in goats than in sheep. For example, Wilson (1980) found 1.5 and 1.4 lambs born per ewe in Sudan and Mali respectively. The corresponding figures for goats were 2.4 and 1.6 kids per doe (Wilson, 1982). Vohradsky and Sada (quoted in ILCA, 1979a) report that in goats 32.9% of the births were single, 52.9% twins, 13.7% triplets, and 0.3% quadruplets, resulting in 260% fecundity. Otchere and Nimo (1976) found a fecundity of 267% amongst West African Dwarf goats in Ghana. According to these sources, both species are highly fertile, but the fecundity of goats is normally superior to that of sheep, largely as a result of greater litter size.

Mortality and offtake

The survival rate of sheep up to 6 months of age was 70% in Mali and 75% in Kenya (Wilson,-1980). The corresponding figures for goats are 65% in Mali and 78% in Sudan (Wilson, 1982), indicating comparable mortality levels for kids and lambs.

In the humid zone of Nigeria, Matthewman (1980) found a preweaning mortality of approximately 15%, but states that this is possibly an underestimate. Major factors influencing preweaning mortality within a breed are birth weight, litter size and parturition number (Wilson, 1980). Trail and Sacker (1966), working with indigenous black-headed sheep in East Africa, discovered that the lambs which died were considerably lighter at birth than the surviving ones. Parturition number and litter size also influenced preweaning mortality rates, since lambs born to gimmers were normally lighter than those born to ewes. The preweaning mortality of lambs born singly to ewes was 16%, that of single lambs born to gimmers was 20%, and that of twins born to ewes was 28%.

Osuagwuh and Akpokodje (1981), working with West African Dwarf goats at the University of Ibadan in Nigeria, found mortality of 38.6% in kids up to 3 months. A review by ILCA (1979a) and an evaluation of data collected in Mali (Wilson et al, 1983) indicate that parturition interval can also influence preweaning mortality in goats and sheep. Rombout and van Vlaenderen (quoted in ILCA, 1979a) found that parturition intervals of less than 7 months greatly increased lamb mortality. The Mali study found that parturition intervals of 183 days or less resulted in a lamb and kid mortality of more than 50%, whereas mortality declined to 25% when the interval was 245 days or more.

Age of dam at first service also influences mortality of young animals. Ngere (quoted in ILCA, 1979a) found that only 42% of gimmers serviced at 8 months conceived, but only 17% produced live births, whereas all animals serviced at 11 months became pregnant and produced 100% live births. However, Wilson and Durkin (1983) argue that systems with controlled breeding (as practiced on stations) may lead to an increase of 100 days or more in age at first lambing or kidding. This increased age may reduce the advantage of a lower mortality; total herd productivity may, in fact, be greater in a system permitting early breeding.

Matthewman (1980) found 15% adult annual mortality for sheep and goats in southern Nigeria, but he points out that this may be an underestimate. Wilson (1976) observed an overall mortality of approximately 30% for sheep and goats in the semi-arid region of Sudan.

Despite a rather high mortality rate, offtake from small ruminant flocks is considerable. In Sudan, Wilson (1976) reported an offtake of 28% for both sheep and goats. The simultaneous increase in goat numbers could be interpreted as underutilization, whereas the declining numbers of sheep would indicate some overutilization. Matthewman (1980) found that more than 90% of male offspring of both sheep and goats were sold immediately after weaning; the total offtake from all lambs and kids in the flocks was about 67%, and offtake from adult animals in the flocks was about 20%.

In ILCA's Mali study, sales and slaughters amounted to about 18% in sheep and 15% in goat flocks (Wilson et al, 1983). However, as in other studies, it was difficult to distinguish between deaths and slaughters in extremis. Therefore, the mortality figures which include such slaughters probably underestimate the percentage of animals used for human consumption. In non-Muslim societies, animals that have died, as opposed to those that have been slaughtered, may also be consumed; this practice is common amongst arable farmers keeping goats in ILCA's case study areas in the subhumid zone.

Weight development

According to ILCA (1979a), the birth weight of sheep is generally 7 to 8% of adult weight. Ngere (quoted in ILCA, 1979a) found an adult weight of 21 kg and an average birth weight of 1.66 kg for the West African Dwarf. In ILCA's village survey in southeastern Nigeria, an average birth weight of 1.8 kg was recorded (ILCA, 1979a). Dettmers et al (quoted in ILCA, 1979a) found an average birth weight of 1.9 kg for single lambs, 1.6 kg for twins, and 1.5 kg for triplets.

