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Department of Agriculture and Horticulture

A SURVEY OF SMALL LIVESTOCK PRODUCTION AT THE VILLAGE LEVEL IN THE DERIVED SAVANNA AND LOWLAND FOREST ZONES OF SOUTH WEST NIGERIA

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A Survey of Small Livestock Production at the Village Level in the Derived Savanna and Lowland Forest Zones of South West Nigeria

by

Richard W. Matthewman

Reading University Research Fellow

This work was conducted at the University of Ibadan, Nigeria. It formed part of a co-operative research scheme financed by the British Ministry of Overseas Development and undertaken by the Animal Health Group, Department of Agriculture and Horticulture, University of Reading in co-operation with the Federal Livestock Department of the Federal Government of Nigeria.

March, 1977.

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INTRODUCTION

The main purpose of this study has been to assess methods of livestock production at the village level in Southwest Nigeria. Throughout the course of the work, it was the primary concern to consider methods and systems of animal production which are appropriate to farmers in low and middle income groups.

The work was carried out under the auspices of the Department of Agricultural Extension Services of the University of Ibadan, Oyo State, Nigeria, as part of the "Pilot Project on Rural Development". The villages studied were situated in the lowland forest and derived (forest) savanna zones of the humid tropics. The main livestock owned in these villages were chickens, goats and sheep.

The study can be divided into three main sections:

(a) a survey of village animal husbandry and management practices, and of the level of productivity, mortality and off-take obtained under the prevailing village conditions;

(b) an extension programme concentrating on broiler poultry and small herbivore production;

(c) a theoretical assessment of the potential for intensive goat and sheep production at the village level.

The main objectives of the work carried out can be summarised as follows:

(i) to describe the present system of animal production in villages of S.W. Nigeria;

(ii) to determine the viability of the system, both in practical terms and in terms of its contribution to future animal protein requirements of the nation as a whole;

(iii) to determine the major constraints to traditional production;

(iv) to determine means of improving the present system and the potential for the introduction of intensive systems of production;

(v) to investigate methods and techniques in livestock extension work, experimentation and data collection at the village level.

The main livestock development work in Nigeria has been carried out in the northern regions of the country, which cover an area approximately three times that of the southern regions. In the south, very little work has been carried out on livestock production at the village level, due to its presumed marginal importance in these regions, based on the knowledge that about 95% of the cattle are to be found in the north (Table 1). This, however, is an inaccurate assessment of the situation, which can be more easily understood by converting the livestock populations into livestock units and taking into account the size difference between the southern and northern regions.

The following 'livestock unit conversion factors' are given in the FAO Production Yearbook, 1965:

Class of Livestock	Factor
Camel	1.1
Buffalo, horse, mule	1.0
Cattle, asses	0.8
Pigs	0.2
Goats, sheep	0.1

Table 1 shows the livestock populations of Nigeria converted to livestock units, using the above conversion factors.

TABLE 1. LIVESTOCK POPULATIONS OF NIGERIA CONVERTED TO LIVESTOCK UNITS. (Adapted from Agricultural Development in Nigeria 1965-80 FAO (Rome) 1966)

	Northern Region		Southern Region				TOTAL
			Eastern Region		Western Region		
	Units (000's)	%	Units(000's)	%	Units(000's)	%	Units (000's)
Cattle	8204.6	94.5	347.3	4.0	135.1	1.6	8687.0
Goats	1431.7	67.5	468.4	22.1	220.4	10.4	2120.5
Sheep	444.8	61.5	175.2	24.2	103.5	14.3	723.5
Pigs	26.6	17.3	32.2	23.7	80.2	58.9	136.1
Total	10104.7	86.6	1023.2	8.8	539.2	4.6	11667.1

The ratio between livestock units in the norhtern and southern regions regions is therefore about 6.5 : 1. The northern region is approximately 3.5 times larger than the southern regions and therefore the ratio of livestock units per unit area between the north and south is only 1.84:1.

The poultry population of Nigeria is about 66 millions of which 37% are found in the southern regions. In terms of poultry per unit area this is a ratio of 2:1 in favour of the south.

Thus, although the greater importance of livestock production in the north must be recognised, the difference is not as vast as would at first appear. The southern regions (with an equivalent of about 2 million cattle) should be recognised as having an important role to play in supplying Nigeria's future animal protein requirements. In particular, goat, sheep, pig and poultry production in southern Nigeria merit greater attention than they have hitherto been given.

CHAPTER ONE

THE BACKGROUND TO LIVESTOCK PRODUCTION IN SOUTHERN NIGERIA

A Comparative Review of Village Livestock Production

Extensive livestock production in the villages of southern Nigeria is similar to village level production in many other tropical countries. This section reviews the published information about livestock (other than cattle) in the villages of Africa and Asia.

a. Fowls. In Ghana* it is reported that poultry are kept throughout the country by almost every family and greater attention is given to fowls than to other classes of livestock. Most poultry owners in northern Ghana construct special pens for their birds, generally either a small beehive-shaped structure in the yard, or a hollow buttress in the compound wall. On release from the pen in the morning, a handful of millet is thrown to them and they spend the day around the compound area, picking up scraps of food waste, insects and seeds. The need to supply animal protein to poultry is well appreciated and white ants are frequently fed to them. It is reported that up to 20 eggs are set in a clutch and that considerable care is taken of the chicks. During the farming season, the hen and her brood are often carried to the farm in a specially constructed basket and released there to range freely until the farmer returns home with them in the evening. Eggs are rarely eaten in the rural areas; they are either hatched or sold for consumption in the towns where there is an increasing demand. The birds are used for religious purposes or to supplement household food supplies on festive occasions or when guests are being entertained.

A similar situation exists in Tanzania (French, 1942) where the usual method of keeping poultry is to let them find their own food and water and roost where they can in the family hut. French notes that under these conditions it is not surprising that egg yields are low and mortality rates high, so that a high proportion of the eggs laid have to be incubated to maintain flock numbers. The young birds develop slowly and are exposed to attacks from hawks and other predators which take a high toll of both adults and young. Losses from disease are occasionally so high that the entire fowl population is wiped out from a group of villages.

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* Agriculture and Land Use in Ghana (1962)

It is generally accepted that two types of poultry keeping are profitable, these being either the low cost back-yard type of enterprise or the large-scale, high cost enterprise where low margins per bird are compensated by the large number of birds involved (Dexter & Barber, 1961).

McArdle (1972) comments that in developing countries intensive methods are frequently suggested in situations where many factors may be missing to put such practices into effect. Inadequate capital, insufficient range of feeding constituents and lack of electric power are major factors. He also suggests that there are three main ways of improving poultry production in developing countries: (i) by upgrading village stock; (ii) by increasing the number of peri-urban producers and (iii) by commercial production. Regarding village stock, short term upgrading is suggested, which can raise village returns by 50% under existing conditions.

It is essential to have all introduced stock vaccinated against Newcastle disease. In Nigeria* , Newcastle disease is considered to be the most serious poultry disease. It is believed to be endemic amongst village poultry and whole flocks can be eliminated before the news of its appearance reaches veterinary staff. Also in Nigeria, fowl pox is widespread, pasteurellosis occasionally flares up but can be controlled, coccidiosis is common, and salmonellosis is believed to be uncommon.

Fowls raised under the extensive village system in Nigeria are of the indigenous variety, though many improved birds have been introduced into villages throughout Nigeria resulting in much crossbreeding. More commercial and intensive units are also being established. Okon (1975) has noted that there are now over a million layers housed intensively around large towns.

The red jungle fowl (Gallus gallus) is thought to be the main ancestor of the modern chicken and the local fowl of Nigeria. Local birds still maintain many of the original features, including low body weight. Local Nigerian fowls show wide variations in comb, wattle and ear lobe structure, plumage and leg colour, and presence of feathers on the legs (Okon, 1975).

Mature body weights of female and male indigenous Nigerian fowl were given by Hill (1954) as 0.45 to 1.35 kg and 0.7 to 1.7 kg respectively. Oluyemi et al. (1973) gave a figure of 1 kg as the average weight of

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* Agricultural Development in Nigeria, 1965-80

400 local female chickens known to be 'in lay' at the time of measurement and raised under local conditions from day old chicks.

Oluyemi and Oyenuga (1974) compared the growth rates of local chickens with those of improved varieties raised under the same conditions and on the same diets and found that between the ages of 4 and 18 weeks the local birds were significantly heavier than White Leghorns, but lighter than Rhode Island Reds. They concluded that the local birds exhibit growth patterns which favour broiler production.

Hill (1954) reported egg production of indigenous birds to be 40 to 80 eggs per annum for laying birds raised under improved conditions on the Univeristy Farm, Ibadan. Egg weights recorded were between 28 and 35 g.

b. Goats and Sheep. In Ghana, goats play a similar part in the life of people as do sheep, but they are not as prestigious and are used more in religious observances. As is the case with poultry, no special goat husbandry is practiced and neither is there any selective breeding. As goats will eat almost anything, they have little difficulty in thriving. The kids are a good deal more hardy than lambs and therefore goats multiply more rapidly than sheep. Goat and sheep skins are equally valued and may be used in the home or tanned for leather. Goat skins are not used as prayer mats, but many are used for drum making, a purpose for which sheep skins are unsuitable. An average sheep skin constitutes 10-12% of the animal's liveweight, compared with 7-7.5% in cattle (Baret, 1975). Normally hides represent 5-10% and skins about 25% of the total value of the animal. Other inedible by-products include intestines, some gut constituents, blood, bones, horns, hooves, wool, hair and bristle - all of which represent valuable raw materials.

In Kenya (Lyne Watt, 1942) the stall feeding of goats and sheep is common among members of the Kikuyu tribe, where stall fed goats and sheep are kept in almost every village. They are fed on sweet potato vines and are kept primarily as a source of oils and fats for cooking and application to the skin and body. Only castrated male animals are stall fed, the females being herded together around the villages and surrounding areas.

In India (Taneja, 1974) goats and sheep are usually herded and are used for milk as well as meat (Pande, 1972). Moshin (1976), however, states

that the goat has so far been neglected by agriculturalists, veterinarians and dairymen, although there is an urgent need for animal protein to cater for the dietary deficiencies of many millions of people in the country.

Devendra (1967) notes that the goat is one of the most important animals to the farmer in Malaya and produces meat, milk and coarse skins, and is used for sacrificial and medicinal purposes. Milch goats such as the Saanen, Toggenburg and British Alpine have not been successful due to the poor heat tolerance of these animals.

The goats and sheep raised in southern Nigeria are mainly West African dwarf goats and sheep, both of which are indigenous to these areas. The goats are hardy animals, resistant to trypanosomiasis, and appear to thrive under the prevailing conditions of northern forest and derived savanna zones. The sheep appear less hardy, more prone to disease and are less prolific than the goats. Conversely, they attain a higher mature body weight and are more valuable than goats. In Nigeria as a whole there are three times as many goats as there are sheep*; this is one indicator of their greater adaptation to the local climate and environment.

The dwarf goats of West Africa are of a well marked type which ranges throughout the tropical part of the continent from the mouth of the Senagal to southern Sudan. The African dwarf goat was known to Linnaeus as Capra reversa and it is considered that they are descended from the ancestral Persian stock (Capra hircus aegagrus) which first reached Egypt from Syria at a period of great antiquity (Epstein, 1971). The goats were then brought south along the trading routes between Egypt, Somaliland, Abyssinia and Sudan, from where they spread west throughout the continent. They are small, plump animals, being less than 50 cm in height and rarely show the angular outlines of other domestic breeds. Their colour ranges from black, brown/yellow to white, being similar, therefore to the wild Capra hircus.

The dwarf sheep of West Africa are characteristic of a dwarf type found in the tropical forest belt of equatorial Africa, extending from southern Sudan in the east, through parts of Congo and Cameroon, with an extension into Angola, through Nigeria, Benin (Dahomey), Togo, Ghana, Ivory Coast, extending into Guinea, Senegal and southern Mali (in fact in the whole of West Africa south of latitude 14^{o}N). In coastal areas this is the only breed of sheep. They are hairy, thin tailed and of a diminutive size (40-60 cm), weighing 20-30 kg as adults. The rams have crescent-shaped horns, but the ewes are polled.

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* Nigerian Development Plan 1965-80 (see Table 3)

Dettmers and Loosli (1974) quote a lambing percentage of 145% for West African dwarf sheep maintained on the Ibadan University Farm, and a figure of 120% was given by Hill (1960) for the university flock. Similarly in 1974 in the university flock, 55% of lambs born were twins compared with a figure of 20% twins recorded in 1960. Dettmers and Loosli (1974) gave a lamb sex ratio of 46 male : 54 female, and a figure of 20% pre-weaning mortality.

No comparable data are available for West African dwarf goats, but Wilson (1957) quoted a kidding percentage of 107.8% for 51 first kidding East African dwarf goats, and a twinning percentage of 12.7%.

Goats and sheep differ in their feeding habits in that goats browse more than sheep, which are largely grazers. Thus goats depend more on herbs and low bushes and sheep on grasses and herbs. Wilson et al. (1975) working in New South Wales, Australia, noted that the diet of goats consisted of more browse species than the diet of sheep which consisted mainly of pasture species. Similarly, Wilson (1957) concluded that goats usually prefer browse and show preference regarding height above ground and stage of growth.

The feeding habits of goats have long been the subject of controversy and until recently it was thought that grasses formed no part of their diet. However, studies by Knight (1965) and Wilson (1957) have shown that considerable quantities of grass are eaten. Staples et al. (1942) also reported that goats will eat the longer grass species, whereas shorter annuals and herbs received little attention. Both goats and sheep show marked individual preference for certain plants and parts of plants (Knight, 1965). It was noted by Topps (1967) that indigenous sheep in Rhodesia selected those parts of the plants highest in protein content (i.e. new shoots). Wilson et al.(1975) noted that nitrogen intake was usually higher in goats. Goats have a higher digestive capacity for fibrous (lignified) material and their food spectrum is wider than that of sheep. Comparative data from Tanzania (French, 1944) showed that goats usually looked healthier than sheep in the same flock.

Hereditary dwarfism, as exhibited by these goats and sheep, is considered to be an adaptation to adverse conditions. Devendra and Burns (1970) note that, in general, goats perform better in the drier tropics and on lighter, sandy soils in preference to the wet and humid tropics, but that throughout the humid tropics, dwarf goats are found which are specially adapted to this climatic zone. These dwarf animals are small by evolution

(adaptation) and are not true dwarfs. Dwarfs are usually not very vigorous and of lower reproductive efficiency. The African dwarf animals, on the contrary, are adapted, vigorous, fertile, resistant to climatic stress, parasites and disease, and scanty and irregular supply of food and water.

The goats and sheep from northern Nigeria are often seen in the south where they are sold at local markets, but they are not reared in the villages. The most common northern goat breeds are the Red Sokoto (Maradi) and the Red Kano goats, and the most common sheep are the "Fulani" sheep (the Uda or Ouda, and Y'ankasa breeds). These animals have not been adopted by farmers in the south for production in the same way as local goats and sheep; this is partly due to the ill-adaptation of these animals to southern environmental and climatic conditions and partly due to social inhibitions against keeping these animals. Northern animals are often cheaper to buy than local goats and sheep, and the local goat meat is preferred to that of the northern goat which are altogether 'leaner' than the West African dwarfs.

c. Pigs. The local pigs (Sus scrofa) of Nigeria are small animals, well adapted to scavenging, and fulfil a useful role in this respect. They are of the long nosed, razor-backed, local black breed; they grow slowly and produce a carcass with a high proportion of fat. The numbers are relatively low and more than 80% of the total population are found in the south. Pigs are discriminated against on religious grounds by Moslems and some Christian sects.

There are disease risks associated with pigs, especially intestinal parasites which can infect both pig and man. Dipeolu (1976) found a high correlation between the parasites found in pigs and those found in the human population of the Eruwa district of Oyo State, Nigeria. It must be noted, however, that local sheep and goats also harbour many similar parasites which may be of equal public health significance.

d. Small Mammals. Although little has been written about them, small mammalian herbivores are included here, not so much for their present importance, but due to their potential as sources of animal protein for human consumption.

Three varieties are considered, the domestic rabbit (Oryctolagus caniculus), the guinea pig (Cavia spp.) and the African giant rat (Crycetomys gambianus) (Ajayi, 1975). The potential of the cane rat (Thryonomys swinderianus) or grass cutter is also noted.

The former two of these are kept in small numbers in many villages of S.W. Nigeria and are usually of exotic origin. The African giant rat is indigenous to this part of West Africa and has recently been domesticated in the Department of Forest Resources Management, University of Ibadan with a view to its use for food production (Ajayi, 1975). It is an important form of bush meat having wide social acceptance in southern Nigeria. A similar domestication programme has also begun for the cane rat, a member of the porcupine group of rodents (but without spines) which is also indigenous to southern Nigeria. These animals are mainly vegetarian and will eat most forms of green vegetation, food scraps and waste, by-products and crop residues so that these animals would not be competing with man for their food requirements. They also have the advantage that they are small, inexpensive to purchase, mature at an early age and have a high reproductive capacity. The reproductive performance of domestic rabbits, guinea pigs and the African giant rat as estimated by Ajayi (1975) is given in Table 2.

