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Economic Trends

Small ruminants

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Small ruminant production in the world

On a world scale the position of small ruminant production within the livestock sector as a whole is a relatively modest one. The average number of sheep/goats is 36 per 100 inhabitants, i.e. 6 LU[1], whereas for cattle it is 29 per 100 inhabitants. Small ruminants primarily consist of sheep, which account for two thirds of the world total and 95% of small ruminants in developed countries. Distribution between developing and developed countries is similar to that for cattle, two thirds being found in the former and one third in the latter. However. there are only two areas in the world where sheep and goat production has any real significance in comparison with the human population or with cattle production. These two areas are the Mediterranean and Australia/ New Zealand. It also plays a fairly important part in non-Mediterranean African countries, but is only a very small sector throughout most of the industrialized world.

1. One livestock unit (LU) equals six sheep or goats.

The traditional production areas of Africa, the Mediterranean and the Middle East contain over 42% of the world flock, while the USSR accounts for 10%. The average number of sheep and goats in these areas is 70 per 100 inhabitants or even 76 if Egypt, which possesses only small numbers, is left out. This figure is already double the world average, but it rises to over 130 in most Mediterranean countries: North Africa, Greece, Bulgaria, Turkey and Syria, as well as in Iraq and Iran. Australia and New Zealand together with South America (especially Argentina

and Uruguay) form a second major sphere of production, more recent in origin and now accounting for 20% of the world flock. Australia and New Zealand contain 192 million sheep, i.e. 13% of the world flock, or 870 sheep per 100 inhabitants. Together they form the largest small ruminant producer in the world. In Europe, the United Kingdom together with Ireland has been, and still is a fairly important producer of sheep, with a flock of 33 million, amounting to 56 sheep per 100 inhabitants. The rest of the world flock is found mostly in India and the Far East. However, in these areas small ruminant production plays a relatively minor role when compared with the size of their human population.

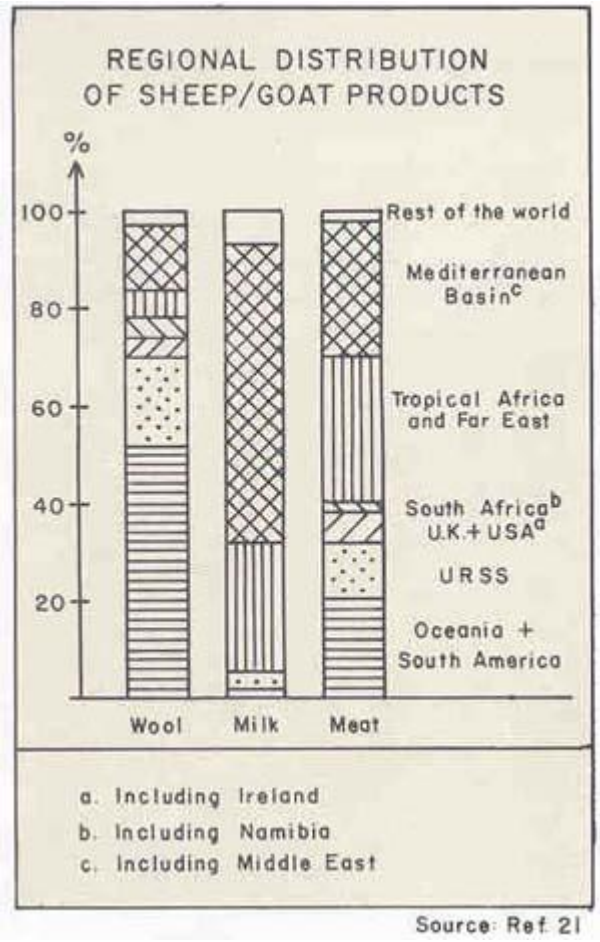
Livestock distribution in the world —1978—

Zones[a]	**Sheep/goat flock**		**World percentage**	
	Total (millions)	Per 100 inhabitants	Sheep/goats	Cattle
Oceania	192	870	13	3
Mediterranean Basin and Middle East	360	70	25	8
Africa south of Sahara	255	71	17	13
USSR	147	56	10	9
Great Britain+ Ireland	33	56	2	2
South America	122	53	8	18
India and Far East	331	15	22	26
Rest of Europe	16	12	1	6
North America	34	10	2	15
Total	1,490	36	100	100

a. Zones ranked according to sheep and goat numbers/100 inhabitants.
Source: Ref. 21

Leaving aside the skin trade, sheep and goat production has a threefold purpose: the production of meat, milk and wool. However, these three production aims vary in significance. In Britain and the USA meat products account for 80% of produce from sheep, excluding skins, while the balance consists almost entirely of wool. In Australia and New Zealand, South America, South Africa and the USSR sheep production is also oriented towards meat and wool. However, in these areas wool production tends to dominate. In Australia, where most of the world's Merino sheep are found, wool accounts for some 60% of earnings from sheep production. Although the emphasis on Wool is a little less pronounced in South America and in New Zealand, which has diversified into lamb for export to the United Kingdom[2], it nonetheless remains an important sector, representing some 40% of overall earnings. In fact, the wool production of Australia, New Zealand and the large-scale South American producers accounts for over 50% of world output. For these various countries it is thus the primary production objective.

2. Primarily by developing dual purpose breeds for wool and meat production, such as the Corriedale.



By contrast, small ruminant production in tropical Africa and the Far East is almost entirely oriented towards meat and milk. Wool production in tropical Africa is negligible, barely exceeding 1% of world output. In other parts of the world small ruminant production generally has a threefold objective—meat, milk and wool—but in the Mediterranean, which accounts for over 60% of world output of sheep, and goat milk, milk production, which is usually processed into cheese, plays an appreciably greater role than it does elsewhere. Wool, on the other hand, plays a minor part.

Meat production, which is globally the most important of the three, is more evenly distributed throughout the various production areas. In most developing countries, including those of Latin America, meat is produced almost entirely for local consumption, giving rise to only a small amount of trade. The sharp rise in consumption in the oil countries of the Middle East has nevertheless in recent years given rise to a considerable flow of imports into this traditional production area.

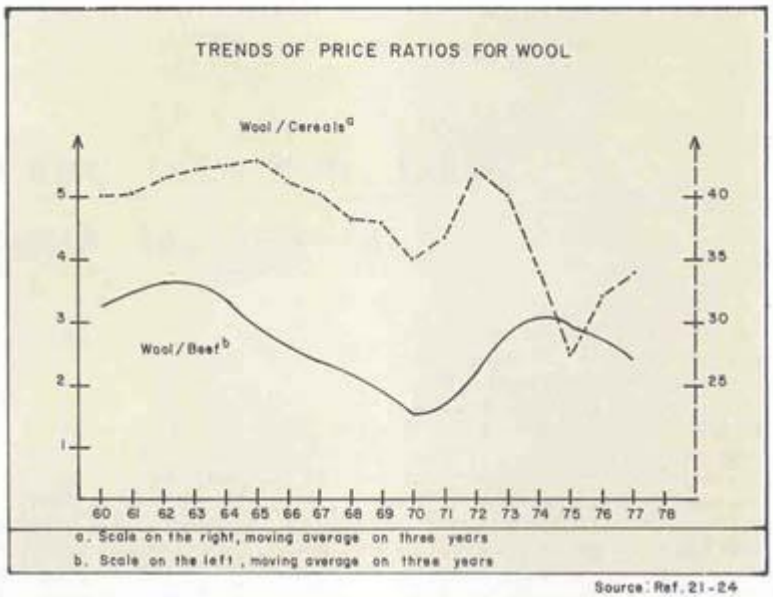
In industrialized countries the consumption of mutton and lamb is negligible in relation to the overall consumption of meat. Nevertheless, the United Kingdom, where sheep production has always played an important part, is an exception. Britain's policy of seeking cheap food supplies meant that she was able to import from Australia and New Zealand at prices very much lower than her own production costs. As a result Britain was for many years the only customer of any real size on the world market, which is almost entirely supplied by Australia and New Zealand.

The emergence of Japan as a relatively important customer, although still well behind Britain, and more recently that of the Middle East, have helped to diversify sales.

However, supplies on the world market are governed by factors which are largely unconnected with the demand for meat, owing to the importance of wool production in the large-scale exporting countries. The fall in wool prices at the end of the 1960s,, caused by competition from synthetic fibres, led to deteriorating wool/beef and wool/cereals price ratios, enticing producers, especially in Australia, away from sheep towards cattle or cereal production. The shift away from sheep production, which continued in spite of the 1973 recovery of the wool market after the rise in oil prices, largely explains the sharp decline in flocks in the developed countries over the last ten years.

Outside Australia and New Zealand, sheep and goat production has also shown a declining trend in other developed countries. Flock numbers, which stood at 185 million animals in 1961–65 (excluding Eastern Europe), were no more than 155 million in 1978. The drop in numbers has been particularly pronounced in the USA, which contained only 12 million sheep in 1978, whereas numbers stood at almost 60 million animals at the end of the second world war. Although there has been no actual decline in real terms in Western Europe, flock numbers have stood still for over 15 years.

Various factors explain the declining trend. First, the downward trend of the wool market has deprived producers of a substantial source of income. But the most important factor is that sheep production, in all but the large-scale production areas of Australia, New Zealand and South America, continues to be managed along traditional lines, and is thus no longer compatible with the new forms of employment emerging in rural areas. Efforts to intensify husbandry systems are confronted with financial constraints, since sheep production requires a high labour input and thus faces competition from production alternatives such as pork, poultry or dairy production, where considerable advances have been made in terms of yields and labour productivity. It therefore tends to play an increasingly marginal role in agriculture, while at the same time high production costs act as a disincentive to the consumption of mutton and lamb, which are increasingly becoming luxury commodities. This trend is the reverse of that in developing countries, where sheep and goat flocks continue to show steady growth. Small ruminant production in these countries is sheltered from external influences and still compatible with the prevailing production conditions.