Fall et al (1982) state that year of birth, month of birth, parturition number, litter size and sex all influenced birth weight significantly. Lambs born in the late dry season tended to be lighter than animals born at other times of the year, lambs at first parturition were lighter than lambs from subsequent parturitions, twin lambs were lighter than singles, and females lighter than males.

For sheep and goats in Mali, the season of birth had no significant effect on birth weight; instead, litter size and sex were the significant factors (Wilson et al, 1983).

Goats generally have lower adult weights than sheep in the same ecological zone (Wilson 1976; 1980; 1982; ILCA, 1979a). Partly for this reason, birth weights can be expected to be lower in goats than in sheep. The larger litter size of goats also accounts for lower birth weights. The ILCA village survey in southeastern Nigeria revealed an average birth weight in goats of 1.2 kg; in Ghana an average birth weight of 1.4 kg was recorded with a range from 0.5 - 2.5 kg (ILCA, 1979a).

Osuagwuh and Akpokodje (1981) found that surviving kids had an average birth weight of 1.24 kg; kids that were born alive but died within 3 months had an average birth weight of 1.04 kg.

For Yankasa sheep, Adu and Ngere (1979) give 35 kg as the mature weight of females and 21 kg as the weight at first oestrus at 8 months. Preliminary results from ILCA's work in the subhumid zone indicate slightly lower weights: about 20 kg at 12 months of age and 30 kg as mature weight attained after 4 years. Orji and Steinbach (1981) found that mature weight of West African Dwarf sheep is 32 kg under station conditions; this weight is reached by ewes at approximately 3 years of age.

ILCA (1979a) found that the mature weight of dwarf goats was approximately 25 kg. These animals matured late; their weight and size were still increasing when they were 3 years old (after three kiddings, on average).

Weaning is assumed to occur among both sheep and goats at 150 days (Wilson et al, 1983), although Matthewman (1977) found that lambs and kids were sucking their dams for only about 100 days after birth.

Productivity

By far the most important product of small ruminants kept in the subhumid zone is meat. Neither sheep nor goats seem to be milked in this region. Hides, particularly those of goats (preferably Red Sokoto), are valued but in many parts of the zone skins are eaten.

Because only one product must be considered, the productivity of the small ruminants in the zone is relatively simple to assess, in comparison with the productivity of multi-purpose cattle. Various formulae for calculating productivity indices are currently used. Wilson (1976) expresses productivity as follows:

$$p = \frac{b \times s \times l \times d}{L}$$

where:

p = meat production
b = lambing/kidding percentage
s = survival rate up to 6 months
l = liveweight of kids/lambs at 6 months
d = dressing percentage
L = liveweight of ewe/doe postpartum.

This formula considers only the production of breeding females and not growth after weaning. However, it is generally agreed that the productivity of breeding females is a good indicator of overall productivity. The use of dressing percentage as a criterion for meat production is problematic, since large amounts of offal not included as 'meat' may in fact be consumed. Therefore, new formulae emphasize liveweight of lambs/kids[1/] for example, that of Fall et al (1982).

[1/ For productivity indices for goats, read 'kids' for 'lambs' and 'does' for 'ewes'.]

$$\text{Index 1}: \frac{\text{weight of weaned lambs per ewe} \times 365}{\text{lambing interval}}$$

There are large weight differences between breeds; for interbreed comparisons, an adjustment must therefore be made for weight of ewe. This yields the following index:

$$\text{Index 2}: \frac{\text{Index 1}}{\text{ewe weight}}$$

Since small animals eat relatively more feed per kg body weight than large ones, metabolic weight may be more meaningful to use, giving the index:

$$\text{Index 2}: \frac{\text{Index 1}}{\text{ewe weight}^{0,73}}$$

In the literature, slightly differing exponents for metabolic weights appear; e.g. 0.734 (Wilson, 1980) or 0.75 (ARC, 1980). Since the exponent represents convention rather than strictly biological function, agreement on the use of only one exponent would facilitate

productivity comparisons. The present author suggests 0.75.

In the early stage of productivity studies, when figures for lambing intervals are not plentiful, some changes must be made in the formulae to permit preliminary calculations of productivity. The following index results:

Index 4 : $p = b \times ls \times s \times l$

b = number of births per ewe per ear
ls = litter size
s = survival up to n months
l = liveweight of lambs at weaning.