TABLE 2. A COMPARISON OF THE REPRODUCTIVE PERFORMANCE OF THREE SMALL HERBIVOROUS MAMMALS (adapted from Ajayi, 1975).

	Guinea Pig	Domestic rabbit	African giant rat
Adult weight (g)	850-900	1300-2730	690-1120
Female breeding age (weeks)	12-20	24-36	20-24
Gestation period (days)	57-67	30-35	-
Weaning age (days)	10	42-56	26
Litter size	1-6	2-10	1-5
Birth weight (g)	100	30-70	14-36
Life span (years)	-	6-7	4-4.5

Livestock Populations of Nigeria

Previous estimates of livestock numbers for the whole of Nigeria and for the western region are presented in Table 3 for comparison with the present figures.

TABLE 3. ESTIMATED LIVESTOCK POPULATIONS OF NIGERIA (000's)
From Agricultural Development in Nigeria 1965-80.

	Northern Region		Eastern Region		Western Region		T O T A L
CATTLE	10255.7	(94%)	434.1	(4%)	168.8	(2%)	10858.6
GOATS	14317	(68%)	4684.3	(22%)	2204.4	(10%)	21205.7
SHEEP	4448	(61%)	1751.4	(24%)	1035.4	(15%)	7234.8
PIGS	118.1	(17%)	161.4	(24%)	400.9	(59%)	680.4
POULTRY	41716.3	(63%)	14263.6	(22%)	10059.7	(15%)	66039.6

It was noted that these estimates "are associated with appreciable unknown errors, and the inadequacy of the data seriously impedes any attempt to forecast future production.....".

More recent estimates of the total population in 1970-71 have been given by Oyenuga (1974) as:

Cattle	11.6	million
Goats	23.5	million
Sheep	8.1	million
Pigs	0.84	million
Poultry	83.0	million

The rural economics survey of Nigeria (1963-64) showed that in Western Nigeria in June 1963, 74.8% of households owned some livestock, 63.7% owned chickens, 39.4% owned goats, 18.6% owned sheep and 1.3% owned

cattle (Table 4.) The survey showed that there was a seasonal fluctuation in the numbers of animals owned per household, with a build up towards December, and also a seasonal fluctuation in the numbers of households owning livestock. Over the two-year period of the survey there was also a general increase in the numbers of households owning livestock. The seasonal build up towards December each year can be explained by the concentration of Moslem and Christian festivals at this time of year. the main Moslem festival at which animals are killed is the festival of Ileya which is celebrated in December (Appendix II). The main Christian festival is Christmas, when animals are killed for celebration purposes.

TABLE 4. WESTERN NIGERIA: HOUSEHOLDS HAVING LIVESTOCK AS PERCENTAGES OF THE TOTAL RURAL HOUSEHOLDS (RURAL ECONOMIC SURVEY).

	June 1963	Dec.1963	June 1964		Dec. 1964	
	West and Mid-west	West and Mid-west	West	Mid-west	West	Mid-west
Any Kind	74.8	78.7	78.4	85.6	82.5	85.6
Poultry	63.7	71.1	70.2	79.9	74.1	79.9
Goats	39.4	42.8	39.8	53.8	43.8	53.8
Sheep	18.6	22.5	22.2	15.1	22.2	15.1
Cattle	1.3	1.4	1.1	1.2	1.1	1.1
Pigs	3.3	5.5	4.8	5.3	4.9	9.3

Upton (1967) reported that in 3 villages* in S.W. Nigeria, 73-98% of households owned chickens, 50-95% owned goats and 15-36% owned sheep. These margins indicate wide 'between village variation', and although the upper limits exceed the findings of the present survey, the lower limits are in agreement.

The mean numbers of livestock per household in western Nigeria in June 1963 were reported as 8.8 chickens, 3.25 goats and 2.8 sheep. Seasonal variation was shown to occur, but was not as pronounced as the fluctuations

* 6 villages were studied, but only 3 had complete livestock data.

of the number of households having livestock. Upton (1967) reported means of 7.4-11.5 chickens, 1.7-3.7 goats and 0.40-1.2 sheep per household in three villages in S.W. Nigeria.

Livestock Development in Nigeria

It was noted by Kurian (1966) that it has been the experience of developed countries that at a certain level of economic development, the area of crop production turned out to be less responsive to human efforts at raising aggregate returns and that the challenge of meeting the increasing requirements of a growing population had to be met by the livestock sector.

"In Nigeria*, it is considered that an expansion of cattle numbers should not be envisaged in the near future, as adequate grazing is already an increasing problem. The available herbage is insufficient for the existing numbers of livestock and any expansion will aggravate dry season subsistence losses in mature animals and encourage greater mortality in the young. Only when further large areas, now under utilised because of tsetse flies, have been cleared, will any expansion in the cattle population be feasible.... In the meantime, more dependence should be placed on other types of livestock".

The long generation interval associated with cattle does not apply to other meat producing livestock in Nigeria. As a result a substantial increase in goat numbers could quickly be achieved, despite the widespread prejudice in many quarters against goats per se. Such a population increase would be possible because of their fertility and reproductive rates, their efficiency in feed conversion, their variety of feeds and their relative resistance to many diseases. It is believed that goat numbers could and should be increased to a greater extent than sheep.

Figures for the proposed increases for these and other classes of livestock are shown in Table 5.

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* Agricultural Development in Nigeria, 1965-80

TABLE 5. COMPOSITION OF NIGERIAN MEAT SUPPLY 1963-64 and 1979-80
(From Table 9, Agricultural Development in Nigeria Ch. 13)

Type of meat	1963-64 quantity tons	%	1979-80 quantity tons	%	Increase %
BEEF	193,000	44.9	300,000	34.3	55
GOAT	95,000	22.1	180,000	20.6	90
MUTTON	41,000	9.5	70,000	8.0	70
PORK	49,000	11.4	150,000	17.1	206
POULTRY	52,000	12.1	175,000	20.0	237
T O T A L	430,000	100.0	875,000	100.0	103.5

It is thought that the quantity of beef available in the south is likely to decrease as population and demand grow in the north. The development of the pig and poultry industry as proposed would help to relieve the pressures on beef in the south. If per caput availability of beef in the south drops sharply there is little likelihood that supplies of goat meat and mutton, which now come almost wholly from locally raised animals, can be increased proportionately with the rise in total demand for meat. The western and eastern regions will therefore be able to satisfy their damand for meat only by vigorous programmes of pork and poultry production. The poultry programme assumes that the rural population will continue to find their supplies from backyard production, while urban markets would be supplied by a commercial poultry industry developed on an intensive basis for the production of both eggs and broilers. It is noted that the initial costs of poultry production are low and can be met by small producers.

The situation is summarised in the following points:
"(a) all the extra beef that is likely to be produced may well be consumed in the north; (b) goat numbers could at least be doubled in the northern

region, but smaller increases would be advisable in the south; (c) sheep numbers in the north could be increased considerably, although less than goats, while possibilities in the south are more limited; (d) a large increase in pork consumption per head would be acceptable in the south, but not in the north; (e) a large increase in poultry consumption would be acceptable in all regions".

"The figures demonstrate that authorities in western and eastern regions need to think in terms of doubling or trebling pork output and trebling or quadrupling the output of poultry meat within the next 15 years" (i.e. from 1965).

Before livestock development can be achieved with any efficiency, the extension services must be developed adequately. This is noted in the Nigerian Agricultural Development Plan where it is stated that high on any list of priorities for agricultural development must come the agricultural extension services. It has been shown in many countries that provided that they are supported by adequate and enlightened research, agrarian reform, credit facilities, farm supplies, marketing and communications programmes, strong agricultural extension services provide a most effective means of achieving widespread progress in agriculture.

Agricultural extension services are essentially the link between the agricultural research and education centres in a country, on the one hand, and the practising farmer and livestock owner on the other. Their function is to pass on to the farmer and to stimulate and encourage him to adopt the latest information which will enable him to improve his methods and systems of production, management and marketing.

Southwell (1969) discussing extension in the West Indies, considers that agricultural extension is only superficially understood by most top administrative officials and it is not surprising, therefore, that extension remains the weak link in the agricultural development chain. At present, very little prestige is attached to extension, but the status of the extension worker must be made equal to that of the researcher, pathologist or agricultural economist, if sufficient talented young people are to be attracted to agricultural extension as a speciality.

The Climate of S.W. Nigeria

The geographical location, size and shape of Nigeria allow the country to experience most of the climatic variations found in West Africa (Griffiths, 1974). Most of the major climatic characteristics (onset of rains, total rainfall per annum, duration of wet season and temperature regimes) are associated with the distance from the source of moisture over the south Atlantic Ocean and with the movements of two distinct air masses, the southerly monsoon and the northerly harmattan, along a north-south axis according to the season (Kassam and Kowal, 1974). These factors result in pronounced climatic differences between the north and the south, causing distinct climatic and vegetational zones (Keay, 1953). The patterns of agricultural land use and the development of livestock and forest industries have evolved in close relation to these climatic factors.

In the southern regions of Nigeria, temperatures are consistently high, having an annual mean of 27°C (max. 31.8°C, min. 20.5°C) recorded at Ibadan (IITA*) in the northern forest zone. Temperatures in the forest zone are on average higher than in the savanna zones (mean forest : 27°C; mean savanna : 24°C) but solar radiation levels are lower in the forest zone, due to greater cloud cover (Table 6).

The mean rainfall recorded over three years at IITA was 1,350 mm with a mean relative humidity of 73%. Rainfall is usually bimodal, with peaks in July and October (Fig. 1). The heaviest rains fall in March, June, September and October. Such rains may last one or two hours and may average 40 to 60 mm. There is a short dry period in August followed by the dry season drought which begins in mid-November and ends in mid-March during which a mean of 25 mm of rain falls.

In these humid and sub-humid tropics, where temperatures, rainfall and solar radiation levels are high, and where a plentiful supply of mineral nutrients is available in the soil, conditions are optimum for plant growth. These factors, however, are often limiting to animal production especially where high temperatures and rainfall result in high humidity.

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* International Institute of Tropical Agriculture, Ibadan.

FIGURE 1. MEAN MONTHLY RAINFALL (Ibadan, IITA)

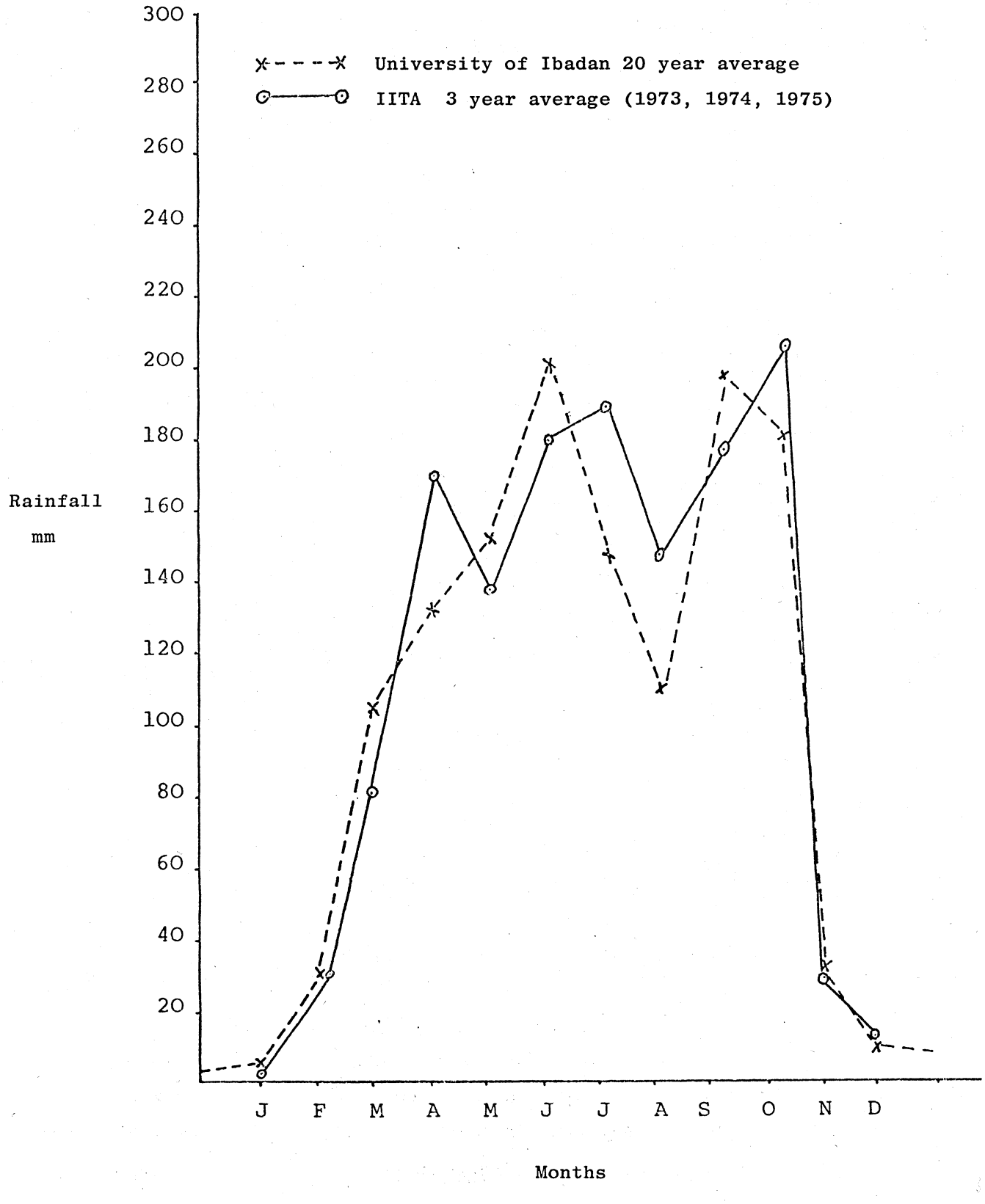


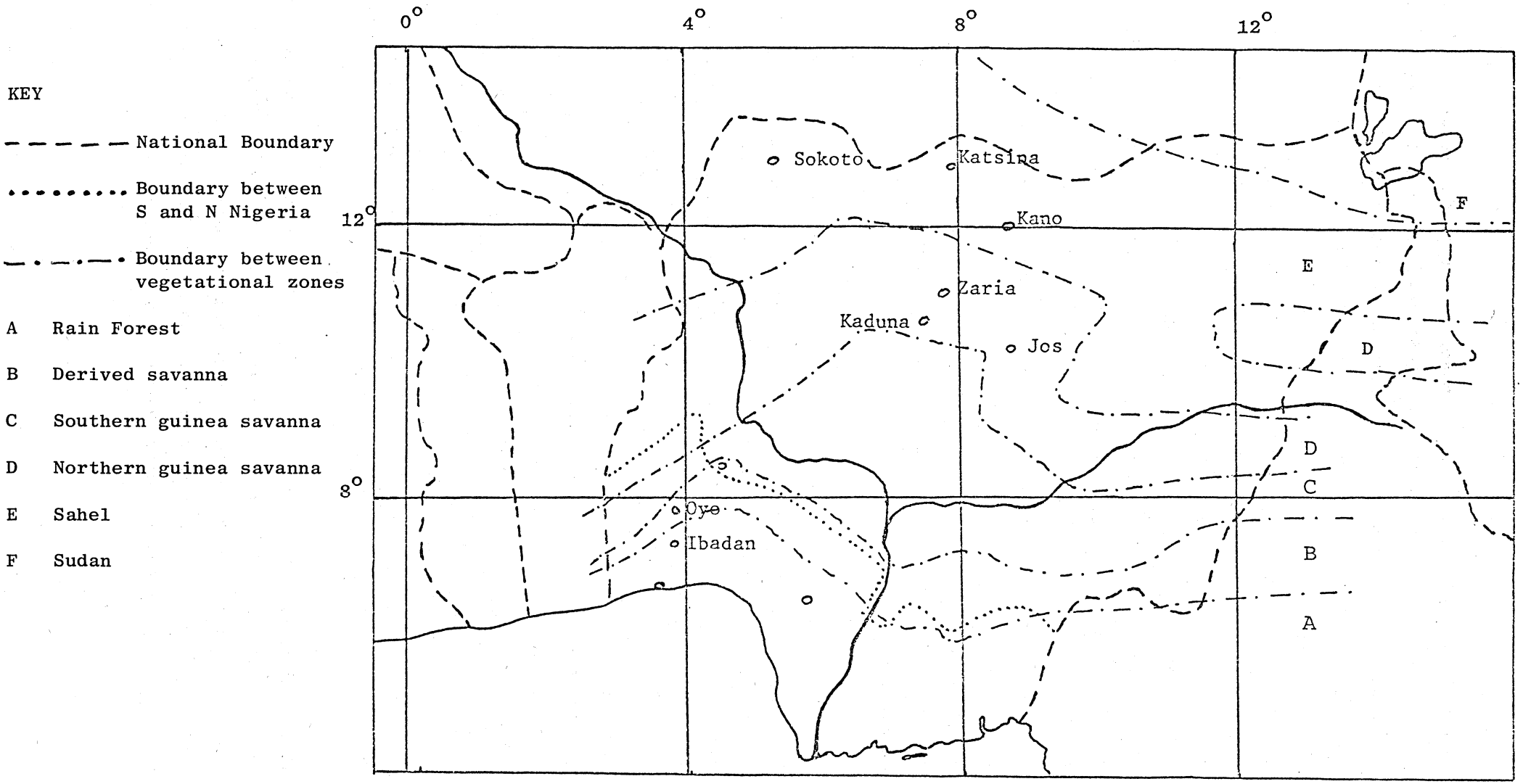
TABLE 6. MEAN CLIMATOLOGICAL VALUES COMPILED FROM IITA WEATHER BULLETINS Jan-Dec. 1973, 1974 and 1975

Month	Total Rainfall (mm)	Total Evaporation (mm)	Solar Radiation (G.Cal/cm^2/day)	Temperature (^{o}C)			R.H. (%)		
				Min.	Max.	Mean	Min.	Max.	Mean
Jan	1.6	131	357	20.1	33.7	27.1	37	92	65
Feb	29.2	144	430	23.0	35.4	29.2	37	93	65
Mar	79.7	169	471	23.5	34.8	29.1	39	93	66
Apr	166.9	141	488	23.0	32.9	28.0	54	95	75
May	137.0	133	445	22.5	32.0	27.3	57	95	76
Jun	179.2	116	425	22.2	30.7	26.4	61	95	78
Jul	185.3	101	375	22.0	29.1	25.6	65	94	79
Aug	144.6	86	346	22.0	28.7	25.4	66	94	80
Sep	176.8	87	360	21.8	28.8	25.2	66	96	81
Oct	208.9	113	414	21.5	30.8	26.1	59	94	76
Nov	31.0	112	433	22.0	32.8	27.4	46	95	70
Dec	8.7	110	381	20.4	32.6	26.6	40	95	68

The Vegetation

Vegetation zones in West Africa are directly related to the climatic gradient of decreasing rainfall from the Atlantic coast to the Sahara. The area is classified into six zones (Figure 2) which are recognised by the presence of certain tree, shrub and grass species (Crowder and Chheda, 1973). The species generally form mixed communities separated by transitional zones of varying widths. Certain dominant grass genera have been singled out and are used to designate particular grassland zones. The type-genera represented in West Africa include Pennisetum (forest zone), Hyparrhenia (derived savanna and southern guinea savanna zones), Andropogon (northern guinea, sudan savanna

FIGURE 2. MAP OF NIGERIA (AND NEIGHBOURING COUNTRIES) SHOWING THE MAIN VEGETATION ZONES



zones), Cenchrus (sahel savanna zone) and Aristida (Sahara fringes). It was noted, however, by Rains (1968) that the existing vegetation usually bears little resemblance to the original associations due to combinations of burning, cultivation, tree-felling and grazing.