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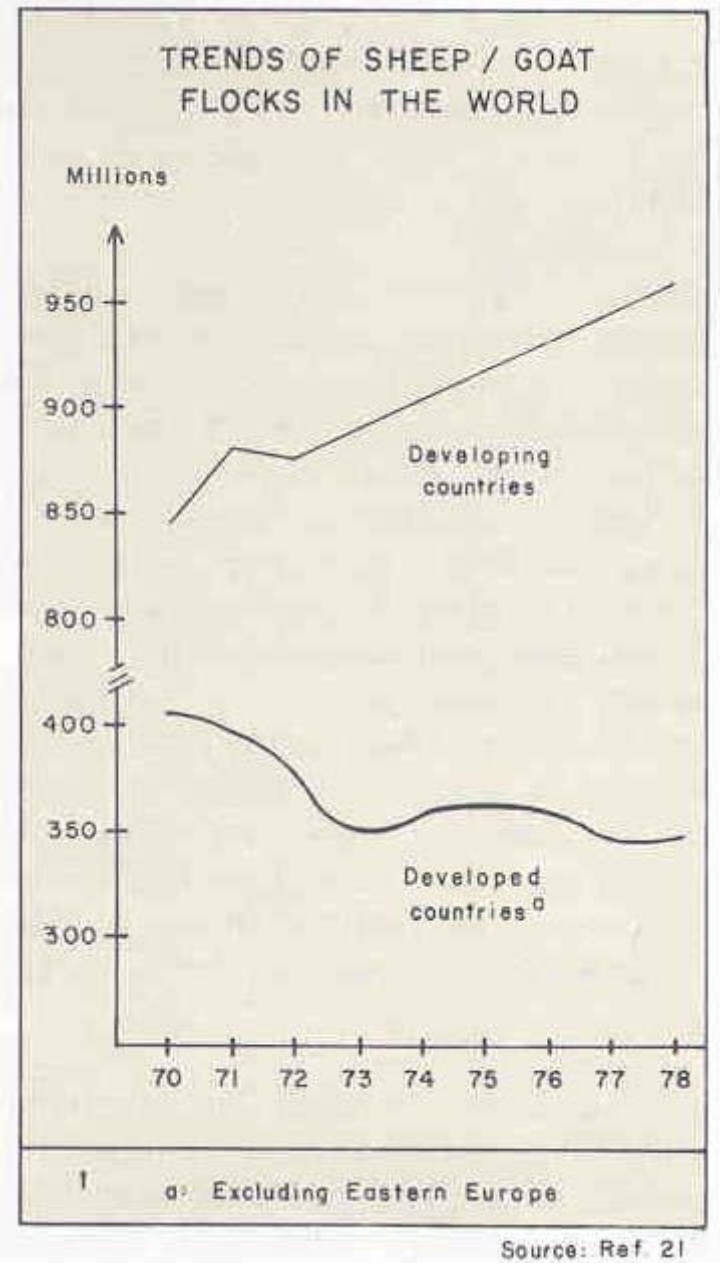


World meat and livestock prices in 1977.

			—in US cents/kg—
	Beef	Mutton	Pork
Meat (c.w.)			
France	315	417	164
United Kingdom	223	207	130
Australia	57	81	124
New Zealand	64	65	110
Livestock (lw)			

Italy	134	241	–
United States	76	113	88
Canada	84	125	–

a. Wholesale prices
b. Producer prices
Source: Ref. 21

Small ruminant production in tropical Africa

Tropical Africa contains almost one tenth of the world's sheep and over a quarter of its goats. Small ruminant production throughout this area takes place entirely under traditional systems, and since the meat produced is mostly for home consumption, a great deal of it escapes official marketing channels. As a result there is an undeniable lack of knowledge as to the part played by sheep and goat production, coupled with the belief that these animals are to blame for the decline of the environment. Consequently, despite its sizeable contribution to meat supplies for local populations, this subsector has been continually omitted from development projects and policies.

Livestock numbers and production systems

As in the case of cattle, the small ruminant flock of tropical Africa is for the most part found in the Sahel countries and in eastern Africa[1]. However, its geographical distribution is evidently somewhat different to that of cattle. Sixty per cent of goats and over 50% of sheep are apparently raised in West and central Africa, whereas for cattle the corresponding figure does not exceed 40% (FAO estimates). As regards the rest of tropical Africa, small ruminants are mostly found in the Horn of Africa (Ethiopia and Spmali2), which is thought to contain one third of the sheep and 27% of the goats found in. tropical Africa (as against 220/0 of the cattle herd). The remaining countries of East Africa, which raise 29% of its cattle, probably possess only 11 % of all the goats and sheep raised in tropical Africa. Outside Ethiopia, relatively few small ruminants are thus found in the highlands of East Africa. Numbers are also low in southern tropical Africa. On the other hand, they increase again in the countries of non-tropical southern Africa (Namibia and South Africa).

1. However, flock numbers are even less accurately known for small ruminants than herd numbers are for cattle, and breakdowns between sheep and goats are frequently only approximate.

Owing to their considerable ability to adapt, small ruminants, and especially goats, manage to survive and flourish in extremely hostile environments, including not only the arid zones but also the humid areas of West and central Africa, where their adaptive powers are traditionally ascribed to their reduced size. The weight and size of small ruminants in tropical Africa, which, like those of its cattle, are very much lower than in temperate countries, tend to reduce steadily from the traditional, arid production areas towards the humid zones in which dwarf breeds have developed.

Goats generally have a lower weight than sheep but are more prolific. Their feeding habits are quite distinct: goats browse mostly on leaves and are reputed to have a high digestibility coefficient for fibrous plants, whereas sheep feed mostly on grasses. Sheep and goat production are thus complementary to one another, and generally also to cattle production. Their browsing habit makes goats less susceptible to intestinal diseases than sheep, but on the other hand they are more inclined to suffer from protracted diseases.

Three main types of small ruminants may be distinguished in tropical Africa, although it is not always easy to identify the different original breeds owing to the extent of uncontrolled crossbreeding. The three categories are as follows: the Sahel and desert breeds found in he arid and semiarid zones, the dwarf breeds of the humid and subhumid zones, and the sheep raised in the highland areas of East Africa. The sheep and goat breeds of the Sahel and desert areas, including the Blackhead Persian and Somali sheep of East Africa and the Nubian goats of Sudan, are adapted to very arid environments. Generally, they are large-sized animals, relatively heavy by African standards, although the size may vary considerably: an adult sheep weighs, on average, 40 to 50 kg in Sudan but usually under 40 kg in the Sahel. They are raised under transhumant or sedentary systems, often in association with cattle production. In the semi-arid zones small ruminants are raised for meat and also for milk production, particularly where goats belonging to transhumant pastoralists are concerned. Goat milk production in local breeds is low when compared with many exotic breeds, often leaving less than 0.5 kg/day for human consumption, although it is, in relative terms, considerably higher than that of indigenous cows raised under similar conditions. Some local goat breeds are, however, very productive. The Nubian goat produces two litres of milk per day, while the Red Sokoto or Maradi, which is a smaller animal, is also a good milker, yielding 1–1.5 kg/day.

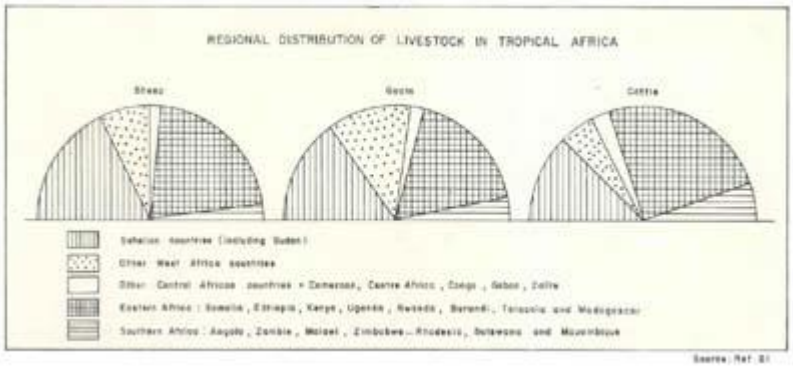
Digestibility of dietary constituents by ruminants.