The value 'b' can be obtained by dividing the number of births per month by the number of breeding females per month and adding the values of all 12 months of the year. This procedure is necessary because the number of breeding females varies from month to month. Weaning is rarely practiced in village flocks. Therefore, a certain age of possible weaning is chosen (e.g. 90 days, 180 days) and weights at this age are taken as weaning weights. As a basis for comparing the productivity levels found in surveyed flocks in the subhumid zone of Nigeria with those of flocks in other countries, the values obtained in productivity studies are presented in Table 1.

Table 1. Productivity levels of sheep and goats in various parts of Africa, calculated according to Index 2 (Fall et al, 1982) (g of lamb raised per 1000 g ewe).

Species	Country	Age of weaning (days)			Source
		90	150	180	
Sheep:	Sudan			600	Wilson 1980
	Ethiopia			510	Wilson, 1980
	Mali			560	Wilson, 1980
	Kenya			510	Wilson, 1980
	Nigeria	454			Mack, 1982
	Senegal			465	Fall et al, 1982
Goat:	Sudan		1030		Wilson, 1982
	Kenya		440		Wilson, 1982
	Mali		620		Wilson, 1982
	Nigeria	359			Mack, 1982

Investigations of small ruminant production in case study areas

Sheep management

Sheep management by settled Fulani pastoralists in the study areas is of fairly low intensity. Many households do not herd the animals during the day, do not restrain them overnight, and some even let their sheep roam without supervision at a considerable distance from the homestead. This is particularly true during the dry season. Fulani living close to hills tend to leave their sheep unattended in the hills during the wet season as well. Sheep tend to be treated as scavengers requiring minimal investment of capital and labour. Supplementary feeding is normally restricted to providing some kanwa (local salt) at irregular intervals. Fulani living close to crop farmers are obliged to pay somewhat more attention to their sheep in order to avoid crop damage. The few crop farmers who keep sheep manage them just as they do goats. Little breeding management is practiced. Some small flocks may be without a fertile male for several months; in others, males between 6 and 12 months may serve the ewes. A few larger flocks, however, keep breeding rams, normally selected from within the flock.

Sheep flock structure

An analysis of flock structure (Table 2) reveals a high percentage of breeding females (50%). This finding agrees well with others on sheep production in African villages (e.g. Wilson, 1980; Mack, 1982). Since there is no reason to believe that males have higher mortality than females, it indicates that males are taken off at a fairly young age. That in turn suggests a strong demand for mutton and/or an urgent need for cash because the preferred animals, especially for Muslim: festivals, are male sheep with at least one set of permanent incisors. In the study flocks, only 2.8% of the sheep were males older than 12 months, and only 1.4% had more than one pair of permanent incisors. Female animals over 15 months (which was assumed to be the minimum age for breeding) accounted for somewhat less than 50% of the flock. The ratio of males over 12 months to breeding females is 1 to 16; the ratio of males over 6 months (which could be regarded as capable of serving ewes but not yet sexually mature) is 1 to 4.5. This agrees well with ratios found in sheep flocks near Ibadan in southern Nigeria (Mack, 1982).

Table 2. Structure of sheep flocks kept by settled Fulani (November 1983), southern Kaduna state, Nigeria.

Class of stock	No. of sheep		% of flock	
	Males	Females	Males	Females
Lambs up to 3 months	17	9	8.9	4.9
Lambs 3-6 months	15	14	7.9	7.3
Lambs 6-12 months	15	20	7.9	10.5
Lambs 12-15 months	2	-	1.0	-
Ewes over 15 months	-	95	-	49.8

Rams over 15 months	4	-	2.0	-
Castrates	-	-	-	-
Total flock	53	138	27.7	72.3
Males over 12 months[a/]			3.1	
Males over 6 months[b/]			11	

[a/] Ratio males over 12 months: females over 12 months = 1:15.8.
[b/] Ratio males over 6 months: females over 12 months = 1: 4.5.

Sheep fertility

In the first year after establishment, ILCA's experimental flock had 1.2 births per ewe, and one pastoralists' flock that was followed continuously showed a fertility rate slightly above 100%. This rate is consistent with 1.12 births per ewe per year found in a wider-based single-round survey. Out of 50 births recorded in the experimental flock, only 2 were twins. The evaluation of animal life histories given by pastoral flock owners suggests a twinning rate of about 20%. The single-round survey suggests a twinning rate of 12% (1.4 lambs/ewe/year). The available data do not permit examination of the seasonality of births.