This study is concerned mainly with animal production in the forest and derived savanna zones and in discussing vegetation, particular attention will be paid to the natural grass and fodder species which occur in these areas.

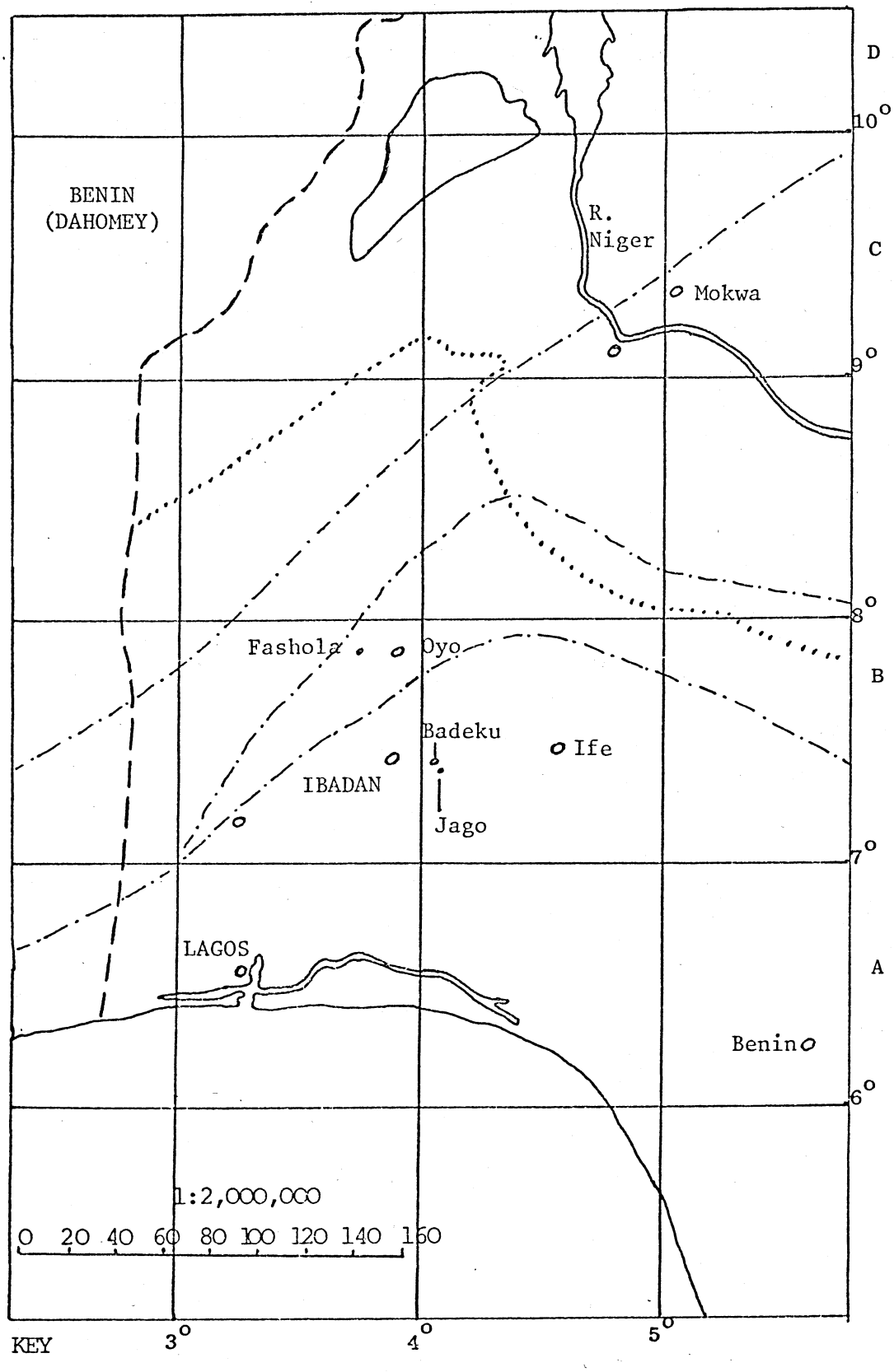
a. Lowland Forest. This forms a belt 60-120 km wide along most of the West African coast from Sierra Leone eastwards and corresponds to the area within the 1,500-2,000 mm (60-80 inch) isohyet in Nigeria. It is a zone of tropical rain forest; the upper canopy usually emerges at approximately 40 metres, with a second more compact layer at 10-16 metres, followed by a shrub layer and a ground layer of tree seedlings and a mixture of herbs. Much of this zone is under some form of agricultural production and is occupied by either farmland or forest fallow.

The northern forest regions (the Ibadan area) fall within the Pennisetum belt as defined above. This belt is closely associated with secondary tree growth following the destruction of forest; it is doubtful whether any virgin forest remains in these areas. The grass species present are characteristic of those commonly occurring in clearings and disturbed areas. Tall, coarse grasses invade cultivated areas and natural clearings, but grass cover is sparse or absent under standing forest. Common colonising grass species include Pennisetum purpureum (Elephant grass), Pennisetum subangustum, Panicum maximum (Guinea grass), Andropogon tectorum (Southern Gamba grass), Hyparrhenia rufa and Imperata cylindrica (Spear grass). McIlroy (1962) notes that after prolonged cultivation the most common grasses found include Andropogon species, P. purpureum, Loudetia arundinacea, Ctenium newtonii and I. cylindrica. There is little bush grazing in the forest region and crop farming is the major land use.

b. Derived Savanna. This zone occupies a narrow belt adjacent to and north of the lowland forest zone from which it was derived by tree felling, cultivation and frequent burning (Nye and Greenland, 1960; Crowder and Chheda, 1973). The area is regularly swept by fire and only fire resistant trees remain, except in moist depressions. Less frequent burning allows

invasion of woody species and a rapid change back to forest. The derived savanna, therefore, is classed as a 'fire sub-climax'. The area falls within the grassland zone characterised by Hyparrhenia species, which extends into the southern guinea savanna further north. In S.W. Nigeria, however, it is found that Andropogon species are more common than Hyparrhenia. McIlroy (1962) states that the grass cover of the derived savanna is predominantly Andropogon with various herbaceous plants. The botanical composition of natural grassland at Fashola Ranch in the derived savanna (Figure 3) was found to be dominated by A.gayanus (Northern Gamba grass) which accounted for 66% of the range pasture (Adegbola et al., 1968). Other important species at Fashola were Pennisetum pedicellatum and Imperata cylindrica. The more common grasses encountered in the derived savanna zone include Andropogon species, Hyparrhenia species, Pennisetum species, Ctenium newtonii, Sporobolus species and I. cylindrica (Crowder and Chheda, 1973).

FIGURE 3. MAP OF SOUTH WEST NIGERIA



—— —— ——International Boundary

. . . . . Boundary between Northern region and Southern region

—.—.—.—Boundary between vegetational zones

A Rain Forest
B Derived Savanna
C Southern guinea savanna
D Northern guinea savanna

CHAPTER TWO

SMALL LIVESTOCK PRODUCTION IN TWO VILLAGES IN THE DERIVED SAVANNA AND FOREST ZONES OF S.W. NIGERIA

In this chapter the characteristics of the present system of livestock production in S.W. Nigeria are described through the medium of a survey carried out in two villages in Oyo State between November 1975 and February 1976. The survey consisted of assessemnts of the present practices of animal husbandry and of the level of production, mortality and off-take obtained under village conditions.

Background to Villages

The villages studied are both included in the 'Pilot Project on Rural Development' (Patel and Olayide, 1976), which was commenced in 1970 by the Department of Agricultural Economics and Extension* of the University of Ibadan. The first village studied was Fashola (Figure 3) situated approximately 60 km north west of Ibadan; this is the largest of the 'Pilot Project' villages in the derived savanna zone. The second survey village was Jago which is situated in the 'cocoa belt' of the forest zone approximately 20 km east of Ibadan.

These villages were chosen for their relatively large animal populations from which accurate data could be drawn. Fashola consists of 76 households and Jago of 105 households. Fashola is situated on a main road and serves as a market village for the area, whereas Jago is situated 6 km from the nearest main road and 8 km from the nearest market.

The villages of southwest Nigeria conform to a pattern which is common to both the forest and derived savanna zones. The houses of one village are grouped together forming a single unit in a clearing in the forest (or savanna). The village is surrounded by forest/savanna and farmland and little or no cultivation occurs within the perimeter of the village. In the forest zone where adjacent villages may be only one or two kilometres apart, the

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* Now the separate departments of Agricultural Economics and Agricultural Extension Services

farmland of each village often overlaps so that a farmer in one village may have land situated nearer to an adjacent village than to his own. This situation has occurred slowly over the generations due to intermarriage between villages and the division of land between eldest sons. Village size may range from small hamlets of two or three houses to villages of 200-300 houses.

In both villages studied, up to 95% of heads of households are involved in crop farming and as many as 70% farm as their main occupation (Biggs et al., 1977). The traditional system of 'slash and burn' crop farming in which one or two acres of forest or bush are cleared every two or three years is still continued in these areas as in many parts of West Africa. A natural, bush (forest) fallow is used to rejuvenate the soil, but with increased pressure on land, the fallow periods are becoming shorter.

Approximately 40 crops of varying economic importance are grown in the forest zone (Ay, 1976). Cocoa, oil palm, kola, maize, cassava, and fruit are major cash crops, whereas crops such as yam, cocoyam, cowpeas and vegetables are grown mainly for home consumption. In the derived savanna zone tree crops such as cocoa and oil palm are of little economic importance, but many of the other crops are similar to those grown in the forest zone. Grains and grain legumes are more important in the drier regions further north. Livestock are kept throughout the southern regions, these being mainly chickens, goats, sheep and small numbers of pigs, ducks, turkeys, guinea pigs and rabbit; only few cattle are kept. The main agricultural priority of this region, however, is crop farming and livestock are of secondary importance to this.

Methodology

Data were collected by observation, direct measurement and questioning farmers regarding livestock production; most information was collected by the latter method. A questionnaire* was compiled based on knowledge gained from initial visits to the villages; two pre-tests were carried out to ensure that the structure, order of questions and the length of the questionnaire were satisfactory and also to ensure that the desired information could be collected by this method. The pre-tests provided an opportunity for the attitudes and reactions of the farmers to be gauged so

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* See Appendix I.

that these could be taken into consideration when compiling the questionnaire. The survey was carried out with the assistance of field staff who were familiar with the social and cultural background of the area and who spoke the local dialect. In general the farmers were co-operative and willing to answer questions. Interviews usually lasted about 40 minutes.

The main sources of error were found to be due to memory, exaggeration and underestimation. The time periods over which data were required were therefore minimised and where possible reference was made solely to the present situation which could be verified at first hand. Animal owners were asked to bring their animals for inspection, thus allowing checks to be made of the number and sex of adult and young. No period greater than one year was considered and production in 1975 was considered to have commenced at Christmas or the Moslem festival of Ileya in December 1974, when a large number of animals were slaughtered for the festivities.

In Fashola an initial survey of every household was carried out in order that the total village livestock population could be determined. It was then intended that the questionnaire would be completed for those households with livestock. On attempting this, however, it was found difficult to re-contact farmers and 60% of households with livestock were taken for completion of the questionnaire. In Fashola, each household was numbered in the 1973 population census so that revisits were possible. The households in Jago were not numbered and therefore a map had to be made.

Based on the experience in Fashola it was decided that a single, total survey of Jago should be carried out in which the livestock population would be determined at the same time as the completion of the questionnaire. This had the advantage that time wasted in re-contacting farmers was eliminated and sampling errors reduced.

Livestock Populations (Census Data)

In order to plan for future livestock development in Nigeria, it is essential to have accurate animal census figures for each region. Similarly, it is necessary to be able to estimate seasonal fluctuations in animal numbers and to know how these change over several years. This is important with regard to both the numbers of animals being reared extensively, and also

those being reared intensively under improved conditions. Intensive production is increasing and it is estimated, for example, that in Nigeria there are now more than one million poultry being reared in this way. Such figures give an indication of the present and future requirements for veterinary and extension services, animal food production, improved breeds of livestock, and marketing and abattoir facilities, and show the economic importance of the livestock concerned.

In the present survey, the data collected refer mainly to traditionally managed, free-range livestock, where the need for accurate census figures is no less acute. It is at the village level that the majority of livestock are found, and it is here that the greatest impact to production can be made. The figures recorded here are based on livestock counts of 80% or more of the households in each village.

TABLE 7. GENERAL CLASSIFICATION OF HOUSEHOLDS* IN FASHOLA AND JAGO VILLAGES

	Fashola		Jago	
	Number	%	Number	%
Houses in village	76	-	105	-
Houses occupied	72	100	100	100
Households where no members present at third visit	6	8	7	7
Unco-operative households	3	4	2	2
Hausa households	5	7	1	1
Households interviewed with no livestock	13	18	13	13
Households interviewed with livestock	45	63	77	77
Mills	2		1	
Churches	1		2	
Mosques	2		2	
Schools	0		1	
Shops/stalls	21		4	

* For the purpose of this study 'household' is taken to mean the total persons living in a house. Data were collected regarding all animals owned in each household. Contact was made with 81% of households in Fashola and 90% in Jago.