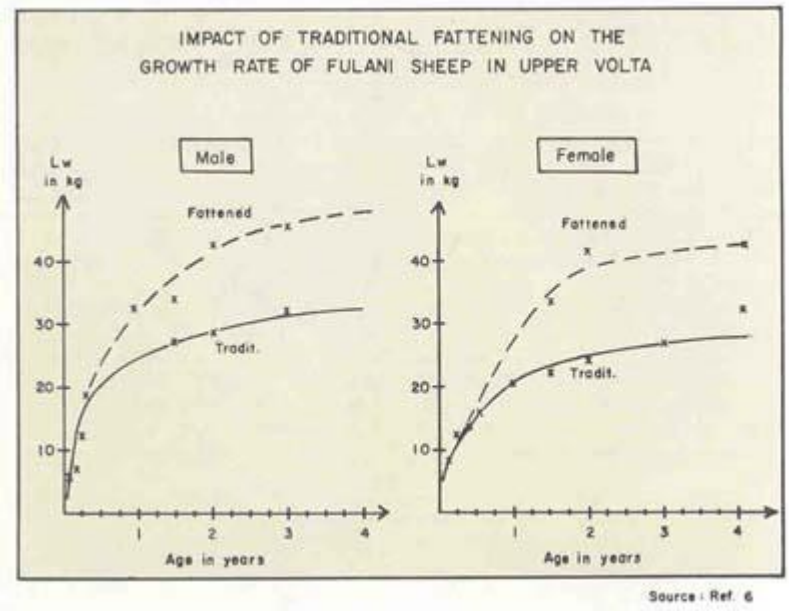
			—in%—
Constituent	Goat	Sheep	Cattle
Dry matter	59.7	59.9	53.5
Organic matter	64.0	62.6	56.4
Crude protein	66.4	64.1	49.4
Crude fibre	66.9	64.3	61.6

a. In India, according to Jong and Majumbar, 1962
Source: Ref. 15

Some fattening practices are found in sedentary systems; usually these involve wethers, which are tethered in the family compound and fed intensively on forages and crop residues (moutons de case). According to a survey in Upper Volta (ref. 6), which took place in an intermediate zone and thus involved both Sahel breeds (notably Fulani) and those of the south (Mossi), fattening practices sometimes assume a substantial role, involving nearly 90% of males under one year and virtually 100% of those in higher age-classes. They enable weights equal to those of adult animals to be obtained in both males and females by the end of the first year. Nevertheless, the

fattening period was generally found to be fairly long, lasting over a year in many cases. It also emerged that the fattening performance of Sahel sheep was better than that of breeds from the south. Similarly, the few data collected during the survey on Fulani sheep in Niger (the Bali Bali breed) showed average fattening weights which were very much higher than those of Fulani sheep in Upper Volta. Fattening performance thus appears to vary according to the breed.





The skins are processed by small-scale local tanners and are also sold on the export markets, where some varieties, such as Maradi goat skins, fetch high prices. Wool production, on the other hand, is virtually zero, since the sheep raised in the arid and semi-arid zones are almost entirely of the coarse hair type. One wool-producing breed, the Macina, is nevertheless found in Mali, but yields are very poor in terms of both quantity and quality.

A wide variety of sheep and goats are found in the subhurnid and humid zones. Their weights and heights diminish steadily towards the more humid climate zones. Varieties found include the Nilotic goat in southern Sudan, the dwarf goat of East Africa (notably the Mubende variety in Uganda), and the dwarf sheep and goats of West Africa, which are found from the mouth of the Senegal river to central and southern Africa (Angola). The latter breeds appear sufficiently similar to allow a simple classification : the Djallonké sheep, also known as the Fouta Djallon, which belongs to the southern Guinean or forest zone, constitutes the only group of sheep,

while the dwarf goat of West and central However, the sheep and goats of the forest zone are smaller than those of the savannah, although Africa, or Guinea goat, again known as the Djallonke or Fouta Djallon goat, is the only type of goat. the latter are nonetheless still dwarf breeds.

The small ruminants of subhumid and humid tropical Africa are generally raised on smallholdings. The animals are occasionally led out to graze, but usually they are allowed to roam freely over any uncultivated land round the farm to browse and scavenge. During the cropping season, however, they are generally tethered during the day to avoid crop damage. Although they may partly be fed on residues to supplement their basic ration, especially during the dry season, they do not receive any improved feeding in the proper sense.

These animals are primarily raised for meat production. The small amount of milk produced is used entirely for feeding the young and is not taken for human consumption. Apart from a few breeds, such as the Mubende goats in Uganda, which produce skins which are highly sought after, the goat and sheep skins of the subhumid and humid areas are not used for tanning. Instead they are often consumed with the meat.

Many of the sheep and goats raised in the East African highlands are to be found on small mixed holdings in the Ethiopian highlands (especially in the area north of Addis Ababa), which contain 75% of the sheep produced in the country and 20% of the total sheep population of tropical Africa. The sheep found in the Ethiopian highlands are small in height and are thought to belong to a fertile breed which is slow to reach maturity but has a long life expectancy.

Their conformation is mediocre and average liveweight does not normally exceed 25 to 35 kg. They are raised for meat and skins and the latter, highly sought after on the export markets, account for a substantial share of the earnings derived from these animals. The milk performance of the ewes is poor. Most of the sheep of the Ethiopian highlands are of the coarse hair type. However, there are a number of wool-producing breeds, giving a product of inferior quality and poor yield which may be used for carpet making. There has been some crossbreeding with wool production breeds (Corriedale and Merino), but in Ethiopia this has been on a very limited scale. In Kenya, however, crossbreeding with Corriedales has been carried out on a larger scale, with the aim of producing both wool and meat. A few experiments in commercial fattening have also been launched by the private sector in Kenya, with the aim of producing prime quality lamb. However, the part played by the commercial fattening sector remains a minor one, given the background role of small ruminant production in general within the livestock sector.

Adult body weight and production purpose of small ruminants in tropical Africa.

Zones/breeds	Countries	Adult weight (kg)	Age (months)	Speciality	References
Sheep					
Semi-arid zone					
Desert x Nilotic	Sudan	42–55	36	Meat	2

Blackhead Somali	Ethiopia	35–40	–	Meat/milk/skin	1
Fulani (Sahel)	Upper Volta	35–40	36	Meat/skin	6
Fulani x Macina x Djall	Mali	30–35	36	Meat/skin	3
Peul Oudah	Chad	48–58	54	Meat/skin	–7
Arabe	Chad	40–48	54	Meat/skin	7
Humid zone[a]					
Mossi	Upper Volta	20–30	36	Meat/skin	6
Djallonke	Ivory Coast	25	–	Meat	9
Mayo Kebbi	Chad	33	54	Meat	7
Kirdi	Chad	27	54	Meat	7
West African Dwarf	Nigeria	20	2,5/4 year	Meat	11
Highlands					
Ethiopian type	Ethiopia	25–30	–	Meat/skin/fibre	1
Goats					
Semi-arid zone					
Nubian	Sudan	up to 60	–	Milk	18
Desert X Nubian	Sudan	43–40	36	Meat/milk/skin	2
Sahel	Upper Volta	25–30	42	Meat/milk/skin	6
Sahel	Mali	31–35	36/42	Meat/milk/skin	3
Sahel	Chad	32–42	54	Meat/milk/skin	7
Maradi (Red Sokoto)	Niger, North Nigeria	23–30	–	Meat/milk/skin	18
Humid zone[a]					
Mossi Goat	Upper Volta	18–20	3/7 Year	Meat/skin	6

Southern Goat	Chad	26	54	Meat/skin	7
E. African (Mubende)	Uganda	30	–	Meat/skin	18
W. African Dwarf	Nigeria	20–30		Meat	12

a. Subhumid zone included

To sum up, small ruminant production as practised in tropical Africa is an extensive production system, sometimes complemented by traditional fattening practices carried out on smallholdings. However, it is in no way integrated with other agricultural activities. The animals are raised for meat, as well as for milk in pastoral areas. Skins are usually processed by local tanners or sold on the export market, although in the humid zones of West Africa they are consumed together with the meat. Finally, as almost all the small ruminants raised in tropical Africa belong to coarse hair breeds, wool production is virtually nil.

For the African stockowner small ruminants are chiefly a form of investment for petty cash. These animals have a relatively low market value, thus representing a lesser investment than the purchase of cattle, with the result that they are more widely distributed amongst the poorest households. This situation, together with the ability of local breeds to adapt to the harshest environments, has evidently promoted the widespread distribution of small ruminants throughout the rural community. Whereas the cattle population is normally concentrated, remaining in the hands of a restricted number of producers (the percentage of farmers owning cattle is estimated at under 20% in the semi-arid areas of northern Nigeria), ownership of small ruminants is almost always more extensive, generally involving over 50% of smallholdings in the livestock raising areas.

Underexploited potential

Little is known about the productivity of small ruminants. There are few estimates on production parameters and these in any case are apparently highly variable, owing to the fact that slaughterings for the most part escape the statistical records, the bulk of available output being absorbed by home consumption. Even when production is marketed, it still remains largely unrecorded owing to the considerable part played by private slaughterings.

Field surveys and on-station research both indicate that the sheep and goat breeds raised in tropical Africa may well have considerable development potential owing to their relative precocity and high fertility, resulting from their year-round breeding season. Average age at first parturition is estimated at 11–12 months for many breeds. First parturition thus occurs well before the females have reached their full adult weight at two to three years. It has also been shown, notably in the case of the dwarf breeds of West Africa, that 11–12 months in fact represents an optimum age, at which all the females mated were able to give birth to lambs or kids with a good survival rate. Unlike cows, in which maturity is traditionally retarded by difficult environments, does and ewes in tropical Africa thus reach sexual maturity at about the same age as, or even earlier than, exotic breeds[2].

2. Average age at first lambing which is generally 12 months in British breeds, frequently reaches 18 or even 24 motns, in Mediterranean breeds and in Merinos, which are raised

mostly in Australia. Age at first lambing is also 18 months for a number of tropical African breeds belonging to the arid zones (Somali and Persian Blackheads) and to the Ethiopian highlands.

First pregnancy and live birth rate for West African ewes.

Age in months	Number exposed	% pregnant	% live births
8	12	42	17
9	13	77	54
10	8	75	38
11	9	100	100
12	9	100	100

Source: Ref. 9.23

Reproductive traits of small ruminants in tropical Africa.