Lamb mortality

The survey of life histories suggests that 25% of the lambs die within 90 days of birth. This figure is likely to be an underestimate because not all lambs included in the survey had reached 3 months, and because animals are rarely weaned by this age. True viability at 6 months is therefore likely to be 65 - 70%. Thus, the number of lambs raised up to 3 months per ewe per year would be about 1, and that of lambs raised to 6 months would be 0.95.

Adult mortality in sheep

One of the main problems in sheep keeping is the high rate of adult mortality. For example, in the experimental flock, four animals died within a week in March 1983 from liver fluke infection. Similar cases were reported amongst pastoralists' flocks: 5 out of 10 ewes died in one flock in May 1983, and 7 out of a flock of 35 died in October 1983. Another major health problem is lameness caused by foot-rot and tick bites during the wet season.

Weight changes in sheep

Average ewe weight was 26.3 kg. Ewes between 1 and 2 years of age weighed 23.1 kg on average, 2 to 3 year-olds weighed 25.4 kg, 3 to 4 year-olds weighed 27.1 kg, and females of 4 years or more weighed 29.9 kg.

Table 3. Weight for age in sheep kept by settled Fulani (1982/83) in southern Kaduna state, Nigeria.

Weight	Pastoralists' flocks		ILCA experimental flock	
	(kg)	(No.)	(kg)	(No.)
Birth weight	1.6	19	1.9	9
30-day weight	4.0	9	5.2	7
90 day weight	11.0	9	8.7	8
180-day weight	17.6	18	14.5	9
360-day weight	22.0	15	21.1	5

Sheep productivity indices

Three formulae were used in two variations to calculate annual production indices.

Index 1: weight (kg) of offspring at 3 (and 6) months per ewe.
Index 2: weight (kg) of offspring at 3 (and 6) months per kg of ewe.
Index 3: as for index 2 but using metabolic weight of ewe.

Data:	at 3 months:	1 lamb/ewe/year
	at 6 months:	0.9 lamb/ewe/year
	average ewe weight:	26.6 kg
	weight data for offspring derived from experimental flocks.	

Productivity according to:

	3 months' survival	6 months' survival
Index 1:	8.7 kg/ewe/year	13.05 kg/ewe/year
Index 2:	0.327 kg/kg ewe/year	0.490 kg/kg ewe/year
Index 3:	0.746 $kg/kg^{0.75}$ ewe/year	1.120 $kg/kg^{0.75}$ ewe/year

The results agree with other studies in African rural environments (Table 1) .

Goat management

An estimated 95% of the goats in the study areas are kept by crop farmers; nearly every farmer keeps some. A total of 33 out of the 35 farmers interviewed were goat keepers, and their average flock size was five. Same farmers buy does for breeding, but

farmers commonly acquire stock by looking after other people's goats and sharing the offspring.

Only 4% of Fulani pastoralists in the Kachia area keep goats (Nweke, personal communication). As a rule, these Fulani have lived at one site for several years and have adapted local farmers' goat management practices. In many other respects, such as hauling, they have also assumed the local farming community's way of life. Same Fulani, particularly women, may own goats but leave them in the care of farmers, who are often also women (Paper 2). The farmers regard goat keeping as a subsidiary business that must fit into the pattern of cropping activities, which are more important. During the growing season goats are tethered for grazing by day and kept in huts overnight. Animals are sometimes not tethered until 11.00 a.m. Labour requirements may not only restrict grazing time but may also place an upper limit on the number of goats that a household can keep. During the wet season (until July/August) the goat manure which accumulated in the goat huts is mixed with wood-ash and applied to millet nurseries as fertilizer. After the grain is harvested the goats are allowed to roam freely and often do not even return to the compound at night. Some feeding is done: grasses and immature grain heads are cut and carried to the animals shortly before harvest, when goats are still being tethered but the quality of natural grasses has deteriorated. Brewers' grain and kanwa are occasionally fed to them as well.

Goat flock structure

The flock structures in the case study area correspond with those in other African settings where goats are kept primarily for meat. At the beginning of the study in June 1982, does of 12 months and above made up more than 50% of the flocks, but as shown in Table 4 their relative importance has decreased since then. The ratio of males to females above 12 months was 1 to 17 in November 1983, although it was initially much lower: 1 to 45 in June 1982. Such low levels may impair flock fertility.

Table 4. Summary of goat flock structures in the Abet case study area(l982/83).