TABLE 8. HOUSEHOLDS HAVING LIVESTOCK AS PERCENTAGES OF THE TOTAL HOUSEHOLDS INTERVIEWED IN FASHOLA AND JAGO

Households with:	Fashola		Jago	
	Number	%	Number	%
Any Kind	45	78	77	86
Chickens	34	59	69	77
Free-range chickens	29	50	69	77
Semi-intensive chickens	6	10	0	0
Gaots	30	52	46	51
Sheep	9	16	26	29
Chickens only	12	21	17	19
Goats only	8	14	5	6
Sheep only	0	0	3	3
Chickens and goats only	14	24	29	30
Chickens and sheep only	1	1	11	12
Sheep and goats only	1	2	0	0
Chickens, goats and sheep	7	12	12	13
Guinea pigs	1	2	8	9
Cattle	6	10	0	0
Turkeys	5	9	0	0
Ducks	3	5	0	0
Doves	1	2	0	0
Cats	-	-	7	8
Dogs	-	no data -	25	28

TABLE 9. FASHOLA LIVESTOCK NUMBERS (Cats and dogs not recorded)

	Adult male	Adult Female	Young	Total	Mean/ Household
Free-range chickens	34	115	96	245	8
Intensive chickens	49	137	153	339	57
Goats	8	76	45	129	4
Sheep	2	17	6	25	2.5
Cattle (Keteku)	-	-	-	50*	8
Turkeys	5	12	2	19	4
Ducks	2	3	8	13	4
Guinea pigs	1	3	0	4	4
Doves	4	7	4	15	15

* Estimate

TABLE 10. JAGO LIVESTOCK NUMBERS

	Adult male	Adult female	Young	Total	Mean/ Household
Free-range chickens	46	209	110	365	5
Intensive chickens	0	0	0	0	0
Goats	3	77	43	123	3
Sheep	0	44	22	66	2.5
Cattle (Keteku)	0	0	0	0	0
Turkeys	0	0	0	0	0
Ducks	0	0	0	0	0
Guinea pigs	-	-	-	87	11
Doves	0	0	0	0	0
Cats	-	-	-	8	1
Dogs	-	-	-	49	2

From the above Tables, it can be seen that the ownership of livestock in the two villages is similar. Chickens, owned by 60-80% of households, were the commonest livestock. Goats were the second most important and sheep third. Although fewer households in Fashola had livestock, the average per household was slightly higher. As shown by Upton (1967) there is wide 'between village variation' in animal ownership, both in numbers and types of animals owned. The greater number of animals per owner in Fashola may reflect the greater wealth of the people in this village or may be a characteristic of the derived savanna zone in general. Alternatively, there may simply be a greater interest in livestock in Fashola compared with Jago. The lower number of animal owners in Fashola was related to the occupations of the villagers. Livestock ownership is usually associated more with farming and with other occupations carried out in the village. Women in the village are also important in this respect as they often own livestock. In Fashola a greater proportion of people were traders spending much time out of the village and some worked full time at Ministry of Agriculture farms situated near to Fashola. It was to be expected, therefore, that there were fewer livestock owners in Fashola than Jago, which has a greater proportion of the population working in the village.

Six households in Fashola had semi-intensive poultry units (chickens, turkeys and ducks) with an average of 60 birds in each. There were no intensive units in Jago at the time of the survey. Goat and sheep ownership was similar in both villages, but again, the mean per household was higher in Fashola. In Fashola, 53% of the people interviewed were either goat or sheep owners, compared with 68% in Jago. Evidence from discussions with farmers would suggest that the number of sheep and goats kept at the time of the survey was lower than in the past. This was due to the greater ease with which animals can now be bought for ceremonial and festive occasions. Before transport was available for goat and sheep movement from the north and before meat supplies in the south improved, a greater reliance was placed on local animals, both for ceremonial occasions and for general consumption.

It is difficult to determine why some people keep animals and others do not. When asked why people did not own sheep or goats the most usual answer was that they could not afford to.

This raises the question of the optimum carrying capacity of the villages for free-range livestock production. The above evidence would suggest that the villages are at present understocked. The carrying capacity will depend largely on dry season food supply and on the level of feed supplementation.

Management and Husbandry Systems, Animal Health and Animal Nutrition

The development of livestock production systems in Africa involves the combined improvement of the genetic constitution of the animals and of the environmental conditions. In the initial stages of development, it is usually the environmental conditions which require primary attention.

Under the extensive systems of production seen in the villages of southern Nigeria, the production environment is the 'natural' environment of the village and its surroundings, and is little affected by management. Under the heading 'management' are included all aspects of planning at the 'farm' level in terms of decisions regarding types of production enterprise, levels of inputs and types of livestock used, and under the heading 'husbandry' are included those aspects relating more directly to the care of animals day by day.

The inputs into animal production systems are land, labour and capital. Of the latter, housing, machinery and equipment, food and veterinary treatment are the most important. The level of inputs depends upon the resources available to the farmer and on his ability to obtain and use them.

In extensive village systems, the land used for production is the common land of the village and its surroundings. This land is an essential component of the system, but does not impose any economic burden on the individual livestock owners. There is usually no land allocated specifically to livestock production, but animals are allowed to wander freely around the village and surrounding area.

a. Intensive Poultry Management. As previously mentioned, some farmers in Fashola raise chickens intensively. Fashola is situated about 3 km from the Poultry Development Centre, Ministry of Agriculture and Natural Resources, and this has undoubtedly influenced poultry production in the village.

The poultry, mainly chickens with some turkeys and ducks, were raised in enclosures of varying sizes, constructed either from split bamboo or chicken wire. The birds were usually bought at a day old and raised on locally bought concentrates. They received some veterinary attention, but this could be greatly improved. Mortality was often high and the systems ran at low profit levels. Fashola is a special case regarding poultry production, and such intensive units are not common in the villages of the area.

b. Extensive Poultry Management. The usual practice in most villages is to raise poultry extensively, allowing them the free range of the village and surrounding area. Chickens raised in this way usually stay near the houses but may wander short distances into the bush at the perimeter of the village, in search of food. Apart from some food supplementation there has been no advance in management techniques under this system, and no attempt is made to control production.

In the survey villages there was usually no special housing provided for extensively raised chickens. In both villages about 40% of families interviewed used baskets for their chickens. These were taken into the bush during the day and brought into the house at night or placed under the eaves outside. Of the remaining 60%, some brought the birds into the house to roost freely, while those that remained outside the house at night, and not in baskets, roosted in trees and bushes or anywhere around the house.

Labour inputs for the maintenance of chickens under free range systems are minimal. Work includes feeding, watering, bringing the birds inside at night, buying food and selling chickens. Of these, feeding is the most important, but may only take a few minutes each day, usually once in the morning and once in the evening. The chickens usually come at the owners call and return to the house at dusk to roost or to be fed. The work involved is carried out equally by men and women, but children may also help.

c. Goat and Sheep Management. In the western region of Nigeria, fewer people keep sheep than goats. The reason given for this is invariably that sheep are more trouble to keep than goats. They are more active and may wander considerable distances from the village. In the cropping season (March to September) this can be a problem as sheep may cause damage. In this season, therefore, sheep must be tethered rather than allowed to wander

freely. They are usually tethered in the bush or in the 'farm'* throughout the day. Any member of the family may perform this task but it is usually carried out by the head of the household when he goes onto the land to work. The sheep are often moved once or twice a day. Young lambs with a ewe are not tethered. Goats seldom stray from the perimeter of the village and therefore do not appear to need tethering.

Only one farmer in Fashola and two in Jago provided any special shelter for their goats and sheep at night, but many allowed their animals to stay inside the house at night. In Fashola in the dry season, sheep usually gathered in the market place and sheltered underneath the stalls, whereas the goats stayed near the houses. In the wet season, sheep are either tethered outside the house at night, or are brought inside.

Goats and sheep are usually fed cassava (Manihot spp.) and scraps, but as is the case for chickens this only takes a few minutes each day and may be carried out by any member of the family.

No attempt is made to control reproduction. Mating occurs at random whenever the female comes into oestrus, and sires are usually young males of less than one year old which have not yet been sold for slaughter. Groups of young males (both mature and immature) are often seen around receptive females in the villages. There is no castration of male animals and no attempts at recording mating by using raddles have been noted.

The females suckle their young for 10-14 weeks or more after parturition, thus lengthening the reproductive cycle. However, the optimum of three kiddings/lambings in two years may not be uncommon.

No record of births, mortality, sales, profits and costs was kept. Thus it is difficult to assess the economic or biological efficiency of livestock production at the village level.

d. Animal Health. Disease control is important for the following reasons:

(a) to reduce mortality and morbidity levels in the animal population;

(b) to increase production;

(c) to remove disease reservoirs causing the spread of disease between different areas and to intensive systems;

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* The word 'farm' is used here to describe the cultivated arable plots which characterise the shifting form of cultivation carried out in these areas.

(d) to reduce the risk of the spread of disease to man.

In the survey villages it was found that mortality levels from disease and natural causes was high. Animals suffered from many common ailments and infections (i.e. ticks, fleas, lice, worms, and fungal, bacterial and viral infections) which seldom, if ever, received attention from veterinary officers. In both villages almost 100% of people reported that they had never had their animals treated.

No data regarding specific diseases were collected in the present survey. Causes of mortality in Fashola were old age, road accident and disease. When animals are no longer productive or show signs of prolonged illness, they are usually sold or slaughtered.

In both localities studied, many animals were maimed in gins, snares or traps set to catch small herbivores or other game. Indeed, animals with limbs missing were a common sight in many villages. Such occurrences can lead to loss of young through reduced milk production, abortion, etc.

Predation losses, especially among chicks, are considerable; dogs, cats, birds and snakes are mainly responsible.

Accurate data on still-births could not be collected in the survey. Kiddings and lambings occur anywhere in the village and no help or attention is given to animals nearing parturition. Still-births and abortions may therefore pass unobserved by the owners.

Economic losses due to disease in these areas could not be assessed with any accuracy, but it is generally considered that losses due to mortality, infections and reduced reproductive efficiency are high and that considerable improvement in production could be achieved by better preventive measures and treatment of common infections.

e. Animal Nutrition. As previously outlined, labour costs, housing costs and veterinary costs are all negligible and food is the only input of any economic importance in extensive production. It has been estimated that food represents 80% of the total costs of intensive livestock production*.

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* Livestock Feed Study Report. Federal Livestock Department, Kaduna, November 1975.

In the villages studied it is estimated that an even higher percentage of the total outlay can be allocated to food. The actual amount spent, however, may still be small.

In the villages of southwest Nigeria, there is usually very little vegetation growing, except at the perimeters of the village. As previously explained, sheep were often tethered in the forest, whereas goats usually remained near to the houses and only wandered short distances into the bush. Time did not allow comparative studies of the types of forage taken and of the time spent browsing or grazing. It is not known, therefore, to what extent the ecologies of sheep and goats differ. Such a study, however, would have considerable significance in helping to determine the individual ecologies of these animals and of the roles played by them in the extensive production system. Such information would aid development planning.

Food requirements are met in two ways. Most animals are required to forage and scavenge for the greater part of their food, but the majority of owners also feed their animals to a limited extent.

The food available to animals from their natural surroundings includes plant materials, refuse and household scraps. Green plant materials (grasses, herbs, low bushes and trees etc.) have high protein contents in the wet season and early growth stages and it would appear that goats and sheep derive most of their protein requirements from this source. Insects, worms and seeds form a source of edible protein for poultry. The exact contribution of this source of protein, however, has not been determined. Vitamin and mineral requirements are met largely by the natural foods available and vitamin D can be synthesised in the skin by the action of sunlight.

Most livestock owners feed their animals to some extent, and there appears to be little variation between farmers regarding the types and quantities of food fed to poultry, sheep and goats.

As indicated in Table 11 maize and maize offal* are the main foods provided for chickens in both areas, and feeding occurs more in the dry season than in the wet season. In Fashola guinea corn was used in the dry season as an alternative to maize and some farmers provided 'mash' bought from the Poultry Development Centre. Mash was never fed in Jago.

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* Maize offal is the residue remaining after milling.

When maize was bought, the average amount spent per chicken per week was 7 kobo* in Fashola and 8 kobo in Jago. Maize was not bought every week, however, and many farmers supplemented with their own maize. 75% of farmers said that they provided water for their chickens. In many cases, however, no water was available at the time of questioning, and when water was available, it was often inaccessible to chicks. Often the water was placed in large pots which were too high for very young chicks to drink from. Water availability is a greater problem in the dry season.

TABLE 11. FEEDING PRACTICES FOR CHICKENS

Products	Fashola		Jago	
	Households feeding[1] %	Households buying[2] %	Households feeding %	Households buying %
Maize	100	53	99	51
Maize offal	47	89	36	79
Guinea corn	42	100	3	100
Cow Peas	11	0	0	0
'Mash' from MANR[3]	16	100	0	0
Ground maize	11	0	0	0
Pepper[4]	6	0	0	0
Rice	0	0	2	0

1 As percentage of total households interviewed

2 As percentage of those feeding the food

3 Min. Ag. Natural Res. - exact composition of this mash is not known

4 One farmer said he fed pepper to prevent disease (unspecified) - this was of the red pepper variety

* 100 kobo = 1 Naira. March 1976 1 Naira = £0.77 sterling; therefore 8 kobo = 6p.

Goats and sheep are usually fed on cassava, maize offal, bean husks, yam and yam peelings. Cassava was fed twice a day by most farmers and maize offal was the main supplement. In Fashola the cassava was home grown by 66% of farmers compared with 80% in Jago. When bought, the average cost was 5 kobo per animal per day. This was also the sale price of the home grown cassava.

Level of Extensive Poultry Production

a. Reproductive Characteristics. The adult sex ratio was 1 cock : 3 hens in Fashola and 1 cock : 5 hens in Jago (Tables 9 and 10). In both cases the high ratio was due mainly to the higher off-take of cocks for sale and slaughter.

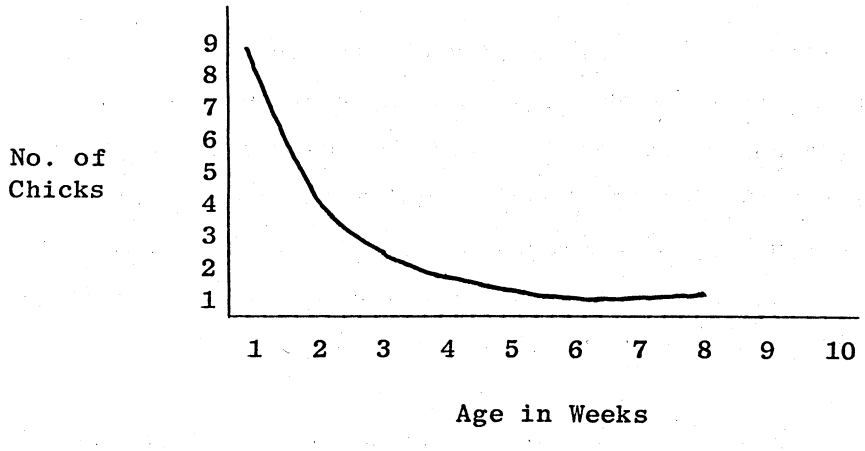
Production data regarding eggs laid, hatch rate and chick survival were collected from a total of 89 hens in Fashola and 209 hens in Jago. In Fashola, 14 hens (16%) were sitting on eggs at the time of survey, and 34 hens (38%) had chicks. In Jago, 43 hens (20%) were sitting on eggs and 85 hens (41%) had chicks. For each hen with chicks, the number of eggs laid, the number hatching and the number of chicks surviving was determined.

The hatch rate was high, and compared well with performances under improved conditions with improved birds. The figures for chick mortality, however, although already high, were considered to be an underestimate due to the sampling technique. The survey only recorded the level of mortality which had occurred at the time of the survey. As eggs were laid over a continuous period, the sample contained an equal number of hens with from zero to eight or more chicks. If the rate of mortality over the first eight weeks of life were constant, 50% chick mortality would be recorded at any one time by this method from a random sample of hens. From frequent observations and questioning farmers as to the age of the chicks belonging to his hens, a pattern of mortality became evident. Thus, if a hen was observed in a village with eight or more chicks, it was immediately apparent that these chicks were either newly hatched or only a few days old, due to their size and evidence given by the farmer. No hen was ever observed with this number of chicks which were more than one or two weeks old. On the contrary, as the age of chicks increased, the number of chicks with the hen decreased proportionately, so that if a farmer said that his chicks were seven or eight weeks old, one could predict that only one or two remained of the original batch (i.e. there was a survival rate at week eight of less than 20%). This was always the pattern found in the villages. On this evidence, an estimated mortality curve was constructed as shown in Figure 4.

TABLE 12. REPRODUCTIVE CHARACTERISTICS OF LOCAL CHICKENS

	Fashola		Jago	
	Number	%	Number	%
Number of hens with chicks	34	38	85	41
Number of eggs laid	303	-	677	-
Mean egg/clutch	9	-	8	-
Range	4-15	-	3-10	-
Number of eggs hatched	266	-	572	-
Fertility	-	88	-	84
Number of chicks surviving at time of survey	155	-	270	-
Recorded chick mortality at time of survey	-	42	-	53

FIGURE 4. ESTIMATED CHICK MORTALITY CURVE



It would appear that over the first eight weeks of life, mortality can be considered almost constant with the greatest mortality in the first few weeks after hatching.

On this basis, if 50% of actual mortality was being recorded then the figures recorded in the survey would suggest that a level of 80-90% chick mortality would be nearer the true situation. The data were collected in the dry season when chick mortality is presumably greater because dehydration is added to other causes of mortality.

This level of mortality also agrees with the level determined independently from the models of chicken productivity shown in Figs. 5 and 6.

Without continual recording, it is difficult to determine the average number of clutches per hen per year under village conditions. Farmers usually reported 2-3 clutches per year. On the basis of the data collected, a similar figure was calculated.

The reproductive cycle is composed of three phases:

i) the laying phase (10 days);
ii) the incubation phase (21 days);
iii) the brooding phase (about 56 days).