Zones/breeds	Countries	Source of observ.	First parturition (in months)	Reproductive parameters[a]			References
				Prolificacy[b]	Fertility[c]	Fecundity[d]	
Sheep							
Semi-arid Zone							
Desert x Nilotic	Sudan	Village	10	1.14	1.30	1.48	2
Masai	Kenya	Village	–	1.05	1.18	1.27	8
Blackhead Somali	Ethiopia	Village	18	1.05	0.70c	0.75	1
Ful. x Mac. x Di.	Mali	Village	–	1.06	–	–	3
Fulani	Mali	Herd	18	1.10	0.90e	1.00[f]	4
Fulani	Upper Volta	Village	12	–	–	1.06	6
Oudah Fulani	Chad	Village	13	1.07	0.98e	1.05	7
Arab	Chad	Village	14.5	1.01	0.85c	0.86	7
Humid Zone[g]							
Mossi	Upper Volta	Village	12	–	–	1.12	6
Djallonke	Ivory Coast	Station	–	1.10	1.50	1.75	9
Mayo Kebbi	Chad	Village	15	1.64	0.95e	1.56	7

Kirdi	Chad	Village	17	1.42	0.99e	1.41	7
West Af. Dwarf	Ghana	Station	–	1.44	–	–	9
West Af. Dwarf	Nigeria	Station	15/20	1.45	1.50	2.18	11
West Af. Dwarf	Nigeria	Village.	–	1.15	–	–	12
West Af. Dwarf	Cameroon	Station	–	–	1.50	–	9
Highlands							
Ethiopia type	Ethiopia	Village	–	1.10	2.00	2.20[e]	1
Goats							
Semi-arid Zone							
Sudan Desert	Sudan	Village	10	1.57	1.32	2.08	2
Masai	Kenya	Village	–	1.25	1.25	1.55	8
Sahel	Upper Volta	Village	12	1.27	1.11	1.41	6
Sahel x Guinean	Mali	Village	9/15	1.24	–	_	3
Sahel	Chad	Station	–	1.50	1.14	1.71	5
Sahel	Chad	Village	14/16	1.20	0.82e	0.98	7
Massakory	Chad	Village	–	1.55	–	–	5
Maradi	Chad	Village	–	1.51	1.15e	1.74	5
Humid Zone[g]							
Mossi	Upper Volta	Village	12	1.19	1.02e	1.21	6
Southern Goat	Chad	Village	15.5	1.58	1.04e	1.64	7
West Af. Dwarf	Ghana	Station	12	1.84	1.40	2.60	9/14
West Af. Dwarf	Nigeria	Village	12	1.54	–	–	12

West Af. Dwarf	Nigeria	Village	12	1.46	1.14e	1.66	8
Sheep/goats							
Humid Zone							
West Af. Dwarf	Ghana	Station	–	1.84	1.54	2.93	9
West Af. Dwarf	Nigeria	Village	12	1.61	0.70[e]	1.11	8

a. Underlined data correspond to village observations.
b. Percentage of lambs/kids born alive per parturition.
c. Percentage of parturitions per ewe/doe and per year.
d. Percentage of lambs/kids born alive per ewe/doe and per year.
e. . Derived estimates.
f. Estimated on the basis of herd structure.
g. Subhumid zone included.

Prolificacy would also appear to be relatively high. The prolificacy rate, which is expressed as the average number of young per parturition, apparently varies between 110% and 140% for ewes. It is probably still higher in goats, frequently reaching 150%, owing to the considerable number of twin or triplet births, and as much as 180% in the dwarf goats of West Africa, according to the results of experiments conducted in Ghana. For the most part these high rates were observed on research stations, but various experts believe them to be linked to genetic factors, so that they would not be influenced by the relatively favourable conditions under which they were achieved (ref. 5). Prolificacy rates observed in goats compare favourably with those currently achieved by different breeds of small ruminants raised in other parts of the world. On the other hand, those observed for sheep appear comparable only to the rates achieved by the least successful breeds.

A second major advantage in terms of fecundity is that potential fertility in indigenous females is relatively high, since their heat periods are not usually subject to seasonality, unlike most breeds raised in temperate zones[3]. As a result they are theoretically able to give birth every six to eight months, giving a fertility rate of 150–200%. In point of fact a rate of 150% (three parturitions every two years) is considered by experts to be the optimum rate. On this basis indigenous females, especially in the dwarf breeds of West Africa which are renowned for their prolificacy, could achieve a fecundity rate (expressed in terms of the average annual number of young per breeding female) of 165–180% for sheep and 225–250% for goats.

3. In almost all females raised in temperate zones, heat occurs during the months in which day-length decreases (July to September in the Northern hemisphere)., leading to a single parturition per year. However, there are some exceptions to this rule, for example the British Dorset breed.

Fecundity rates of over 250% for goats and 200% for sheep have actually been achieved for dwarf breeds on several research stations in West Africa (see table opposite). In Southern Darfur, rates were 208% and 148% respectively for seven herds of goats and ten flocks of sheep which were monitored for a period of 15 months. According to estimates used by the

FAO in a study on livestock production in Ethiopia (ref. 1), fecundity rates are also higher than 200% for sheep in the Ethiopian highlands, which normally give birth twice a year, 10–15% on average being twin births. However, although few data are available, so that it is difficult to draw definite conclusions, the fecundity rates normally achieved at village or farm level appear to be much lower than these estimates, standing on average at 140–150% for goats and 110–120% for sheep. Analysis of flock composition leads to similar conclusions. Particularly in the case of females, all of which are assumed to be retained in the flock for breeding purposes, the proportion of young in the age-class 0–1 year is frequently far lower than the level which it should in theory reach on the basis of production parameters.

The fecundity rates observed on research stations thus appear not to be achieved at village level, where environmental and management conditions are less favourable, leading to reduced fertility in females. Inadequate management doubtless leads in many cases to a situation in which too large a number of unproductive females are kept in the flock. Similarly, the lack of control over mating is conducive to an excessively rapid series of pregnancies, resulting in abortions and prenatal mortality. Unfortunately the data required to quantify these different factors with a fair degree of accuracy are not available. Available information, however, tallies with the theory that mortality rates are particularly high for small ruminants in tropical Africa. On different occasions mortality rates for lambs and kids have been estimated at between 15 and 20% during the first month of life and are evidently even higher in cases of multiple births. They are frequently estimated at 15–20% for the flock as a whole, which is a very high figure. Moreover, rates appear to fluctuate widely, reaching 40–50% in extreme cases. Despite their considerable adaptability small ruminants thus appear to be very prone to disease.

Impact of parturition interval on survival rate of lambs.

—In %—		
Deaths	Lambing interval	
	Under 7 months	Above 7 months
Abortions, prenatal	22	0
up to 1 month	30	20
1–6 months	41	40
Surviving at 6 months	7	40

Source: Ref. 9–22

Mortality rates of small ruminants in tropical Africa.

Zones/breeds	Countries	Source of observ.	Mortality rate[a]			References
			Before Weaning	0–1 year	Herd (Yearly aver)	
Sheep						
Semi-arid zone						
Masai	Kenya	Village	–	6.5[b]	11	8
Desert x Nilotic	Sudan	Village	–	30.5[b]	23	3
Fulani	Upper Volta	Village	–	44.0[c]	21	6
East Af. Blackhead	Uganda	Station	20.1	–	–	17
Oudah Fulani	Chad	Village	–	23.0	14.2	7
Arab	Chad	Village	–	25.0	15.3	7
Humid zone[c]						
Mossi	Upper Volta	Village	–	23.0	17	6
Djallonke	Ivory Coast	Station	–	–	10	9
Mayo Kebbi	Chad	Village	–	37.0	24.7	7
Kirdi	Chad	Village	–	36.0	23.5	7
West Af. Dwarf	Nigeria	Village	15	–	13	12
West Af. Dwarf		Station	–	20.0	–	11
West Af. Dwarf		Village	–	–	21	9
West Af. Dwarf	Cameroon	Station	–	–	32	9
Goats						

Semi-arid zone						
Masai	Kenya	Village	–	7.613	13	8
Desert	Sudan	Village	–	29.513	18	3
Sahel	Upper Volta	Village	–	37.Oc	23	6
Sahel	Chad	Village	–	32.0	19.1	7
Humid zone[c]						
Mossi	Upper Volta	Village	–	29.0	13	6
Mubende	Uganda	Station	30	–	–	16
Southern Goat	Chad	Village	–	35.0	22.8	7
West Af. Dwarf	Nigeria	Village	15	–	14	12
West Af. Dwarf	Ghana	Station	22	–	–	9
West Af. Dwarf	Nigeria	Village	29	45.0	20d	8
Sheep/goats						
Humid zone						
West Af. Dwarf	Nigeria	Village	20	47.0	20d	8

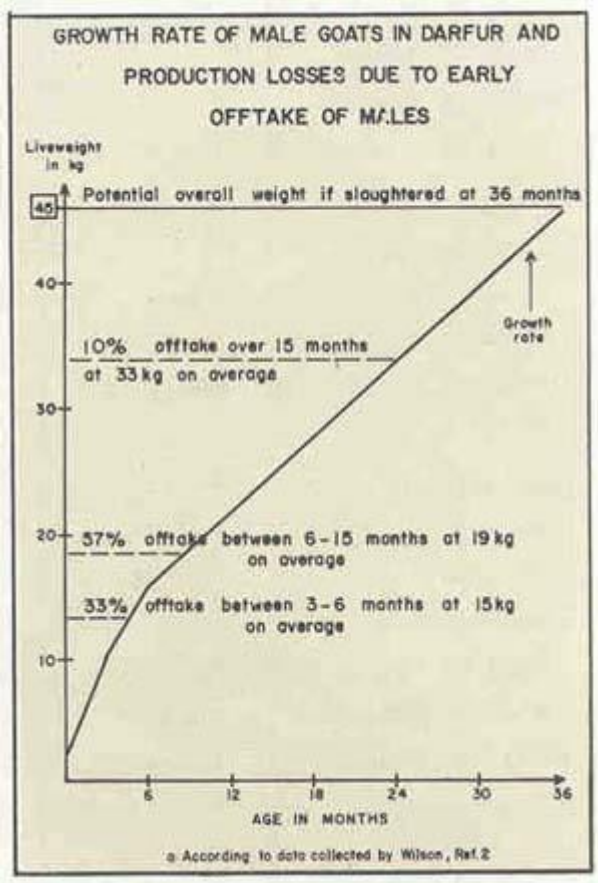
a. Percentage deaths of livestock in same age class.
b. Age class 0 to 6 months.
c. As the survey was conducted in. 1974, mortality rates may have been inflated by the impact of the Sahel drought.
d. Adjusted on an annual basis for flocks monitored by ILCA for 9 months in Nigeria. e. Subhumid zone included.