Class of stock	No. of goats		% of flock	
	Males	Females	Males	Females
Kids up to 3 months	20	17	10.1	8.6
Kids 3 - 6 months	15	21	7.6	10.6
Kids 6 - 12 months	9	9	4.6	4.6
Kids 12 - 15 months	4	14	2.0	7.0
Does over 12 months		86	-	43.4
Bucks aver 12 months	2	-	1.0	-
Castrates	1	-	0.5	-
Total herd	51	147	25.8	74.2
Intact males over 12 months[a/]			3	
Intact males over 6 months[b/]			7.6	

[a/] Ratio intact males over 12 months: females over 12 months = 1:16.7.
[b/] Ratio intact males over 6 months: females over 12 months = 1:6.7.

Goat fertility

The fertility rate of 98.6% in the surveyed flocks is fairly low for goats (Table 5). During 1983, the rate was only 85.3%, but 65% of the births occurred from June to September. In 1982, when the study started in midyear, 73.8% of the number of recorded births occurred between July and September. This seasonality may be caused partly by the maturing of young bucks that had been spared from previous sales and now had free access to does, but it may also be influenced by nutrition, since from February to April the growth of shrubs before the wet season provides highly nutritious fodder.

Table 5. Fertility of goats kept in the Abet case study area (1982/83).

	1982						1983					
	JL	A	S	O	N	D	J	F	M	A	M	Jn
No. of breeding females	90	88	99	99	90	90	92	96	94	97	98	104
No. of births	22	10	9	8	1	6	3	5	9	2	7	11
Fertility %	24.4	11.4	9.1	8.1	1.1	6.7	3.3	5.2	9.6	2.1	7.1	19.6
Total fertility: 98.6%												

The distribution of birth events according to litter size during the period July 1982 to June 1983 is shown in Table 6.

Table 6. Distribution of kid births according to litter size in the Abet case study area (1982/83).

Type of birth	No.	Percentage of birth events
Single	57	61.3
Twin	32	34.4
Triplet	3	3.2
Quadruplet	1	1.1
Total No. of births	93	100

This yields an average litter size of 1.44, which is similar to findings in Ibadan. Sex distribution among kids born was 49.3% males and 50.7% females.

Goat mortality

Kid mortality up to 3 months of age was 22.4% over the first year of recording, while overall flock mortality was 14.4%. These apparently law figures may be due to gaps in the recording and should be treated with caution. The relatively small sample size did not permit analysis of kid mortality according to litter size.

Goat weight changes

The weight changes from birth are shown on a yearly basis because there were large differences between the 2 years (Table 7). The favourable nature of 1983 is indicated by low mortality figures and increases in animal numbers, as well as by generally higher weights.

Table 7. Weight changes in goats (kg) in the Abet case study area (1982/83).

Year of birth	1982			1983		
	No.	Mean	(SD±)	No.	Mean	(SD±)
Birth weight	17	1.42	(0.34)	50	1.75	(0.29)
30-day weight	17	2.31	(0.67)	62	3.42	(1.07)
90-day weight	16	3.86	(1.21)	58	5.37	(1.16)
180-day weight	16	6.08	(1.64)	7	10.80	(2.29)

The average postpartum weight of dams was 19.3 kg. When weights are classified according to age (Table 8), increased weight is evident in animals more than 4 years old. This increase clearly indicates the high reproductive capacity of goats, which are already reproducing long before mature weight has been reached.

Table 8. Postpartum weight of dams (kg) according to parity and age (kg) in the Abet case study area (1982/83).

	Weight (kg)		
	No.	Mean	(SD±)
Parity:			
First	24	15.5	(3.55)
Second	12	19.2	(3.54)
Third	14	20.0	(2.72)
Fourth or more	28	22.3	(3.40)
Age of dam:			
Below 2 years	16	14.3	(2.53)
2 - 2.5 years	15	18.4	(3.42)
2.5 - 3 years	17	19.8	(3.47)
3 - 4 years	13	21.9	(2.48)
Above 4 years	15	22.6	(6.37)

Goat productivity indices

For calculations of goat productivity, the following data were used:

Average weight of dam	19.3 kg
Fertility rate	0.98
Average litter size	1.44
No. kids born/doe	1.4
No. kids to 3 months raised/doe/year	1.09
No. kids to 6 months raised/doe/year	1.0
Weight of kid at 3 months	4.6 kg
Weight of kid at 6 months	8.44 kg

Calculation of goat productivity according to the different indices yields the following results in terms of kg kid production:

	Assumed weaning age	
	3 months	6 months
Index 1: Liveweight of kids raised/doe	5.01 kg	8.44 kg
Index 2: Weight of kids raised/kg doe	0.259 kg	0.437 kg
Index 3: Weight of kids raised/kg$^{0.75}$ doe	0.544 kg	0.917 kg

These data indicate that sheep are more productive than goats in the study area. One reason for this may be that goats are kept by people whose main enterprise is cropping, so the animals are severely restricted during the wet season, whereas sheep kept by pastoralists are less restricted.