Thus, the maximum number of clutches per year is 4.2 per hen. If all adult hens were capable of producing fertile eggs and all produced 4.2 clutches per year, then at any one time, all hens would have either eggs or chicks. It was found, however, that only 60% of hens had either eggs or chicks (i.e. 54% in Fashola and 63% in Jago). On this basis a figure of 2-3 clutches per year would seem a more reasonable estimation. In later calculations, therefore, a figure of 2.5 clutches per years is used.

b. Adult Mortality. All farmers commented generally on high mortality as being the greatest constraint to production. Many farmers were unable to recount exact mortality figures, but simply said that many had died in the past year. The figures for mortality were therefore estimated from those farmers who were able to say with certainty and confidence how many of their chickens had died. In Fashola there was 31% adult mortality calculated as a percentage of the present population compared with a figure of 51% in Jago.

c. Level of Off-take. Approximately 45% of owners in both villages killed chickens for home consumption in 1975. These were killed mainly at Christmas, New Year and other festive occasions such as naming ceremonies and weddings. In Fashola the off-take for home consumption was 10% of the chickens owned, compared with 12% in Jago (Figs. 5 and 6). Off-take for sale was slightly higher in Fashola than in Jago, being 12% in Fashola and 8% in Jago. Similarly, the number of owners who sold chickens was higher in Fashola, being 42% compared with 28% in Jago. Higher home consumption and lower sales in Jago may be due to a relative scarcity of other meat sources.

d. Egg Production and Consumption. From the figures determined in this survey, the level of fertile egg production in the villages is in the range of 20-30 eggs per annum (i.e. a mean clutch size of 8-9 eggs, and 2.5 clutches per year). The potential for egg production under village conditions is undoubtedly higher than this figure, which depends largely on the number of clutches raised per annum.

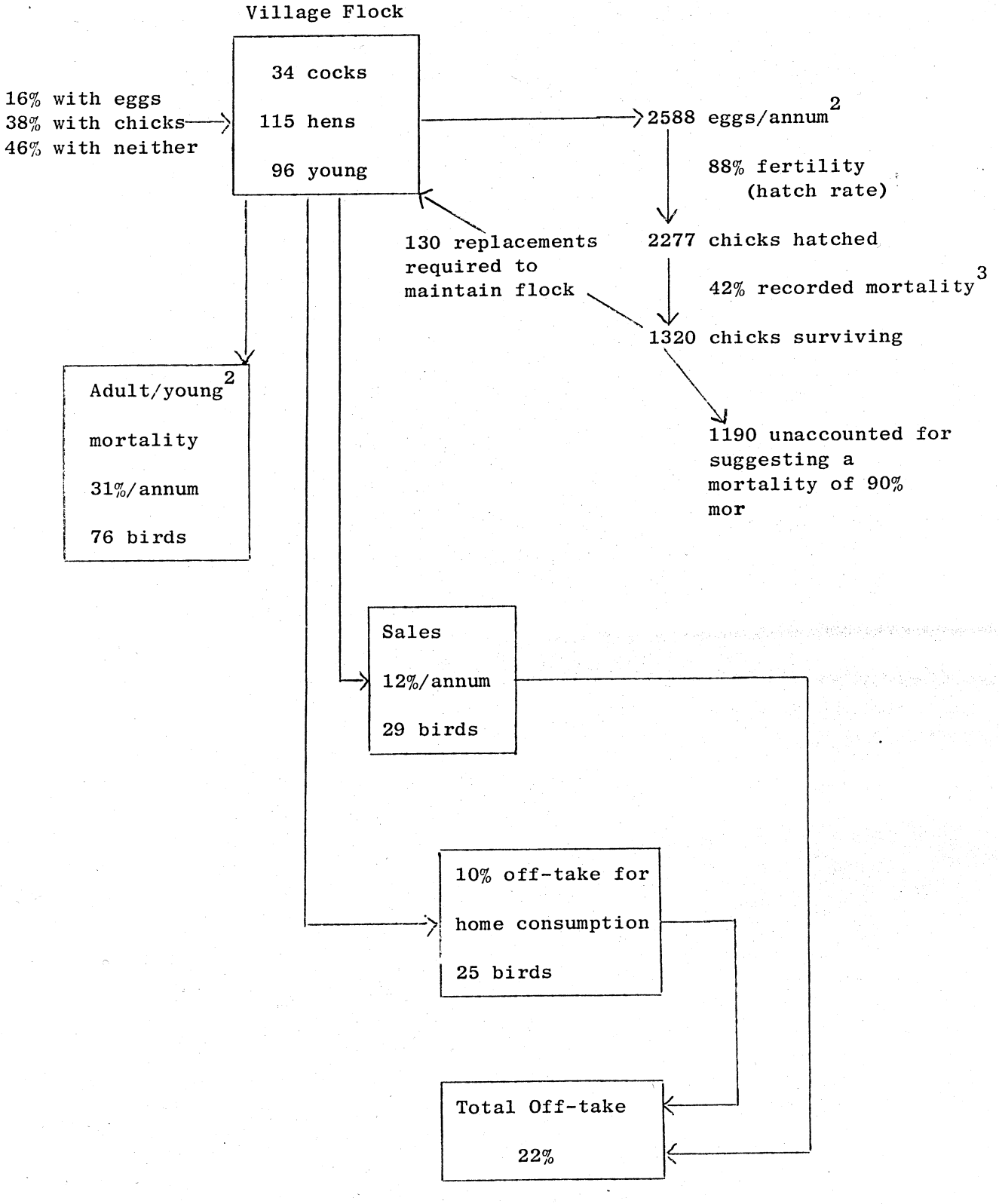
Under the traditional system of production, chickens are not raised to provide eggs for human consumption. Most people said that they were not 'wealthy enough' to eat eggs and that they preferred to leave them to hatch. It was difficult, therefore, to determine the level of egg consumption. In Fashola 70% of people said thay they did eat eggs, compared with 36% in Jago. In Fashola, 80% of people bought eggs compared with 19% in Jago. Thus, in Jago, 61% of people neither bought nor ate eggs. The higher figures in Fashola are undoubtedly due to the close proximity of the Poultry Development Centre where eggs can be bought relatively cheaply. The figures recorded in Jago are considered to be more typical of most villages in both areas. Many people in the villages, however, who said thay they did eat eggs, were unable to give exact details as to how many and when they were last eaten. In both villages, examples of when eggs were eaten were as follows:

(a) when too many were laid by one hen;
(b) when eggs were abandoned or did not hatch;
(c) when meat was not available;
(d) when they were prescribed by the doctor, mainly for elderly people, young children and pregnant women.

The consumption of eggs is not encouraged because of the belief that children who become accustomed to such foods, may not be able to afford them in later life, thus causing them to steal. The production and consumption of eggs is an area where education can play an important role in development, and requires the combined efforts of health, nutrition, home economics and livestock specialists.

e. Poultry Production Models. From the reproduction, mortality and off-take data presented above, two models of village poultry production have been constructed (Figs. 5 and 6.).

FIGURE 5. MODEL OF CHICKEN PRODUCTION IN FASHOLA VILLAGE

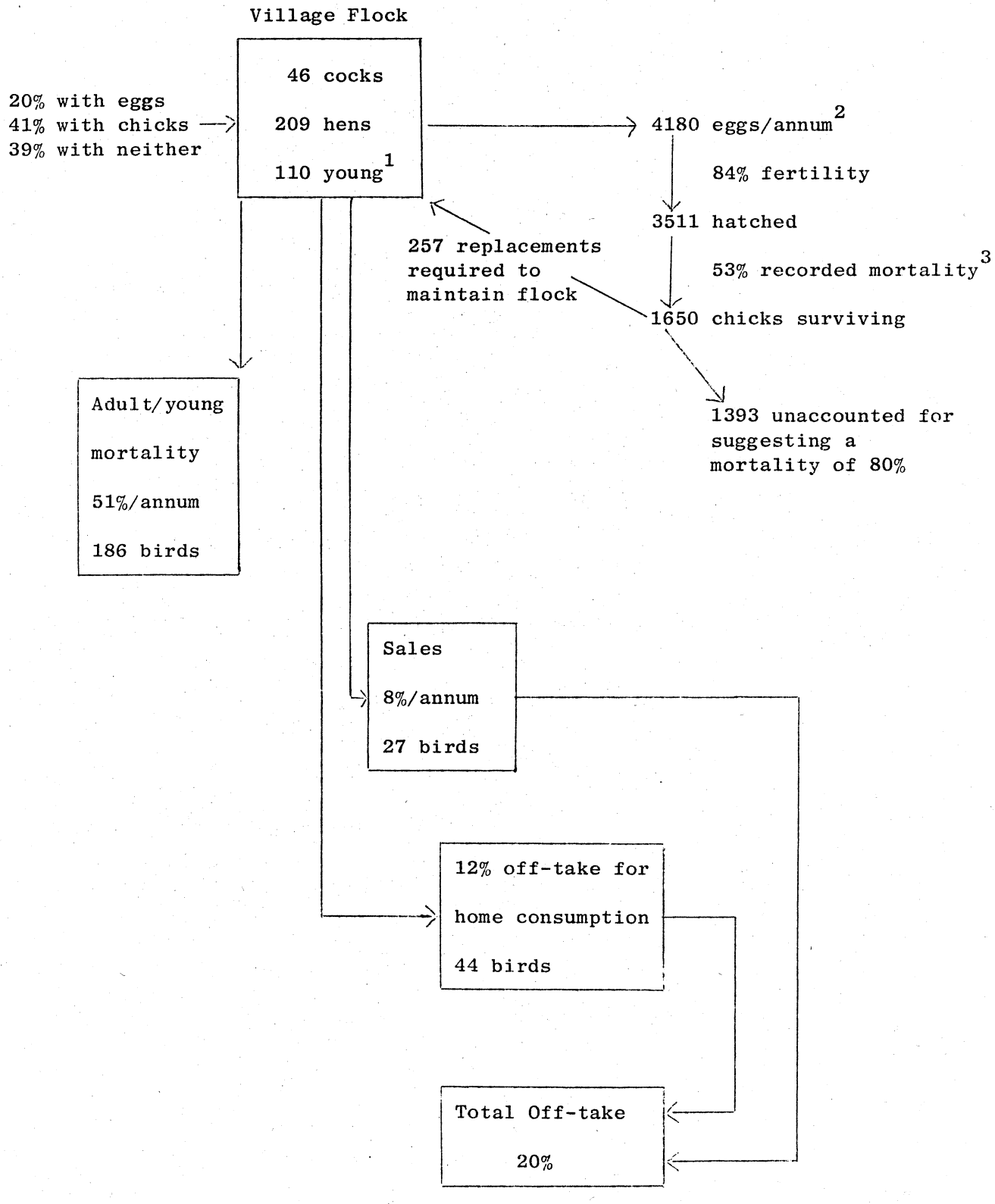


1 8-16 weeks

2 Assume 2.5 clutches per annum and 9 eggs per clutch

3 Underestimate due to sampling technique

FIGURE 6. MODEL OF CHICKEN PRODUCTION IN JAGO VILLAGE



[1] 8-16 weeks

[2] Assume 2.5 clutches per annum and 8 eggs per clutch

[3] Underestimate due to sampling technique

These models show an overall similarity in off-take between the villages, amounting to approximately one bird for each household with chickens. This emphasises the relatively low productivity of village poultry and draws attention to the extremely high mortality rates of both adults and chicks. The earlier estimate of 80-90% chick mortality is strengthened by this evidence and would appear typical of villages in southwest Nigeria. Vast benefits to production would, therefore, result from improved veterinary treatment, nutrition and management practices.

Level of Goat Production

The main breed of goat found in southern villages is the West African dwarf, which is owned by approximately 50% of households. These goats are more abundant, better adapted and more prolific than the local sheep. For reproductive purposes, the total population of goats in a village can be considered as a single, interbreeding herd.

In most villages the number of adult male goats is considerably lower than the number of adult females. Old male goats are rarely seen in the villages and males are usually only kept until the age of one year before being sold. 95% of male goats are sold immediately after weaning. Due to these factors, it was not possible to estimate the longevity of male goats in the villages. The sex ratio is in the region of 1 male : 10-20 females.

Production data were collected from 45 adult females in Fashola and 72 in Jago. In Fashola, 20 (44%) females were still suckling their young, 12 (27%) had recently weaned their young, and 13 (29%) had not kidded. In Jago 28 (39%) were suckling their young, 21 (29%) had recently weaned their young and 23 (32%) had never kidded.

Specific age data were difficult to obtain for adult females, but the number of kiddings was more easily determined (see Table 13). It is realised, however, that this can only be taken as a rough guide to age structure.

The survey was carried out in the dry season (Nov.-Feb.). In this period there were more adult female goats with suckling young than there were without young, excluding those that have never kidded (61% in Fashola and 57% in Jago). Thus from the grouped sample (excluding those females which have never kidded) 59% were suckling young at the time of survey. This suggests a seasonality of breeding with a peak in the dry season.

TABLE 13: AGE STRUCTURE OF FEMALE GOAT HERD AS DETERMINED BY NUMBER OF KIDDINGS

Number of Kiddings	Fashola	Jago
0	13 (29%)	23 (32%)
1	5 (11%)	15 (21%)
2	14 (31%)	20 (28%)
3	6 (13%)	9 (12%)
4	7 (16%)	2 (3%)
5	0 (0)	2 (3%)
6	0	1 (1%)

Birth rates were assessed in relation to the last kidding of each adult female. For animals with young, the data could be verified and for pregnant animals, the time lapse since the last kidding was considered short enough to avoid inaccuracies due to memory.

The total number of live births at the last kidding of 32 goats in Fashola was 51 (25 female and 26 male kids). In Jago, 49 goats produced 74 live kids (36 females and 38 males). In Fashola, these included 14 singles (27%), 34 twin births (67%) and one set of triplets. In Jago, there were 25 singles (34%), 46 twin births (62%) and one set of triplets (5%). As would be expected, the kidding percentage increased with parity.

TABLE 14: KIDDING PERCENTAGES

	Fashola	Jago
Kidding % at first parity	100% (5/5)	107% (16/15)
" " " 2nd "	164% (23/14)	165% (33/20)
" " " 3rd "	150% (9/6)	167% (15/9)
" " " 4th "	200% (14/7)	200% (4/2)
" " " 5th "	-	250% (5/2)
" " " 6th "	-	100% (1/1)
" " " 7th "	-	-
Overall kidding percentage	159% (51/32)	151% (74/49)

From the figures in Tables 13 and 14 it would appear that under village conditions the maximum reproductive life of female goats is about 6 years, but with a more usual reproductive life of 4 years.

Pre-weaning mortality in Fashola was 10% compared with 9% in Jago. These are underestimates due to the method of sampling, which included some unweaned animals. From later estimates a figure of 15% was obtained.

After weaning, the kids were either sold, kept for breeding or killed for home consumption. The farmers were asked what they had done with kids already weaned, or what they intended to do with their kids when they were weaned.

TABLE 15 : NUMBER OF KIDS SOLD, KEPT FOR BREEDING OR KILLED FOR HOME CONSUMPTION

	Fashola		Jago	
	Male	Female	Male	Female
Sold outside village	22	12	32	11
Kept/sold in village	0	11	2	22
Killed for home consumption	1	0	0	0
(Dead before weaning)	(3)	(2)	(4)	(3)

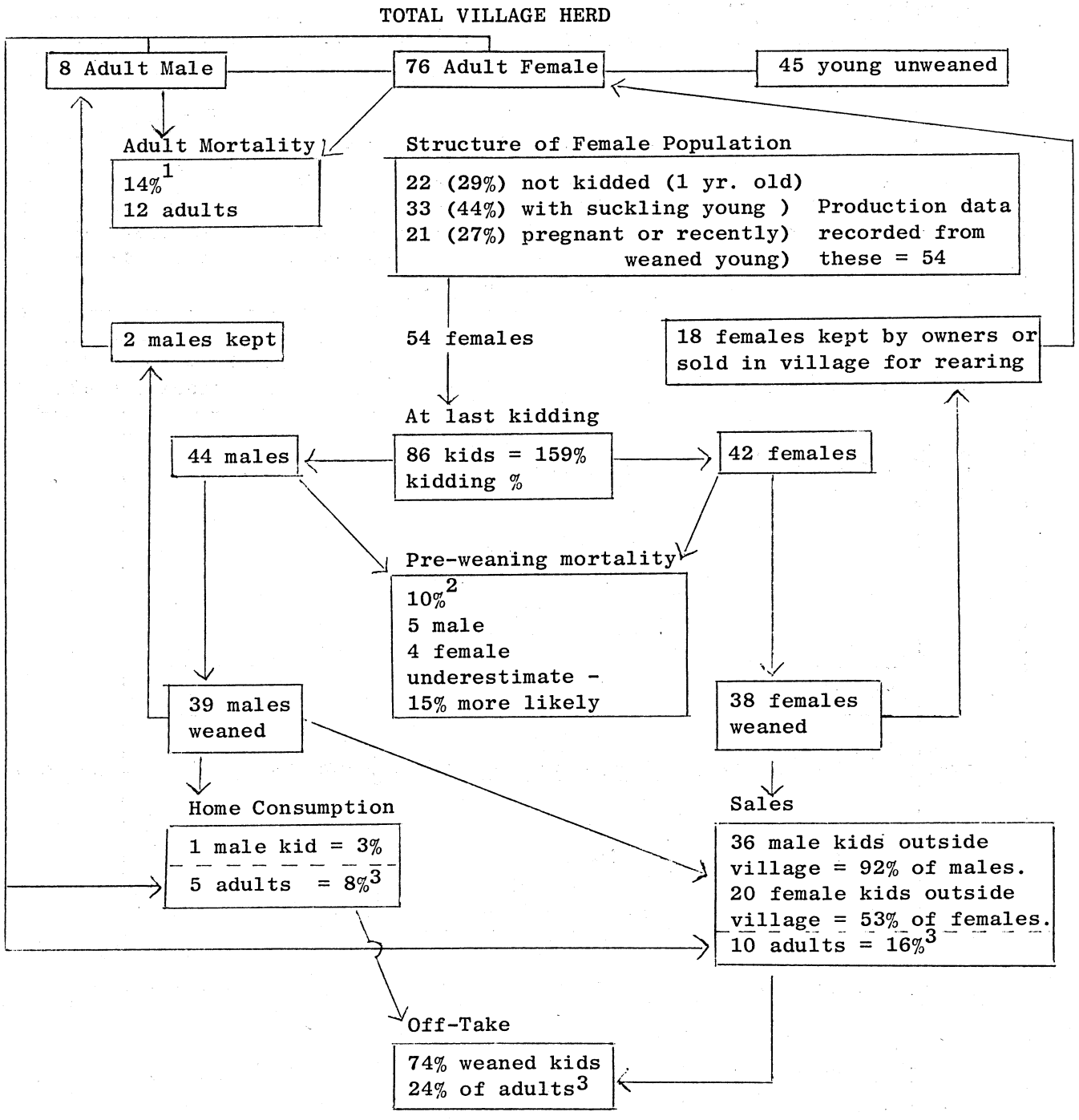
In addition, seven households in Fashola and five households in Jago reported having sold adult animals in the past year (these included any animals other than those accounted for in post-weaning sales). These totalled 10 (16%) in Fashola and 5 (9%) in Jago and were sold outside the village.