The lack of information on mortality prevents it from being clearly linked with specific diseases. Generally speaking, however, the diseases to which small ruminants in tropical Africa are subject consist mainly of respiratory diseases, such as pneumonia, and intestinal parasites, with the seasons playing a decisive part in their occurrence. It was noted in Ghana that mortality increased during the second part of the rainy season and hence during the time of greater humidity, which is generally held to be a favourable factor in the development of parasitic gastroenteritis. Similarly, it was shown in a survey carried out in Upper Volta (ref. 6) that the

frequency of intestinal parasites, which accounted for over 50% of diseases diagnosed in small ruminants, fell considerably in the drier northern areas. Hence the impact of peste des petits ruminants (PPR) is thought to be important. It is also probable that morbidity caused by chronic diseases has adverse effects on animal productivity which are just as important as those caused by mortality, but here again the Information available is rudimentary.

Generally speaking, a proportion of potential output is lost at the outset owing to inadequate management and environmental constraints. An additional loss factor is associated with the premature offtake of young males, which in many cases apparently begins at three or four months. It emerged from a survey conducted in two villages in the humid zone of Nigeria (ref 12) that 95% of males were sold after weaning, i.e. at three or four months. This was probably an exceptional case, but most surveys carried out in this field nevertheless show that the marketing of males at under one year old reaches considerable proportions.

Marketing apparently begins at about the age of six months in flocks investigated in Southern Darfur (Sudan), in the Niger delta in Mali (ref. 3), in Upper Volta (ref. 6) and in the humid zones of West Africa (Nigeria), where nearly half the young males are sold before they reach 15 months. These observations are confirmed by the analysis of flock composition, which shows there are a lower number of males than females in the age-class 0–1 year. Most of the sheep raised in the Ethiopian highlands are also sold before reaching maturity. According to a 1974 survey on 13 urban and rural markets in the highlands, 82% of the sheep sold had no permanent teeth, or in other words they were under 14–15 months old. The reasons for this premature offtake are not clear. They are probably connected with the pressure of demand (cash requirements, festivities requiring the consumption of meat) and not with any specific policy on the part of stockowners. Several experts have also come to the conclusion, from surveys carried out over the last ten years, particularly in West Africa, that sheep/ goat flocks are not only marketed prematurely, but that offtake exceeds replacement rate. There is a risk that the number of livestock will decline, although this does not emerge from the time series data published by the FAO. On the other hand, many estimates point to a stagnating trend, if not an actual decline, in the ownership of small ruminants on smallholdings throughout tropical Africa.



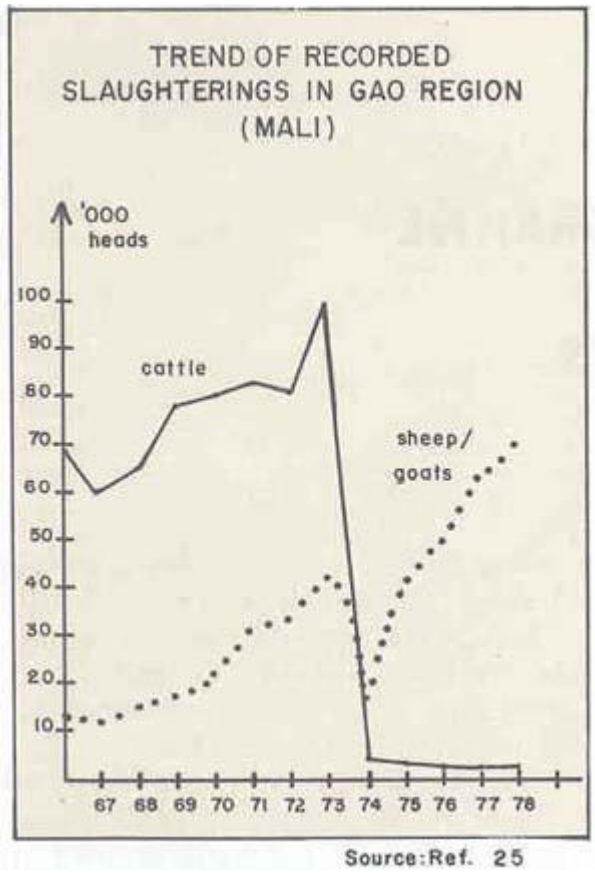
Prospects

In many respects very little is known about small ruminant production, which has not received a degree of attention from governments commensurate with its actual significance in real life. The contribution made by goats and sheep to meat supplies in tropical Africa is fairly large. According to FAO estimates it represents 45%, approximately the same as that of beef, i.e. some 780,000 tonnes in 1977, on the basis of an annual offtake rate of 29% for sheep and 30% for goats, with a yield per flock unit of approximately 4 kg of carcass weight (c.w.) far sheep and 3 kg for goats[4]. Moreover, it is possible that this contribution has been underestimated, since we have already seen that not enough information is available on production figures.

4. In the rest of the world, offtake rates are about 36% for sheep and 39% for goats, with yields per flock unit standing at 5.6 and 4.6 kg c.w. respectively (FAO estimates).

Consumption of sheep and goat meat plays an important part in rural areas, especially in the humid and subhumid zones, where sheep and goats frequently make up the bulk of domestic livestock. Owing to their better adaptation to hostile environments, small ruminants are also better able to resist drought, and it has been estimated that during the Sahel drought in the early 1970s sheep and goat losses were substantially fewer than those of cattle (Bulletin No. 3), thus providing disaster areas with some relief in terms of meat supplies. In northeast Mali, for example, where cattle losses were estimated at 80% in 1973–74, leading to a subsequent collapse in cattle slaughterings, sheep and goat slaughterings would appear to have risen substantially, according to the official figures. Small ruminants thus appear to play a reserve role

during difficult periods. Sheep and goat meat also seems to be preferred by local populations. It has been observed that in most tropical African countries the price of sheep or goat meat is substantially higher than that of beef. Mutton is usually preferred to goat meat, although available statistics rarely distinguish between the two categories.



Source:Ref. 25

However, in some countries, Ghana for example, the preference is probably for goat meat. In Nigeria, on the other hand, the prices of sheep and goat meat are roughly equal, but always lower than that of beef.

Moreover, small ruminant production under existing systems is, like that of cattle, characterized by low costs and minimal inputs. In arid zones it uses marginal land where opportunity costs are almost nil, while in the humid zones it utilizes fallow land or household refuse which would otherwise be wasted.

Price differences between mutton or goat meat and beef in tropical Africa.

	—number of countries—	
Price differences[a]	Beef with bone	Boneless Beef
Over 50%	6	2
25–50%	5	0
0–25%	3	7
Same price	2	3
Cheaper	1	2
Average price difference	+ 35%	+ 8%

a. Price ratio of mutton or goat meat/beef.
Source: Ref. 18–19

Compared to cattle production[5] it has the added advantage of greater productivity, expressed in terms of meat production per 100 kg of breeding female or per 100 kg of total flock liveweight. This is especially true in terms of potential. The needs of sheep and , goats are also often considered lower than those of cattle, since in relation to small ruminants the latter have been shown to be less efficient converters of the nutritive elements contained in their feed.

5. In ILCA's report on trypanotolerant livestock in West and central Africa, a productivity index is given using the weight of progeny (and, for cows, the liveweight equivalent of milk produced) per 100 kg of female maintained per year. According to this index, productivity was estimated at 40.9 kg/100 kg of cow, as against 45 and 41 kg respectively per 100 kg of ewe/doe maintained per year. The index of productivity appeared to be still higher for trypanotolerant small ruminants: respectively 64 and 69 kg/ 100 kg of ewe/doe maintained, as against 37.1 kg/100 kg of trypanotolerant cow maintained.

However, there are two conflicting schools of thought as to the possible advantages of developing small ruminant production. Those who argue against it acknowledge the ability of these animals, and especially goats, to digest coarse forages and their resulting higher productivity in certain environments, but maintain that they are only advantageous under extensive systems and that the cost involved in any search for improvements is not justified by their productivity. To this argument is added their reputation for destroying the environment. Owing to their ability to survive in degenerate areas small ruminants are often considered as a cause of deforestation and soil erosion. Their notoriety in this respect has in many cases evidently been a factor in their exclusion from livestock development strategies.