Goat offtake

As shown in Table 9, actual offtake over the year was 23.4%. Together with an increase in numbers of 15.2%, the potential offtake was 38.6%. Goats were sold in order to pay for fertilizer; in addition, a poor harvest forced some farmers to buy grain, and inflation has increased in Nigeria since June 1983.

Table 9. Offtake from farmers' goat flocks in the Abet case study area (July 1982 - June 1983).

Offtake classification	No. of animals
Net transfers out	4
Sales	32
Slaughters	8
Total offtake	44
Percentage offtake	23.4%

[a/] Average flock size, 5.37; total animals surveyed, 188.

Offtake was analysed in more detail for June 1982 to October 1983. Of 50 goat sales recorded between June 1982 and October 1983, 25 (50%) occurred during June and July 1983. This peak in offtake may partly be a reaction to the increase in the size of flocks over the previous year, but also to the high price of mineral fertilizer, which was available only on the unofficial market at up to four times the official government prices. In 16 out of the 50 sales, it was explicitly stated that animals were sold because money was needed to buy fertilizer; 13 of these 16 sales were recorded in June and July 1983. other reasons for sales included the ill-health of an animal (5 cases or 10%), general lack of money without an indication of how the money would be used (28 cases or 56%) and raising money to equip a son going to college (1 case). Ill-health was the most frequent reason for slaughter (6 of 14 cases), followed by slaughtering to provide meat for participants in communal farming (4 cases), and for various ceremonies or other occasions (4 cases).

In total, data on sales and slaughters indicate that a relatively small part (17%) can be attributed to ill-health. The most important reason for sales is the need for cash for purposes unrelated to goat production. In other words, the small ruminant is used as a 'savings account' from which money can be readily withdrawn. The extent of goat slaughters for communal farming is underestimated by these figures, for it is known that some farmers buy goats on the market for this purpose even though they may have goats of their own. Since the purchase and slaughter of goats as payment for communal farming often take place on the same day or within only a few days, these goats do not appear in the survey data on farmers' flocks.

Potential intervention points in small ruminant production

The major problem in sheep production is adult mortality from respiratory diseases and liver fluke infections. Furthermore, animals lose condition in the wet season because of ectoparasites. A veterinary package should therefore be the first priority in research and development.

During the establishment phase of the ILCA experimental flock, lamb mortality was about 60% for the first 6 months. Birth weights of lambs that died averaged only 1.3 kg compared with a 1.9 kg average birth weight in surviving lambs. Improved nutrition led to an increase in birth weight and lamb survival, although the lamb mortality rate in 1983 was still high at 35%. In 1983 there was no difference in birth weight between surviving lambs and those that died.

With regard to goat production, the data must be treated with some caution because 1983 appears to have been a very favourable year. A late and short wet season reduced the time of stress (due to confinement) and high disease susceptibility. In addition, greater quantities of immature millet were a source of good-quality feed around harvest-time. The difference in weight development of growing animals between the 2 years and the fact that 34% of kids born between June and December 1982 had died by December 1982, indicate that there might be more problems in other years.

The inclusion of more males of breeding age in the flocks seems an obvious intervention for raising fertility, but what is preventing the farmers from doing this must be established first. An exceptional case of quadruplet (all female) birth led to the observation that there is same scope for improvement of goat nutrition. Birth weights of the quadruplets ranged between 1.0 and 1.1 kg; upon the author's advice, the goat owner started to feed the dam. Not only did all four kids survive, they also grew at an above average rate and within 1 year of their birth two of the kids had already given birth themselves. With regard to weight development, there is some evidence of a period of weight loss in the late wet season. Since grazing or cutting of Stylosanthes spp. at that time of year would endanger the persistence of the plants, utilization of browse plants might be a more suitable intervention for improving goat nutrition.

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