In Fashola 5 goats were killed for home consumption (at ceromonies and festivals) compared with 4 in Jago. These were goats reared in the village and did not include any animals bought from outside. The figures are surprisingly low and indicate that animals are kept mainly for financial gain.

From the data collected, tentative models of village production have been constructed (Figs. 7 and 8). The models show that in both cases male kid off-take is at a maximum and could only be increased by a reduction in pre-weaning mortality. Female kid off-take is lower than male off-take due to the herd replacement requirement and could be increased by a reduction of the replacement requirement or a reduction of pre-weaning mortality.

FIGURE 7. MODEL OF GOAT PRODUCTION IN FASHOLA VILLAGE

Calculated from 60% of village herd and scaled up to full herd level



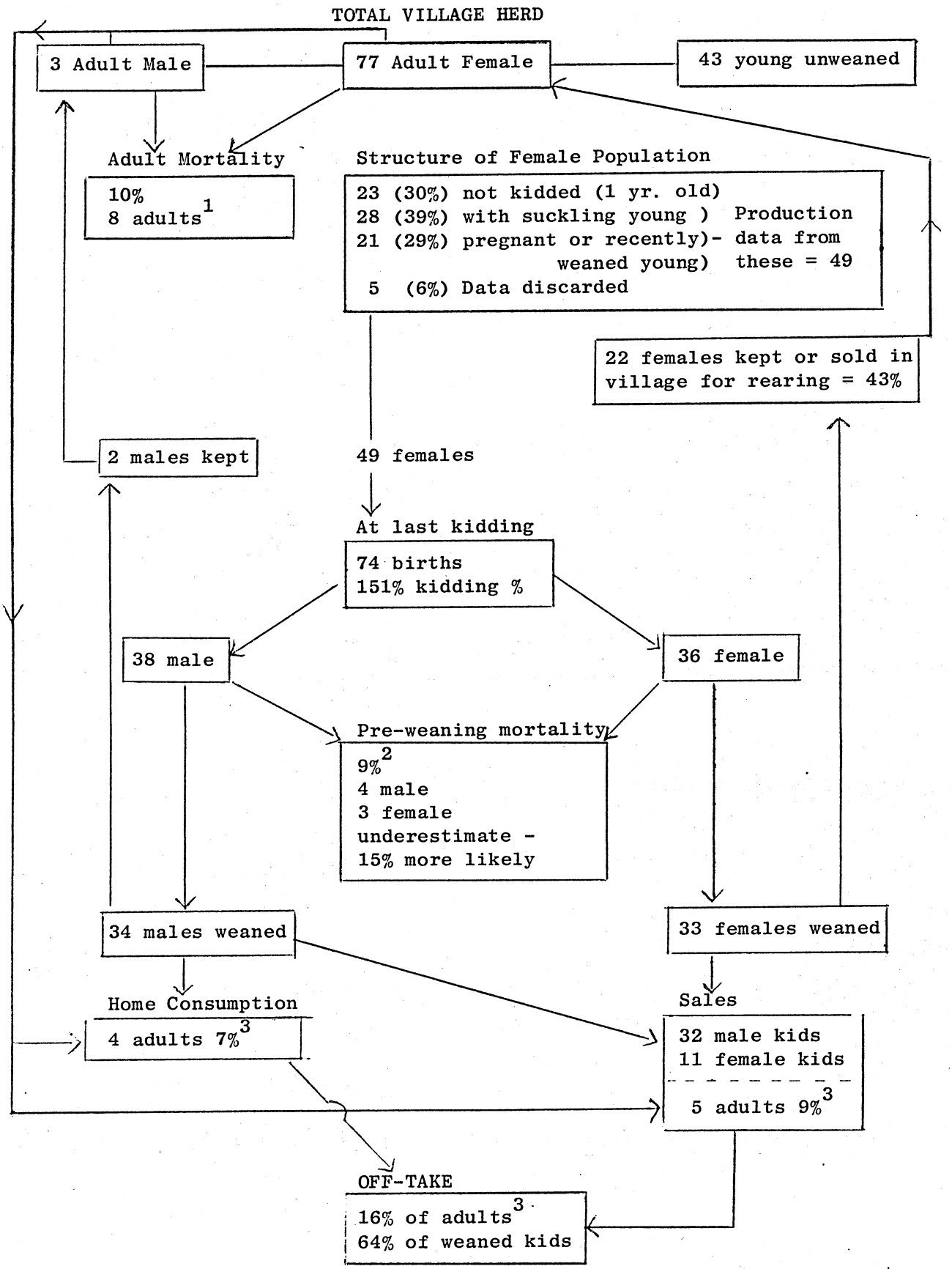
[1] calculated from total adults (ie. 84)

[2] calculated from pre-weaning mortality to time of survey

[3] calculated from total adults minus females not having kidded

NB: A correction factor must be applied to both Figures 7 and 8. This is to take into account any young born during the year to those adults which are included in the figures under the headings of 'adult mortality', 'adult sales', or 'adult home consumption'. It is assumed that approximately 50% of these females would have kidded before either death or 'off-take'. Thus kid replacements, kid pre-weaning mortality and kid sales are all approximately 15% low. From the Jago figures 15 adults either died, were sold or killed during the year. Thus, on the assumption that mortality and off-take are constant throughout the year, 7 (ie. 50%) of these probably reproduced during the year giving 11 kids.

FIGURE 8. MODEL OF GOAT PRODUCTION IN JAGO CALCULATED FROM TOTAL VILLAGE HERD



1 calculated from total adults (ie. 80)

2 calculated from pre-weaning mortality to time of survey

3 calculated from total adults minus females not having kidded

The herd replacement requirement could be reduced by a reduction in adult mortality. The adult off-take figures probably include culls, which for reasons of old age or other factors are no longer productive.

It is concluded that maximum off-take is being achieved under the conditions; but, with improved veterinary treatment and nutrition, mortality would be reduced, resulting in greater off-take.

Level of Sheep Production

Due to the very low numbers of sheep in Fashola, production data are presented for Jago only. In this village, data were collected for 42 sheep which included 8 ewe lambs (19%), 19 ewes with young (45%) and 15 pregnant ewes (36%).

A total of 39 lambs were born at the recorded lambing of 34 ewes which gave a lambing percentage of 115%. 85% of births were singles and 15% were twins. No triplets were recorded, but have been recorded at other times in these villages. Of the 39 lambs born, 18 (46%) were male and 21 (54%) were female. A 15% pre-weaning mortality was recorded, but this was an underestimate, as with other species, due to some lambs being unweaned at the time of survey.

TABLE 16 : FLOCK AGE STRUCTURE ACCORDING TO NUMBER OF LAMBINGS AND LAMBING PERCENTAGES AT DIFFERENT PARITIES

Number of Lambings	Number of Ewes (% of Village flock)	Lambing Percentage
0	8 (19%)	0 0
1	6 (14%)	100% (6/6)
2	12 (29%)	117% (14/12)
3	7 (17%)	129% (9/7)
4	6 (14%)	100% (6/6)
5	2 (5%)	100% (2/2)
6	1 (2%0	200% (2/1)

All the male lambs were sold except one which was killed for home consumption. 50% of ewe lambs were sold and 50% kept for breeding. Four adults had been sold during the past year (1975), 3 had been killed for home consumption and 5 had died. From these data, a model of sheep productivity (Fig. 9) has been constructed. This has the same format as the models of goat productivity.

The model for sheep production resembles those constructed for goats. Male lamb off-take is maximum, whereas female lamb off-take could be increased by a reduction in the herd replacement requirement.

With a lambing percentage of 115%, sheep are less prolific than goats which have a kidding percentage of about 150%.

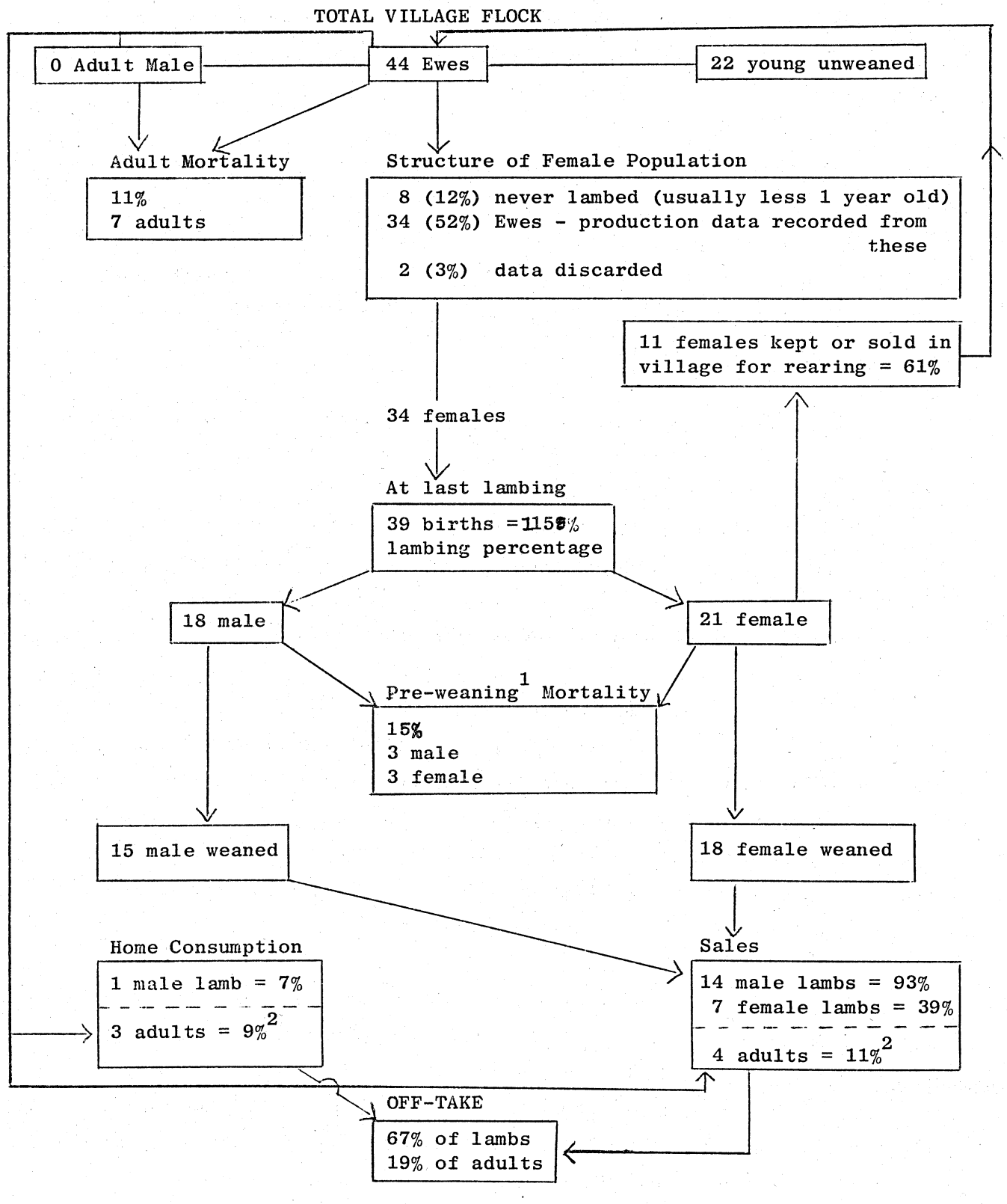
The Role of Livestock Production at the Village Level

Traditionally, village communities have functioned as closed systems, being almost wholly dependent on local produce for their subsistence. Sources of animal protein included game, fish, locally produced livestock and livestock brought from the north. Such communities now have greater contact with the main urban centres which allows access to other forms of animal protein food such as tinned fish, eggs and milk. Meat distribution from the urban centres is also more efficient and communities near to towns are becoming more dependent on these sources.

In Fashola, 90% of people said that they depended mainly on beef bought from local butchers. 25% also regularly bought dried fish. The average spent on meat or fish was 80 kobo per adult per week, from a sample of 25 households. In Jago people depended more on fresh fish than meat due to the distance from Ibadan and infrequent visits by butchers, the village being 6 km from the nearest main road. Fish is obtained locally from the Oshun River and 90% of households depended upon this; only 10% bought beef. The average amount spent on either fish or beef was 56 kobo per adult per week from a sample of 85 households. There is a more plentiful supply of beef in the derived savanna zone due to the recent increase in small cattle ranches in these areas.

Game was probably more important in the past when the human population was less and game was more abundant. In Fashola 42% of farmers said that they caught game by either hunting or trapping compared with 14% in Jago. There appears to be more hunting in the derived savanna zone and it is more common

FIGURE 9. MODEL OF SHEEP POPULATION DYNAMICS IN JAGO VILLAGE



[1] calculated from pre-weaning mortality to time of survey

[2] calculated from total adults minus females not having lambed

in the dry season. One farmer in Fashola remarked that only 'true hunters' go hunting in the wet season. It is difficult, however, to assess the present contribution of bush meat to human protein requirements. Ajayi (1975) estimated that this could be as high as 20% of animal protein intake in some rural areas in West Africa. This was presumably true in the past, but the role is probably declining.

Olayide et al. (1972) showed that of the daily per capita available protein to Nigerians in 1968, 50% was from grains, 20% from starchy roots and tubers, 11% from pulses, 4% from other vegetable sources and 14% from livestock sources. These figures, however, do not take into account bush meat, locally caught fish and tinned protein foods, which would substantially increase the percentage from animal sources.

The protein component is thus obtained from the following sources:

(a) tinned milk, fish and meat;
(b) bush meat, snails and fish;
(c) locally produced livestock;
(d) butchers;
(e) plant sources.

It has already been remarked that local livestock are only killed on special occasions and that livestock population densities in the survey areas are relatively low. Although local animals are seldom killed to provide meat for home consumption, the potential contribution of local livestock to human protein requirements is significant. From the data collected in the survey it has been calculated that local goats and sheep produce 2.3 ounces of edible meat/adult/week (see Appendix III).

It is often stated that goat is the 'poor man's cow'. This description, however, applies more to goats in the arid tropics where crop farming is not possible and where livestock play a significant part in the lives of the people. In such areas as these, goats and sheep are also milked. In southern Nigeria goats and sheep are mainly meat producers as are chickens. In the survey villages hides are rarely kept (Appendix II) and local goats and sheep are not milked. The reason for this is mainly that young animals are allowed to suckle until the milk supply of the dam dries up, and also to the low potential of dwarf animals as milk producers. Mba et al. (1975) give a yield of about 0.5 kg milk

for West African dwarf goats, but give no details of the length of lactation. In some areas goats and sheep manure may be utilised for farming but no evidence of this was found in Jago and Fashola.

To the individual livestock owner, therefore, the main role of animals is to provide small periodic income and thus serve as an investment. In a low input system, the returns from production are mainly profit, even though they are small. In a joint sample of 95 livestock owners 91% said that the main reason they kept animals was for financial gain, 4% as an investment and only 5% said it was for food. For the average family, sales may amount to one or two kids or lambs and perhaps one or two chickens per annum.

It has been shown that for a sample of 232 farmers in the Jago area (including 27 farmers in Jago)* the average income from farming (after expenses have been deducted) and second and third occupations was 332 Naira per annum. Income ranged from 14 to 2,116 Naira. The median income was 219 Naira and the modal income was between 80 and 120 Naira. 80% of farmers had incomes less than 500 Naira.

For some families livestock may account for a substantial part of the total income per annum. The current price for a weaned kid or lamb is about 10 Naira and for a chicken 2.50 Naira. Thus an average family may expect an income of 25 Naira per annum by selling two kids and two chickens. This amounts to 11% of the median income and 25% of the modal value.