However, this notoriety is disputed. The devastating effects attributed to sheep and goats may in fact be largely the result of poor management of the rangelands, which they inherit after these

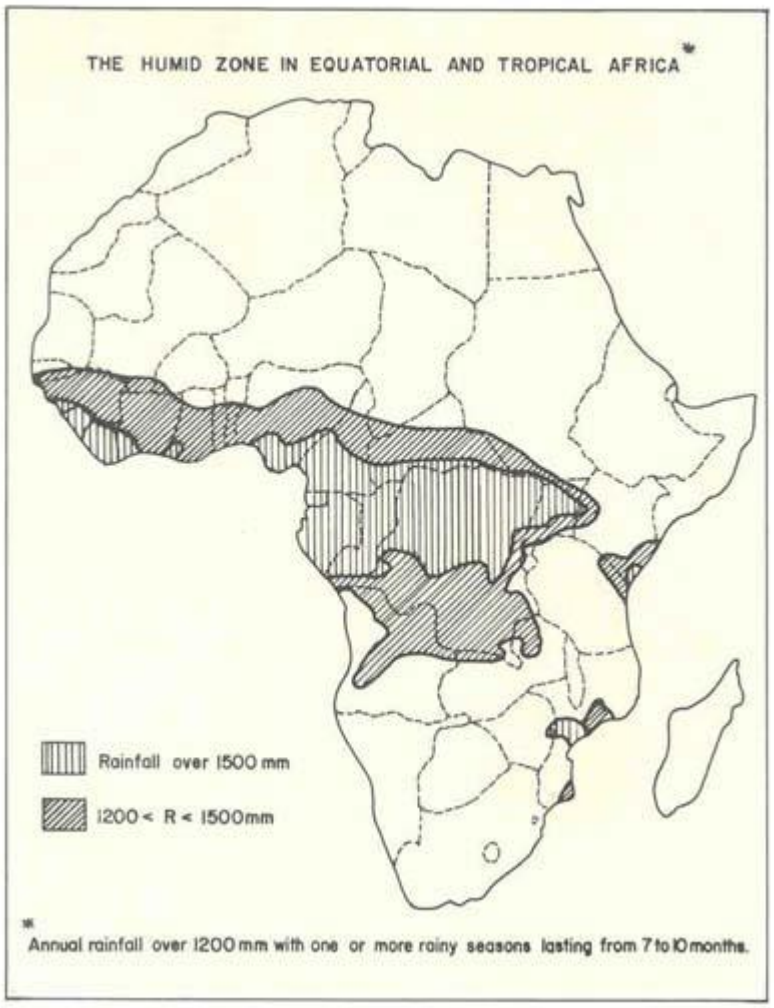
have been overgrazed by cattle. According to this school of thought, small ruminants may even play a positive part in the protection of the environment. Goats, in particular, are thought to be instrumental in controlling bush encroachment in humid' zones[6]. Furthermore, small ruminant production would appear to be complementary to cattle production, since sheep and goats graze herbage which is left untouched by cattle. Finally, many experts believe that there is a place for intensive fattening systems, basing their arguments on the digestive efficiency of small ruminants and on the apparent response of local breeds to traditional fattening methods. Development possibilities in this field are considered all the greater to the extent that the present level of offtake causes considerable losses which could be recovered immediately by merely postponing the marketing of young animals. Theories such as this, however, are based on results obtained from a limited number of samples and which are not necessarily universally transferable, taking into account the wide range of small ruminants raised in the differing ecological zones of tropical Africa.

6. According to the conclusions of an FAO report on the decline of Mediterranean sheep breeds, the sharp drop in the number of sheep may have contributed in some areas (for example, the Pyrenees) to undesirable ecological changes amongst which bush encroachment in areas previously covered by pasture grazed by sheep.

To sum up, despite a potential based on the apparent fecundity of indigenous animals and on the possible suitability of certain breeds for fattening, small ruminant production has until now been relatively little studied, so that the constraints to its development are all too often poorly understood. Future research on their potential performance under improved systems will therefore have to be accompanied by in-depth investigations to assess the results currently obtained by stockowners in existing production systems.

The ILCA research programme on small ruminants

The research on small ruminants undertaken by ILCA has been oriented in several different directions. In the first place data are collected in a number of countries in the semi-arid zone, among them Mali and Kenya, in order to obtain an in-depth understanding of the main production parameters, on which the information gathered in the past has been somewhat fragmentary. In addition there are plans to introduce a sheep production component as part of the East African highlands research programme at the Debre Berhan station in Ethiopia (see Bulletin No. 4), as a means of harnessing the potential of the region in this field. However, the main focus of ILCA's research on small ruminants is on the humid zone. This zone contains a relatively large population of sheep and goats, but no development efforts have so far been devoted to them and there has been little specialized research. Many experts, however, believe that small ruminant production has a high development potential and is an important asset for the humid zone, especially since its unfavourable climatic conditions have traditionally thwarted the development of most kinds of animal production, leading to a severe protein deficit for its inhabitants. The ILCA research programme on small ruminants in the humid zone, launched in 1978 in southern Nigeria, is aimed at identifying possible ways of improving production under existing structures, not only on smallholdings but also involving the small-scale entrepreneur who is less directly connected with agricultural activities.



The humid zone

The humid zone corresponds to the areas of low altitude found along the Atlantic coast of West and central Africa. These are covered by forest and receive an annual rainfall of over 1250 mm. The climate is slightly bimodal, with an unreliable dry season in July–August in addition to the long dry season. The temperature varies between 27 and 32° and relative humidity lies between 80 and 90%.

The forest zone is bordered by a transition zone between it and the savannah, called 'derived savannah'. The humid zone covers an area of some 2 million km^2. It is densely populated, containing about 75 million inhabitants (i.e. 38 inhabitants/km^2). There are, however, fairly sizeable variations, with population density exceeding 150 inhabitants/km^2 in some regions (eastern Nigeria, for example), whereas there are fewer than 20 inhabitants/km^2 in the humid zone of Ivory Coast.

Crop production focusses primarily on tubers (yam and cassava) and a few cereals (notably maize), grown for subsistence needs, and on various cash crops, such as cocoa, coffee, oil palm, etc. The main production system until recently was shifting cultivation. Hence increases in drop production arose primarily from the expansion of the land area cultivated, rather than from

intensification. Owing to population pressures and the extension of cash crops this situation has led to reduced land availability and shorter fallow periods. Diversification nevertheless seems to have taken place in some areas, where it takes the form of multistorey cropping, combining tree, grain and root crops, with improved water control and fertilization.

Sheep/goat flocks in four countries of West Africa.

			—in 000—
Countries	Non-humid Zone	Humid Zone	TOTAL
Ivory Coast			
Sheep	170	533	703
Goats	139	426	565
Total	309	959	1,268
Ghana			
Sheep	529	344	873
Goats	496	246	742
Total	1,025	590	1,615
Togo			
Sheep	316	342	658
Goats	335	304	639
Total	651	646	1,297
Nigeria			
Sheep	5,732	1,886	7,618
Goats	15,698	6 634	22,332
Total	21,430	8,520	29,950
Four countries			
Sheep	6,747	3,105	9,852
Goats	16,668	7,610	24,278
Total	23,415	10,715	34,130

Source: Ref. 9

Livestock ownership in Nigeria and Ivory Coast.

Area	Household owners (%)		Average number per owner	
	Sheep	Goat	Sheep	Goat
Nigeria[a]				
Western	9.3	41.7	4.4	4.0
Mid western	6.1	40.8	8.2	5.1
Eastern	8.1	33.3	8.6	6.3
Humid zone	8.3	37.4	6.5	5.2
Ivory Coast[b]	27.1	23.2	4.9	4.4

a. In 1974.
b. In 1973, including non-humid zone
Source Ref. 9–19

Since the entire zone is infested with tsetse fly, the vector of trypanosomiasis animal production is at present limited to those species which tolerate the disease. Apart from a few trypanotolerant breeds of cattle, most of the livestock consists of sheep and goats. In both the latter cases the animals belong to dwarf breeds weighing from 25 to 30 kg when adult. Their small size results from adaptation to a particularly difficult environment. ILCA estimates that the humid zone of Ivory Coast, Togo, Ghana and Nigeria probably contains some ten million small ruminants, of which eight million alone are found in Nigeria. Taking into account the estimated number of small ruminants in the other countries lying wholly or partly within the humid zone, the total number of small ruminants belonging to dwarf breeds is probably in excess of 25 million. Little is known as to the distribution of sheep relative to goats, but it is certain that the number of goats is far higher than the number of sheep, although this situation derives from the fact that in Nigeria there are 3.5 times as many goats as sheep. In fact, the reverse was found in other countries surveyed by ILCA, where the number of sheep was apparently slightly higher than the number of goats.

The distribution of small ruminants appears to be relatively skewed. In Ivory Coast only 27% of rural households owned sheep in 1973, while 23% possessed goats. In the humid zone of Nigeria the figures stood at 8% for sheep and 37% for goats in 1974, according to the Department of Statistics. But as will be seen below, the numbers observed by ILCA in the study area selected for the humid zones programme were very much higher. The average number of animals per household owning them was found to be four or five. The number of sheep and goats kept tended to increase with the size of the enterprise, especially where sheep were concerned, albeit without ever reaching very high levels.

The traditional village production system remains by far the commonest. It requires a minimum of inputs, since the animals are generally left to themselves during the daytime, except during the growing season when they are tethered to avoid damage to crops. They feed on herbage and any household refuse available, such as cassava, plantain and yam peels, etc. The animals usually receive no veterinary care and mating is not controlled. Production practices, which consist of sales and the culling of females, are generally determined by events external to the economics of herd management: emergency slaughtering of diseased stock, cash needs and the occurrence of festivities, etc. First and foremost, however, the animals play an important

part in the socio-economic life of the community, and are widely exchanged or loaned between friends and relations. In southern Nigeria, for example, it was observed (ref. 9) that the customary way of obtaining breeding females was to borrow them from a relation or a friend. Particularly in the case of owners possessing only a few animals, a high proportion of them would thus be on loan (over half, according to the ILCA survey). Transactions of this kind appear to be a response to economic as well as social factors, arising from shortages of cash on the part of the borrower and of time on the part of the lender. These factors are largely assumed to determine the number of animals which each individual can obtain.

