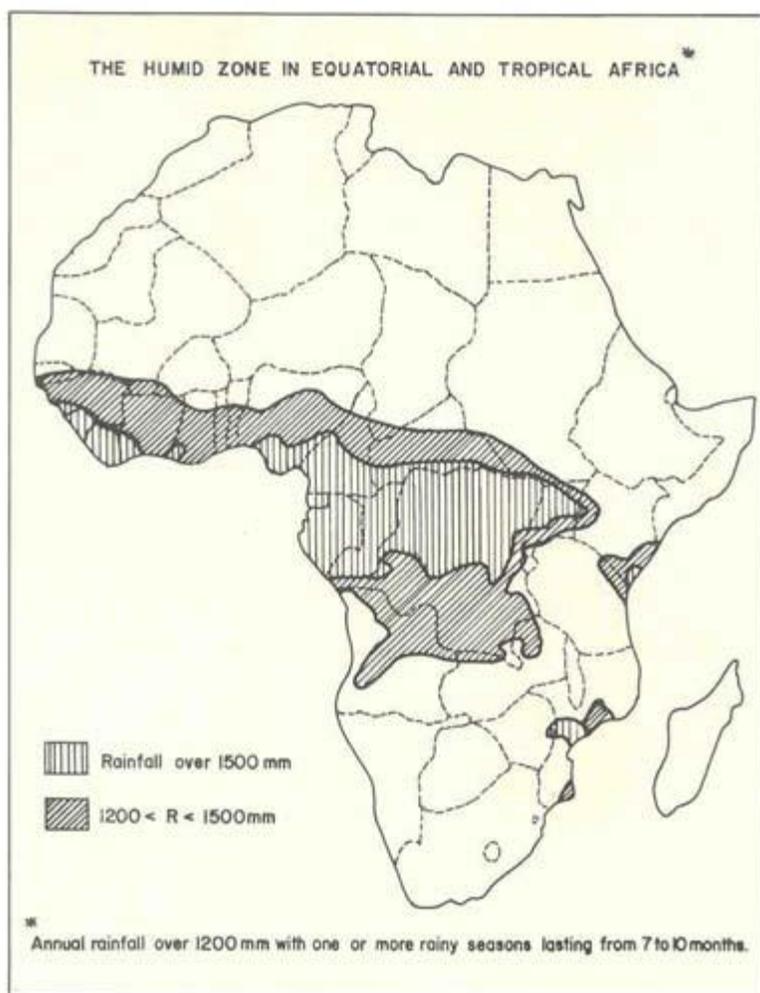


The ILCA research programme on small ruminants

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 km². It is densely populated, containing about 75 million inhabitants (i.e. 38 inhabitants/km²). There are, however, fairly sizeable variations, with population density exceeding 150 inhabitants/km² in some regions (eastern Nigeria, for example), whereas there are fewer than 20 inhabitants/km² 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	<u>139</u>	<u>426</u>	<u>565</u>
Total	309	959	1,268
Ghana			
Sheep	529	344	873
Goats	<u>496</u>	<u>246</u>	<u>742</u>
Total	1,025	590	1,615
Togo			
Sheep	316	342	658
Goats	<u>335</u>	<u>304</u>	<u>639</u>
Total	651	646	1,297
Nigeria			
Sheep	5,732	1,886	7,618
Goats	<u>15,698</u>	<u>6 634</u>	<u>22,332</u>
Total	21,430	8,520	29,950

Four countries			
Sheep	6,747	3,105	9,852
Goats	<u>16,668</u>	<u>7,610</u>	<u>24,278</u>
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	<u>8.1</u>	<u>33.3</u>	<u>8.6</u>	<u>6.3</u>
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	<u>37.5</u>	<u>47.0</u>	<u>13.1</u>	<u>6.1</u>
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 phases¹. 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	<u>16.7</u>	<u>13.2</u>
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 fend 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.

Age class	—in % ^b —	
	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	<u>23.9</u>	<u>5.6</u>
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 gestations* 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 $\frac{2n(1+m)}{N}$, with

n = females under 1 year

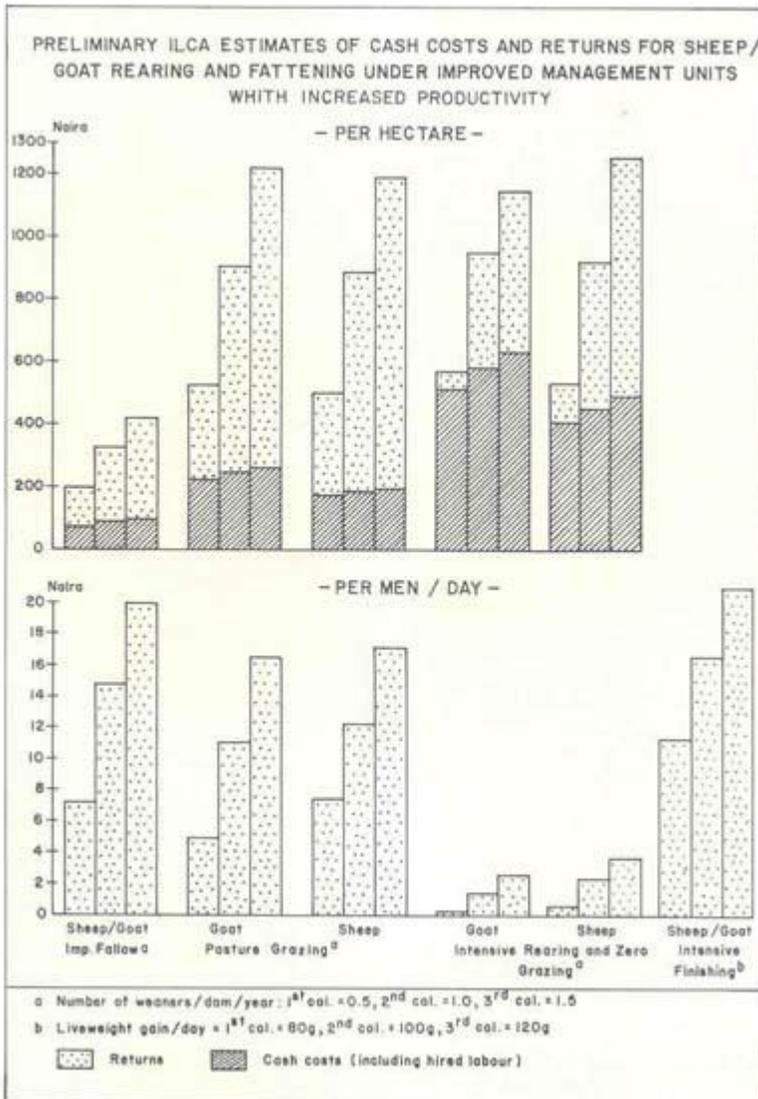
m = average mortality rate 0-1 Year

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 market² 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 concentrates³. This situation is confirmed by research in similar environments 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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