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* Peter Ay (1976)

CHAPTER THREE

EXTENSION WORK

Livestock Extension

The development of livestock production requires an efficient extension service to educate and inform farmers regarding new methods and techniques of production. Experience has shown that many farmers desire to learn about improved practices, but that they are unable to obtain the necessary practical knowledge without outside help. For example, the methods of production which are practised in large scale commercial poultry enterprises are only feasible on a smaller scale at the village level if modified to utilise the limited resources that are available. The infrastructure for the modification and introduction of such methods, however, has not been established.

Development by its very nature involves a dynamic process of change. This is normally a slow process, especially when new concepts are being introduced which involve complex methods. Thus, in helping bring about change, the extension services should act as catalysts in this natural process of change and diffusion of ideas. It is considered that livestock extension work in S.W. Nigeria should be aimed at the 'quick adopter' or 'leader' class of farmers, with the intention of then allowing the adoption process to follow a natural pattern with the spread of ideas and information from farmer to farmer.

In the present context the emphasis of extension is on education by practical demonstration and involvement. It is considered that one of the most effective ways of introducing new ideas is to establish demonstration projects and schemes which involve a whole production cycle (i.e. one growing season for crops, or from day old chicks to marketing for poultry in the village). Such projects may be expensive, and part, or all, of the costs may have to be borne by the extension services and the work carried out by extension workers with the aid and participation of the local farmers. When new systems of production are being introduced it is probably enough to initiate one unit per village, group of villages or co-operative. These principles have been adopted for work on poultry production and small herbivore production as described below.

Intensive Village Poultry Production

It was noted that certain farmers in Fashola had begun to rear chickens, and in some cases ducks and turkeys intensively. In the villages of the forest zone, such as Jago and Badeku, however, no evidence of intensive production was found.

An extension programme was therefore commenced in order to investigate the possibilities of intensive poultry production in these villages. The objective was to establish two intensive units in separate villages in order to demonstrate improved practices to farmers and to investigate the problems of intensive production at the village level, including food availability and marketing.

A deep litter system based partly on the methods already adopted by farmers in Fashola and partly on those used on the University of Ibadan Teaching and Research Farm appeared most suited to village production. Broiler production was chosen rather than egg production because the broiler cycle is shorter and requires less capital input. The problems of egg production at the village level have not been investigated, but the longer production cycle, resulting in higher food costs, and the problems of marketing eggs made it a less favourable option for the initial programme.

Under terms laid down for the extension programme by the University of Ibadan, the capital cost of establishing the units had to be borne partly by the farmers and partly by the extension services, and the labour and general running of the units was to be the entire responsibility of the farmers. In a programme such as this, which involves high costs, the extension services must bear some of the risk involved in the initial stages. Having demonstrated the viability of the methods being proposed, other farmers would be expected to bear the full costs of establishing units as well as subsequent production.

a. The Extension Programme. The programme began on May 1st 1976 and three or more trips were made to Jago and Badeku each week. Suitable farmers had been chosen in the course of the survey work carried out, and it remained to see their reactions to the proposals.

The farmer in Jago was a man of some importance in the area and was the chairman of the village maize and cocoa co-operatives. In many respects

he was held in greater esteem and had more authority than the Chief (Bale) of the village. He was relatively wealthy and had four wives. The farmer in Badeku was chosen as a contrast. He was as a normal village farmer but like many others had a second occupation as a basket maker. He was also chosen for his interest in poultry production*.

Discussions were held with each farmer and their views and ideas assessed. Types of housing and methods of production were described and the contribution which each farmer could afford was determined.

The farmer in Jago agreed to build a poultry house and chose a high cost design which he thought suitable for his village. The farmer in Badeku said he could not afford to build a house, but indicated that he had a suitable spare room in his compound where he already kept chickens. It was decided that his contribution should be a greater share of food costs.

The University contribution was to be the provision of the day old chicks, veterinary care, food and technical assistance. It was intended that the farmers should assume total financial responsibility as the project progressed and that all the profits of the project should be theirs. This was agreed upon by the farmers and 80 day-old chicks were promised to the farmer in Jago and 40 to the Badeku farmer. This difference in numbers alloted was due to the different housing facilities possessed by each farmer and the higher initial financial input provided by the farmer in Jago. The two units were to be established and run in parallel and the chicks taken from the same batch and given to the farmers on the same day. This would facilitate the buying of food and synchronisation of vaccination dates, as well as reducing the number of trips by veterinary staff to the villages.

The building of the Jago house was to begin immediately and the farmer gave assurances that this would be so. The construction, however, took a total of three months, with the final work being finished on the day that the chicks were installed. The construction of the housing progressed as follows:

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* At the outset of the programme he was keeping 8 improved broiler chickens purchased at one week old from a local trader. They were in poor condition, however, with vitamin deficiencies and three later died from chronic respiratory disease (CRD). These birds were put on an improved diet with antibiotic treatment and five were eventually marketed at about four pounds liveweight.

5 May	First meeting with farmers
19 May	6 holes dug for corner posts and uprights of house
31 May	Uprights placed in holes
9 June	Wooden superstructure complete
23 June	Roof completed
8 July	Mud walls built
20 July	Artificial brooder and litter taken to village
28 July	Walls and floor concreted
31 July	Wire netting fixed, door completed, plastic sheeting bought for outside drapes (against wind and rain), chicks installed.

Throughout this period visits were continued to the villages and constant encouragement had to be given. The delays were due to genuine problems of acquiring materials and labour, to lack of certainty on the part of the farmer that the University would keep its promises, and to stalling in the hope that the University would provide some money and materials for construction.

This part of the programme demonstrated that extension and development work can be an extremely time consuming occupation for which the short term rewards appear minimal. Work on this phase of the programme in Jago was at the best slow and at the worst very frustrating. Four consecutive trips were made at one stage without any sign of progress on work that had been agreed. Such problems must be expected, however, when dealing with farmers who are instinctively cautious regarding outside organisations and innovations.

Problems of this type did not arise in Badeku as the farmer was not expected to build a poultry house. It was decided, however, that he should build a small hut from local materials (bamboo and palm) for his older broilers. This involved minimal expenditure for wire netting to line the floor and sides, and even this could have been dispensed with had more care been taken in the building. The farmer used his own labour and the hut took about three weeks to complete with little encouragement. He was clearly very interested in learning about poultry production and because there was no financial constraint, the work was soon finished.

After the day-old chicks were installed, visits to the village continued three times per week to monitor progress and to provide food and veterinary treatment.

The broilers were of a cross-bred variety and under ideal conditions should have reached market weight in about ten weeks. At thirteen weeks 50% of the birds in both villages weighed $3\frac{1}{2}$ pounds and could have been sold. Both farmers, however, delayed selling until mid-December when they predicted that demand would be higher.

The first production cycle, from the introduction of the day-old chicks on 31.7.76 to marketing in early December, lasted 18 weeks. Both farmers were encouraged to begin another production cycle financed by themselves from the profits of the first cycle and other farmers in these and other villages were brought into the programme. This work was continued by the Department of Agricultural Extension Services after the author left Nigeria. In the expanded programme, new farmers were to provide suitable accommodation and all running costs after the first month. The extension services were to provide day-old chicks (units of 100), food and veterinary treatment for the first month and technical assistance for the duration of the programme. In one village to be included in the expanded programme, two groups of eight farmers each asked to start group farms and were given assistance to begin intensive poultry production. the results from these units were not known at the time of writing.

b. Housing. The usual type of house found in Fashola consisted of a lean-to or free-standing chicken run (Fig. 10) constructed out of local materials such as bamboo slats, or if the farmer was reasonably wealthy, of chicken wire. Within this was placed a chicken coop or other small type of house. This offers minimal protection to the birds and allows contact with local fowl in the village. In the forest zone adequate protection from heavy rains must be provided. A simple house which fulfilled the basic requirements was designed by the author and variations of this are shown in Figs. 11 and 12.

The farmer in Jago decided that the house shown in Fig. 12 was the most suitable design for high intensity rainfall areas such as the forest zone. Figs. 13 and 14 show the house while under construction and finished. It had an area of 10 m^2 (2.8 x 3.6m) with 1.2 m mud walls surmounted by one metre of chicken wire. The roof was of corrugated iron sheeting and the inside walls and floor were concreted. The cost of construction was 88 Naira (1 Naira = £0.77 sterling). The building of such a house represents considerable initial expenditure for the farmer, but the cost can be discounted over the first few production cycles.

The low cost house in Badeku was constructed mainly from bamboo and palm thatch and is shown under construction in Fig. 15. It was 4.7 m^2 in area (1.8 x 2.6 m) with a raised floor 0.65 m from the ground. It could have been made entirely from bamboo and palm fronds, but the floor and walls were made more secure by a lining of chicken wire at a cost of five Naira. This house was build as an experiment in low cost housing. It was not adequate for day-old chicks as it did not provide the protection and warmth necessary in the early stages of growth. Such a house is, however, very suitable for older birds such as layers or broilers in the later growth stages.

Prior to installing the day-old chicks, the newly built house in Jago and the room which the farmer in Badeku was to use were disinfected, using a strong solution of household disinfectant, and a layer of litter (wood shavings) was placed in each. Artificial brooders such as shown in Fig. 16 can easily be constructed in the village, the size depending on the number of chicks to be raised. For heating the brooder, an electric lamp can be used if electricity is available, or a paraffin burner can be successfully used, as was the case in the present units. An area was partitioned off around the brooder so as to restrict the movement of the chicks and keep them near the source of heat. Success in the initial stages depends greatly on the efficiency of the brooders; growth is retarded if the temperature is not optimum.

Water containers were bought and food troughs were made in the village.

c. Nutrition. In the initial stages of the project, a feed mix* was bought from local dealers and was fed from day old to ten weeks of age. In the latter stages the farmers were encouraged to buy locally grown maize and to use this as a supplement to the purchased feed. This was suggested partly for experimental purposes and partly to ease the cost of buying feed. Maize alone is not sufficient for good growth, as was demonstrated by the Badeku unit in which maize and vitamin supplement were fed for weeks 11 and 12. No growth was recorded in this period and possibly the birds lost weight. Useful comparison of weights between Badeku and Jago at this stage was made impossible by the farmer in Badeku selling ten of his largest birds. The Badeku farmer then reverted to half maize and half concentrate feed. Tables 17 and 18 show the weights recorded at 8 and 15 weeks.

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* The exact composition of this feed was not known but the main constituents were maize, groundnut cake, fishmeal, vitamin additive, ground oyster shell and salt.

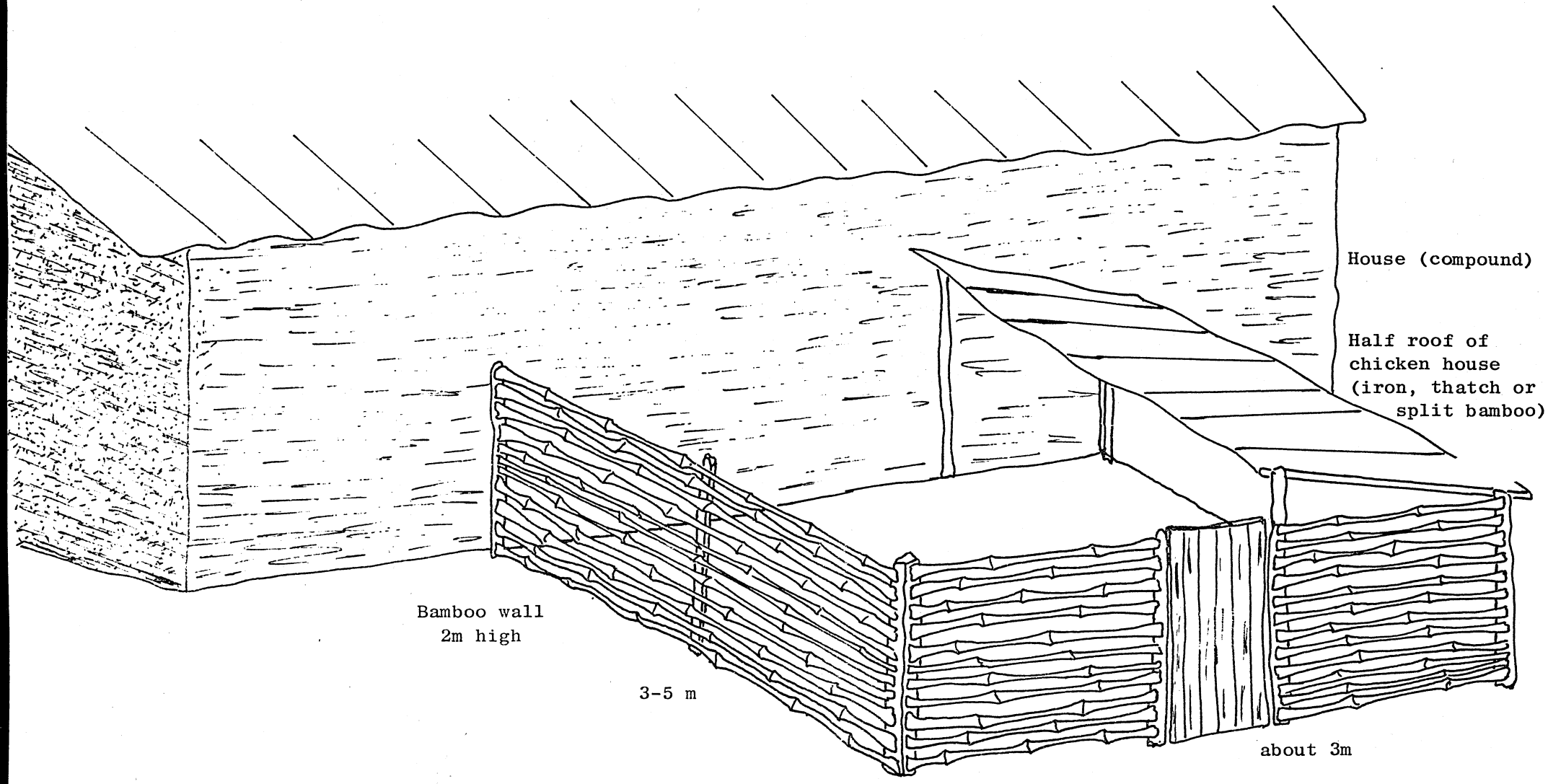


FIGURE 10. LOW COST POULTRY HOUSE I. (120 birds)

FIGURE 11. LOW COST POULTRY HOUSE II. (120 birds)

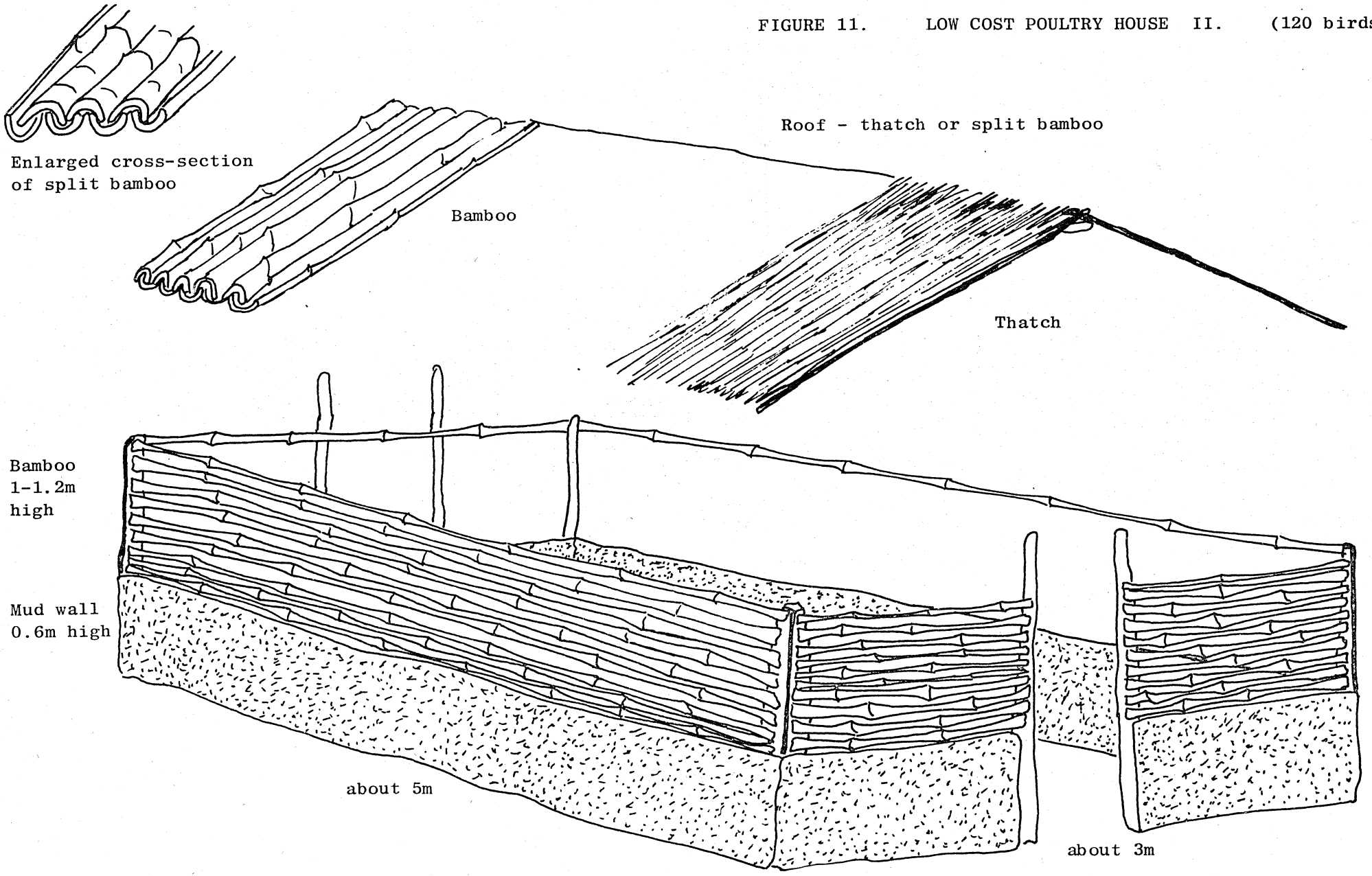


FIGURE 12. HIGH COST POULTRY HOUSE (120 birds)