In some areas attempts have been made to improve the existing system. In these instances the animals are permanently tethered and fed according to a cut-and-carry system. Manure is collected and spread on the fields to maintain soil fertility. Commercial operations, usually involving sheep production, have also developed on a fairly large scale in Ghana and Ivory Coast. Development in this field may be explained in terms of the successful results experienced by farmers who have improved their production methods. The resulting increase in their livestock numbers has encouraged them to set up farms specializing in livestock production, using improved methods such as rotational grazing, supplementary feeding and veterinary care. Entirely spontaneous development of this kind is encouraging.

Distribution of livestock ownership by size of holding in Ivory Coast—1973—

Size of holding (in hect.)	Livestock ownership[a]		Average number per household[b]	
	Sheep	Goats	Sheep	Goats
Less than 0.5	9.9	14.5	4.4	2.8
0.5–1	16.7	12.9	4.2	3.0
1–2	22.8	20.4	3.7	3.1
3–5	25.2	20.9	3.9	4.4
6–10	28.3	23.5	5.4	5.0
11–20	31.6	23.4	5.8	5.6
21–50	39.9	18.5	12.2	10.3
51–100	37.5	47.0	13.1	6.1
Total	25.7	21.1	4.9	4.6

a. Percentage of owning households.
b. Owning a flock
Source: Ref. 9

As in its other research programmes, the methodology adopted by ILCA for its work on small ruminants in the humid zone comprises three main, interconnecting phases[1]. In the first phase an initial problem analysis based on literature review and field survey is carried out, in order to obtain a first definition of existing production systems The second phase involves the formulation and testing of improvement packages on experimental management units under ILCA's control or with participating farmers at their own risk. An early result of this approach is the identification of gaps in available technology. More detailed studies on existing systems are continued during this second phase, while experiments on specific components offering the best prospects for future improvement are also carried out. The experimentation is entirely subject to

the gaps identified in the initial problem analysis and during the testing of improvement packages. At the same time, mathematical models are constructed with a view to improving the understanding of production systems and assisting in the selection of new research topics and the transfer of results to related systems, When sufficiently conclusive results are obtained, the knowledge may be transferred to other farm or production units and ultimately to development schemes: This process forms the third phase, and is accompanied by the monitoring of progress as a means of initiating new problem analysis.

1. This approach is described in detail in the ILCA 1979 brochure, recently published on the occasion of ILCA's fifth anniversary

The ILCA study areas

In 1978 ILCA established two research stations in southwestern Nigeria. They were located in contrasting environments. The first is in the forest zone, 80 km south of Ibadan; it has an annual rainfall of circa 1800 mm and is typical of the humid zone climate. The second station is 60 km north of Ibadan, in the derived savannah zone. It belongs to a drier climate, with annual rainfall standing at approximately 1100 mm, and is representative of the conditions found in many parts of West Africa.

Farms in these two areas are usually small, under two or three hectares being cultivated in most cases, and often employ only one or two people. They are oriented towards both cash and subsistence crops, notably cocoa, maize, cassava and yam. Cocoa cropping predominates in the forest zone, occupying over half the land under cultivation, whereas subsistence crops, especially tubers, are foremost in the derived savannah. The proportion of land left fallow, generally for a period of three years, is also much higher in the derived savannah over 55% in 1971, as against 26% in the forest zone. These figures are, however, open to question. They correspond with estimates carried out on several different occasions, both in the south and the southeast of Nigeria but not with the results of the most recent surveys. The latter show that a large proportion of enterprises contain no fallow land. This contradiction may result from the recent reduction of fallow land caused by population pressures or by mechanization. In order to clarify this question ILCA intends to compare aerial photos taken in 1963 and 1975.

Farming systems in ILCA research areas in Nigeria.

Main characteristics	Forest zone	Derived savannah zone
Climate		
Rainfall (mm)	1,800	1,100
Farm area (ha.)		
Small farm	3.1	3.0
Medium farm	8.2	6.5
Large farm	16.7	13.2
Average	6.6	n.a.
Under fallow		
(% of farm area)	26%	55%
Cropping pattern (%)		

Tree crop	57–77	40–48
Cacao	52–56	22–34
Maize	9–20a	11–19
Cassava	7–15a	14–16
Yam	6–11a	11–15
Animals (units)		
Goat	1.4	4.3
Sheep[b]	1.5	–
Average	2.9	4.3
Annual Income[c] (in Naira)		
from farm	399	224
from outside	297	185
% Livestock	2.8%	4.9%

a. Includes mixed cropping.
b. Only 50% of farmers in the forest zone hold sheep.
c. According to J.C. Flin in 1974; since then, prices for agricultural products have risen by 300% in Nigeria.

Livestock ownership in ILCA research areas in Nigeria.

Ownership	Forest zone		Derived savannah zone	
	Rural	Town	Rural	Town
% owners[a]	85	64	71	94
Owners holding (%)				
- goats only	53	62	100	64
- Sheep only	20	13	–b	7
- Sheep and goats	27	25	–b	29
Average number				
per owners[a]	2.9	2.8	4.3	3.0

a. Household.
b. Sheep were banned in villages surveyed by ILCA.

Animal production plays a minor role, accounting for less than 5% of agricultural income. From the ILCA baseline survey it emerges that 85% of farmers interviewed in the rural forest zone own small ruminants and 70% in the derived savannah zone. Ownership of goats is clearly ahead of that of sheep. Nearly half the farmers in the forest zone possess sheep, many of the flocks being mixed, containing both sheep and goats. Generally speaking, the number of animals is limited to a few heads per owner: 4.3 goats on average in the derived savannah and 3 sheep/goats in the forest area. The survey also reveals that many town-dwellers own small ruminants. However, it does not disclose any precise link between the number of livestock and the size of farms. The pressure put on owners of larger flocks to lend some of their animals to relatives or friends apparently has a levelling effect on the size of flocks.

The reasons given for keeping sheep and goats differ between the derived savannah, where home consumption appears to be the prime factor, and the forest zone, where the main purpose is to provide cash income in a rural environment. The difference doubtless arises from the fact that producers in the forest zone are nearer to the larger towns and markets, which offer them better chances of selling their animals. Nevertheless, the two reasons, cash requirements and home consumption, appear to be equal for the inhabitants of the forest zone as far as sheep are concerned, whereas for goats cash requirements are uppermost.

It also emerges that in many cases animals receive supplementary feeding. This consists of household residues in rural areas and purchased feeds in towns. In contrast to what is generally believed, animals also receive a certain amount of veterinary care: 60% of farmers in the forest area said that they had bought drugs during the past year. Producers consider disease to be the major constraint to the development of their flocks, leading as it does to high mortality. From statistical surveys in which flocks were monitored for a nine-month period, ILCA has obtained an average mortality rate of approximately 15% (i.e. 20% on an annual basis). Mortality appears to reach 20 to 30% during the first three months of life, and the chances of survival until the end of the first year for young lambs and kids are only 55%. Mortality in higher age classes also appears to be high, as well as somewhat skewed. It reached 10% over 9 months (13% per annum) for animals over one year old in flocks monitored by ILCA in the derived savannah, but over 20% in the forest zone (27% annually).

Mortality rates are thus distinctly higher in the forest zone, a situation confirmed by observations on disease. The more difficult climate conditions found in this area have a severe impact on animal health. The survey also throws light on the influence of nutrition on mortality, animals left to tend for themselves showing mortality rates up to four times greater than those of animals receiving supplementation in the form of crop *residues or* maize by-products.

Mortality rates in sheep/goats flocks monitored by ILCA[a].

	—in %[b]—	
Age class	Forest zone	Derived savannah zone
0–1 year		
0–1 month	17.8	25.6
2–3 months	5.6	11.9
4–6 months	13,5	12.4
7–12 months	34.5	5.13
1–2 years	14.3	18.5
Over 2 years	23.9	5.6
Average	15.2	15.0

a. The monitoring period covered 9 months only.
b. In % of the age class.

To sum up, mortality in small ruminants is definitely a major obstacle to livestock and meat production in the humid zone of tropical Africa. High mortality rates are caused by the many diseases, amongst which peste des petits ruminants (PPR), intestinal and ectoparasitic

diseases play an important part, and are further aggravated by nutritional deficiencies. To the losses arising from mortality are added those caused by the apparently low fecundity of does and ewes.

The data collected by ILCA on other production parameters during the first nine months in which the flocks were monitored are still very fragmentary. Moreover, their interpretation is problematic owing to their disparity and inherent contradictions. According to *these data,* prolificacy rates (i.e. the average number of young per litter) for does and ewes average 160%, in the forest zones and 145% in the derived savannah. Preliminary estimates of average fecundity rates (the annual number of young per breeding female) show 110% in the forest zone and 166% in the derived savannah area, resulting in fertility rates of 83% and 114% respectively.

The fertility and fecundity rates observed in the forest zone thus appear particularly low. ILCA had already had an opportunity to observe this phenomenon indirectly when, in 1978, the composition of flocks in the area was analysed. It became apparent that the number of females under one year old was abnormally low in relation to the number of breeding females, when compared with the levels observed in surveys on animals of the same species in other parts of Africa. The fecundity rates calculated on the basis of flock composition also appeared to be far lower than those observed on research stations. Although higher than that of forest animals, the fecundity of goats in the derived savannah area appears lower than the potential for this breed. These results thus demonstrate that at village level the fertility of dwarf breeds is very much lower than the optimum level of *three gesta*tions every two years achieved on research stations. The question is an important one, since it is necessary to obtain high fecundity rates in order to ensure the profitability of the intensive production systems which ILCA intends to apply.

The data collected by ILCA also provide interesting information on the attitude3 of producers to the possible development of their flocks. Generally speaking owners felt that animal numbers could be doubled without undue strain on feed resources. They also felt that any large increase in animal numbers would lead them to impose some restrictions on animal movement or to adopt more sophisticated feeding techniques such as a cut-and-carry system or the fencing of grazing areas. Many indicated, however, that labour bottlenecks would probably thwart their efforts in this field.

Fecundity rates of ewes/does derived from herd composition.

	Upper Volta		Nigeria[a] West Af. Dwarf
	Sahel	Mossi	
Reprod. females[b]	46.1	44.7	66.0
0–1 years	24.1	24.0	15.0
Apparent fecundity[d]			
M = 20%	1.25	1.29	0.55
M = 30%	–	–	0.61

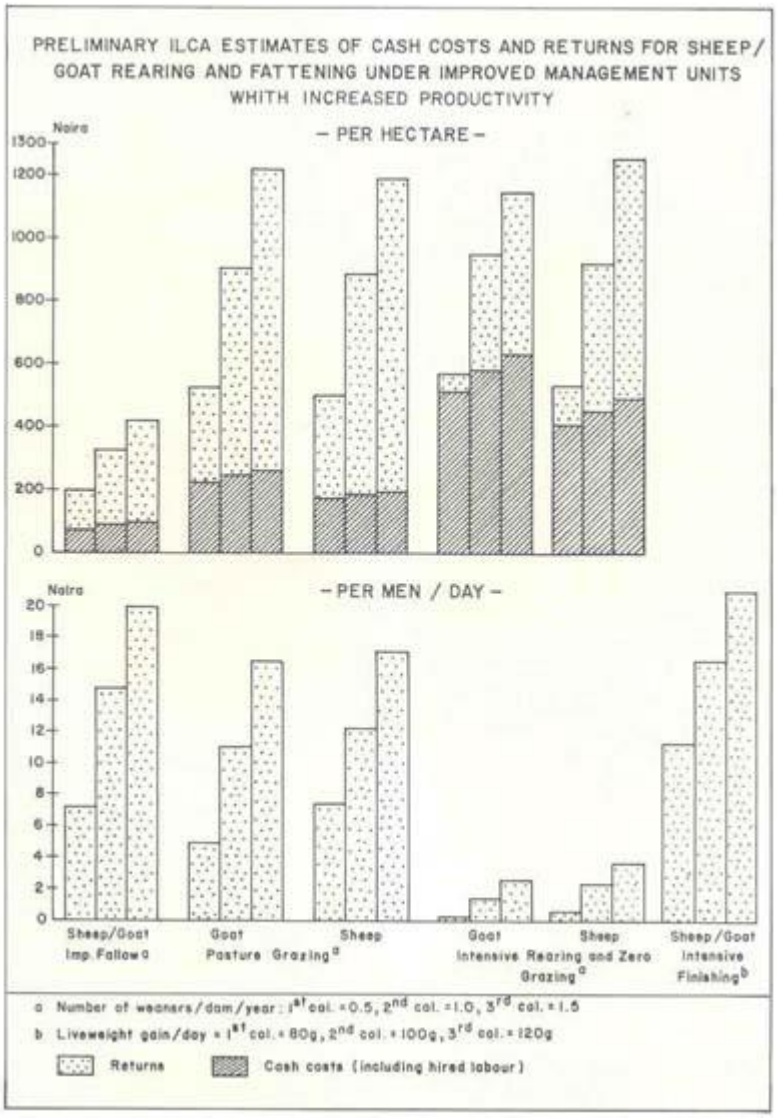
a. Forest zone.
b. Females over 1 year in % of flock.
c. In % of flock
d. Calculated as $\frac{2\,n\,(1 + m)}{N}$, with
n = females under 1 year

m = average mortality rate 0–1 Year
N = females over 1 year

The improvement of existing systems

During the first phase health problems have emerged as the major obstacle to increased production, and an improvement package consisting of veterinary inputs has already been formulated. It includes the control of ectoparasites, deworming and the prevention of epizootic disease, notably PPR. Soon the package will be tested at village level, in cooperation with the veterinary services and the Federal Livestock Department. Its cost, which could represent up to 10% of the market value of the animals, nevertheless threatens to curb its acceptability to farmers. If this initial stage meets with success, livestock numbers for farmers participating on the programme may show rapid development without, at least initially, meeting with any serious obstacles, especially given the resources available in the humid zone. However, it is hoped that the results obtained will bring home to producers the advantages of an improved management system, and will thus encourage them to change their methods. The way will thus be opened for a new phase in which producers will be encouraged to adopt a further package of innovations, once again in collaboration with the Government and other specialized agencies.

Research is under way to develop these innovations. ILCA's approach in this field is based on the assumption that veterinary improvements will have to be combined with improved feeding regimes in order to realize the full productive potential of these animals by reducing mortality and increasing fertility. The improved systems now being tested on the two research stations have been designed in accordance with this assumption. They cover a wide range of innovations, designed to meet the needs of different kinds of producer with varying approaches depending on their access to the various production factors: land, capital and labour. For example, the system designed for smallholders, possessing limited financial and labour resources but some spare land, will have to allow a higher return on labour without incurring high cash costs. The entrepreneur, on the other hand, who has no land but owns the necessary capital, will obviously only be interested in the livestock component, and his primary concern will be with profitability.



The improved systems currently being tested are four in number, consisting of improved fallow grazing, controlled pasture grazing, and intensive rearing and zero grazing systems using forages and/or agro-industrial by-products.

They require quite different inputs, both in terms of labour, which is a limiting factor in many small enterprises, and of intermediate goods such as fertilizer, seeds, veterinary products etc, the purchase of which requires an initial financial outlay. The returns expected, whether calculated per hectare or per man/day, also vary very considerably, since the systems are designed for very different types of production.

In order to assess the viability of these four systems, albeit on a highly provisional basis, ILCA has estimated their principal cash costs and returns on the basis of initial experiments and a number of assumptions, especially as regards fecundity. According to these estimates, the first system, that of improved fallow grazing, which is now being tested in the derived savannah zone on some 40 sheep and goats, would have a comparatively high return per man/day while incurring minimum labour and other inputs, and hence low cash costs. However, returns per

hectare are relatively low. Nevertheless, the system might meet the needs of small farmers with some spare land, since the package would enable them to earn extra income in return for a limited initial outlay, while improving the fertility of their soil.

The second system, that of controlled grazing, is tested separately for sheep and goats. It implies a higher volume of inputs and thus far higher cash costs, in terms of both labour and intermediate goods, but the returns per hectare are calculated to be two or three times higher than in the previous system. According to the preliminary estimates made by ILCA, returns would be close to or even higher than those obtained from the crops currently grown, regardless of whether the calculation system used is that of returns per hectare or per man/day. Nevertheless, this system implies relatively high cash costs, as well as a higher labour input. Recurrent cash costs would be two or three times higher than those incurred by crops with similar returns, a problem which may turn out to be a real financial constraint for many farmers.

The prospects for the third system, that of intensive rearing with zero grazing, which will require a high labour input, appear more modest. Cash costs would be two or three times higher than in the second system, without any corresponding improvement in farm income over and above the benefits of the latter, even assuming relatively high animal productivity.

Preliminary estimates for the fourth system, which unlike the others will be entirely oriented towards fattening on agro-industrial by-products to the exclusion of rearing operations, are still very fragmentary. In any case, the conditions for launching fattening operations on the ILCA stations are not at present favourable, owing partly to the unavailability of good quality animals on the market[2] and partly to the health problems encountered with those which have already been purchased.

2. To some extent this situation results from the fact that a large proportion of exchanges consist of loans or exchanges between relations and friends, and thus take place beyond the market.

The management units were launched only in the second half of 1979, with the result that sufficient data are not yet available to enable an objective assessment of the initial results to be made. A number of problems have already arisen which may subsequently turn out to be real constraints. In the first place it has become clear that in the derived savannah zone animal feed supplies are inadequate during the dry season, thereby requiring supplementation in the form of forage or concentrates[3]. This situation is confirmed by research in similar en0ronments in Nigeria and Ivory Coast. Furthermore, improved fallow and grazing land is rapidly invaded by species which are unpalatable to livestock (e.g. *Eupatorium odoratum* in the forest zone and *Imparata cylindrica* in the derived savannah). These species are very common in the humid zone and may seriously limit not only the productivity of pastures but also the viability of the improved fallow system itself. Health control problems have also been acute, especially at the forest zone station, where mortality has once again proved far higher than in the derived savannah, owing to the harsher climatic conditions.

3. Supplementary feeding trials using sugar cane are planned to take place at a later date, with a view to overcoming this constraint.

Since the state of knowledge on small ruminant production is still limited and the ILCA research programme in this field is only in its early stages, it has not yet been possible to identify, even on a provisional basis, the improvement packages, other than for animal health, to be

suggested to farmers wishing to participate in this programme. This third stage is currently scheduled for early 1981, assuming that the results expected for the present year materialize. Since it includes the transfer of improvements tested on the research station to village level, the third stage will doubtless raise a new set of problems in both technical (disease control and forage production) and socio-economic fields, limiting the ability of farmers to absorb innovations which are relatively foreign to their traditional approach. Consequently, socio-economic studies are already being carried out with a view to screening the obstacles most likely' to act as blockages when the innovations are introduced, so as to anticipate the means to surmount them when the time comes.

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