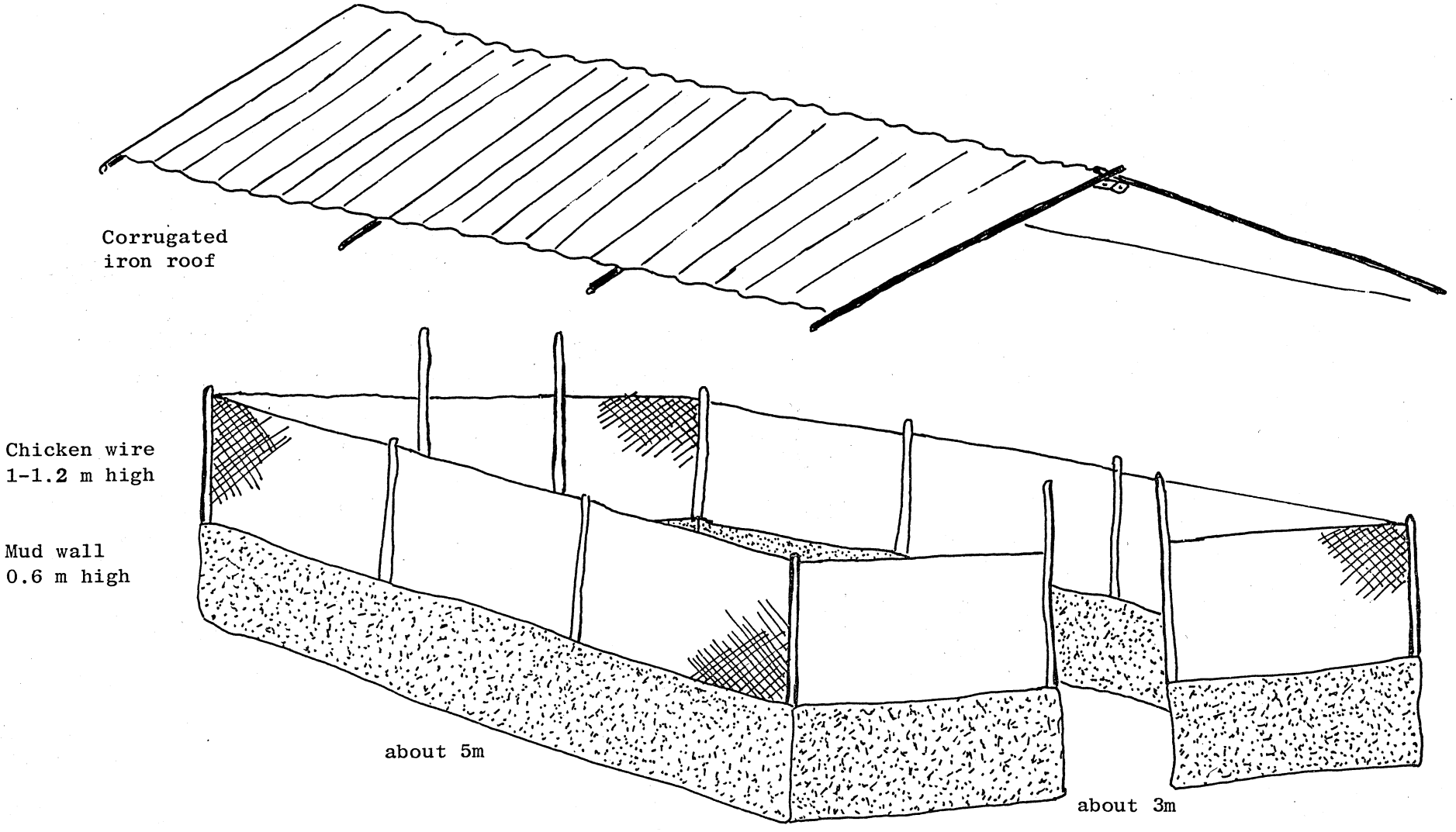


Figure 13. Poultry house under construction in Jago village

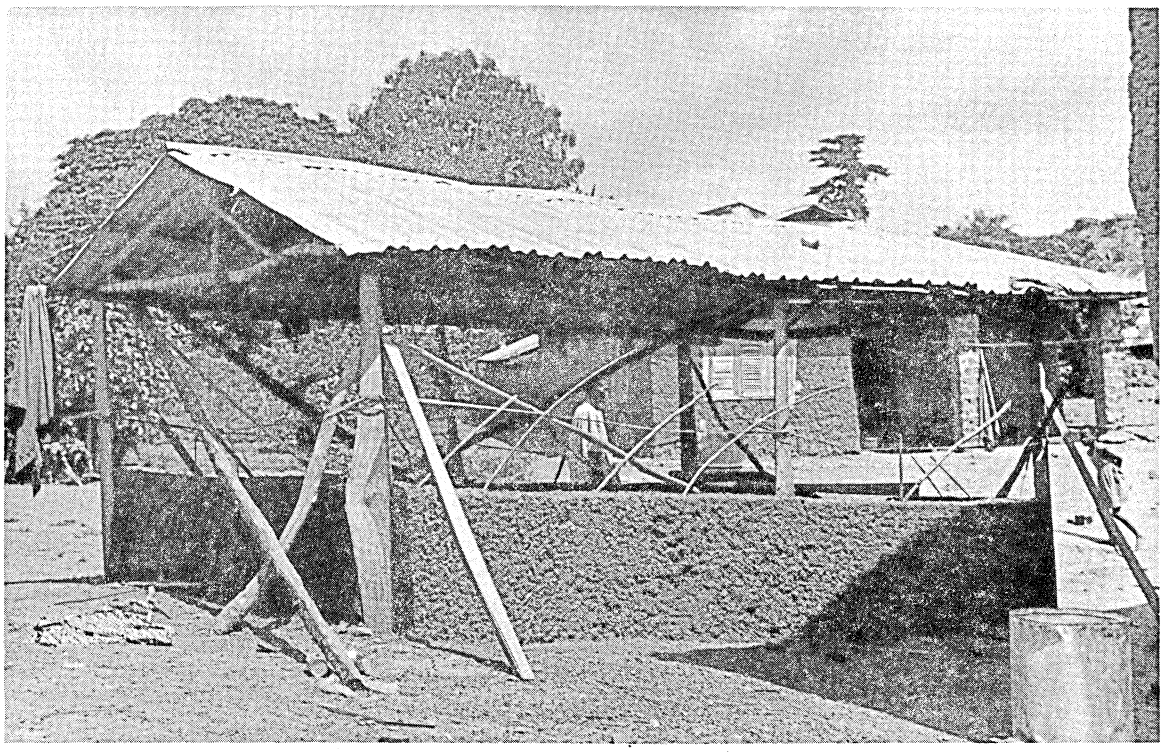


Figure 14. Completed poultry house in Jago village

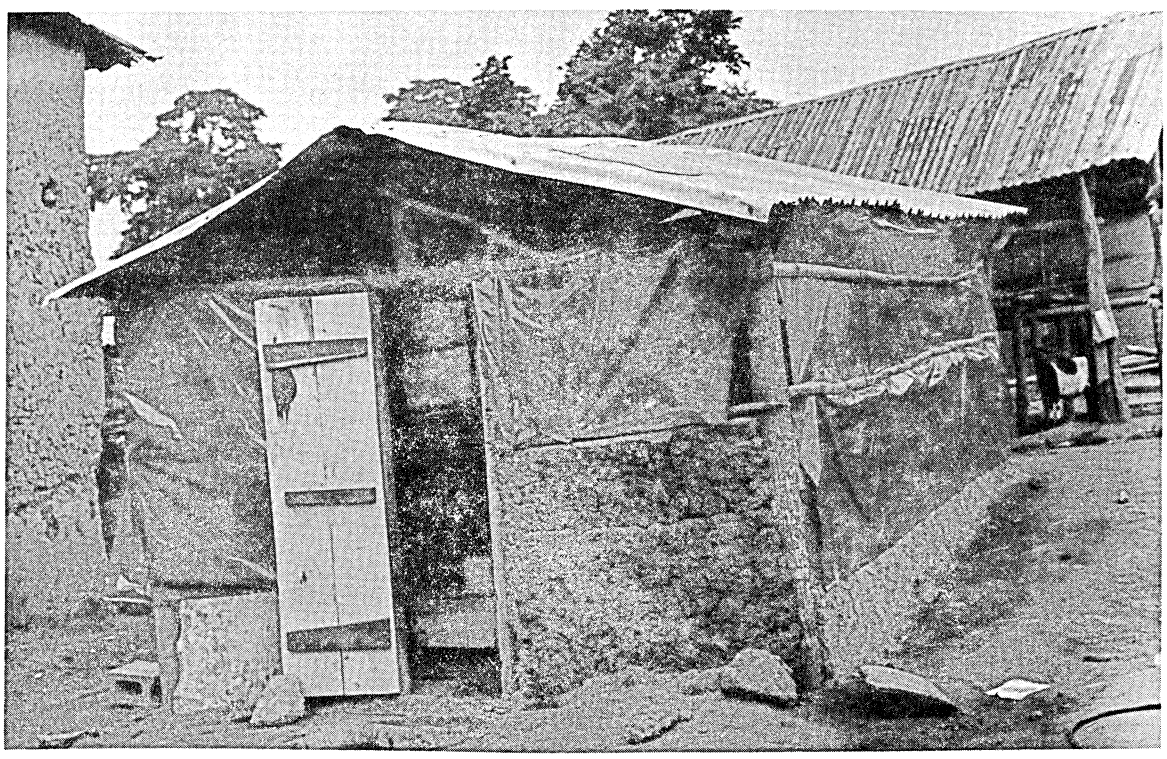
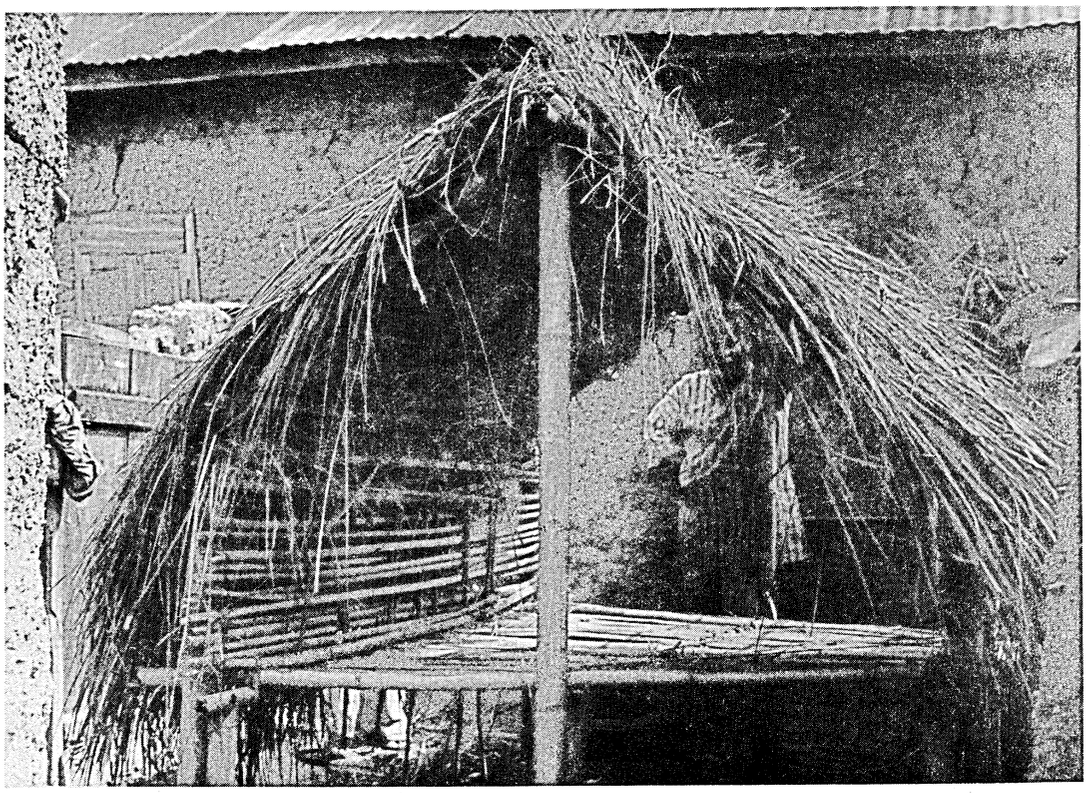
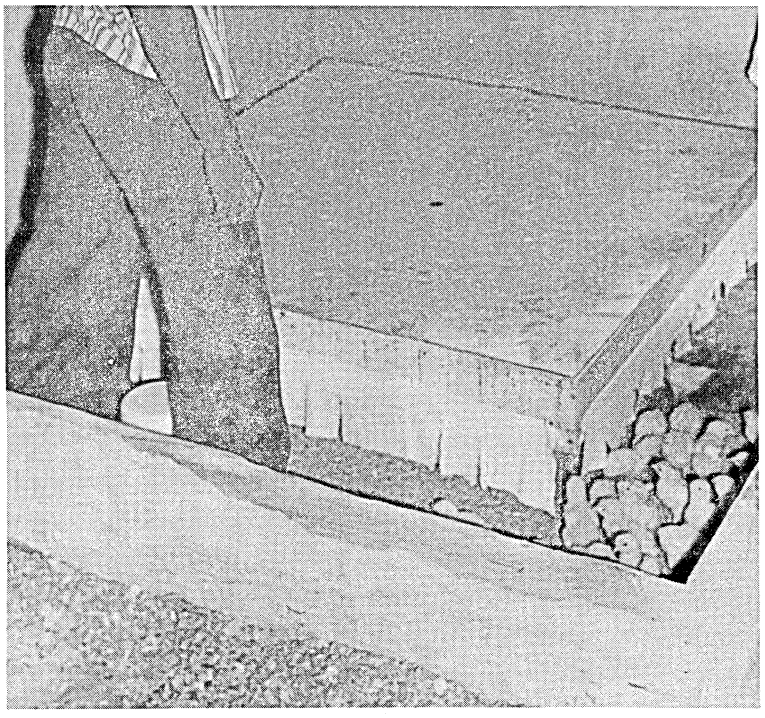


Figure 15. Low cost poultry house in Badeku village



This house was designed for older birds and had a wire floor to allow droppings to fall through. Such a house could be built by any farmer from local materials at no expense. It is not suitable for day-old chicks.

Figure 16. Brooder suitable for day-old chicks.



A paraffin burner is placed in the centre of the brooder underneath the hole, or an electric light bulb fitted through the hole. The latter is more efficient where electricity is available.

The difference in mean weights was thought to be due to the different housing conditions used. The Badeku house was probably warmer than the Jago house and was less draughty. The birds in the Badeku house had approximately twice as much space per bird (0.25 m^2) as those in Jago. Feather pecking was not noticed, but may have occurred in Jago where numbers were higher. All other factors were the same in both units.

TABLE 17. RECORDED WEIGHTS (g) OF BROILERS AT 59 DAYS OLD

	JAGO	BADEKU
	Random sample weighings of pairs of birds	Random sample weighings of pairs of birds
	625	1050
	800	1025
	950	1000
	575	1150
	675	1275
	825	1175
	1025	1200
	725	900
	525	450
	975	1100
Mean Weight per Chick :	385	516
	Individually selected large birds	Individually selected large birds
	550	650
	600	650
	525	675
	Individually selected small birds	Individually selected small birds
	225	300
	175	400
	200	150

TABLE 18: RECORDED WEIGHTS (g) OF BROILERS AT 109 DAYS OLD

JAGO		BADEKU	
Large birds	Small birds	All birds	
1300	875	1075	1300
1400	850	1175	1200
1300	1050	1200	1050
1375	750	1325	775
1300	800	1150	1100
1350	800	1550	1100
1650	750	1000	1175
1400	600	850	800
		1300	700
		1350	700
		1300	
Mean: 1097		Mean: 1007	

The Jago figures for week 15 are taken from a total of 70 birds (none of the original 80 had been sold and recorded mortality was 12.5%). The Badeku figures were taken from the 21 remaining birds from the original 40 after 10 had been sold* and 5 (12.5%) had died. Thus the data are not comparable. The mean weight in Jago was 1097 g and the mean in Badeku was 1007 g. It is assumed that had 10 of the largest birds not been sold in Badeku, the mean weight in Badeku would be higher than that of Jago at week 15. This would indicate the importance of heating in the early stages of growth and shows that birds did not recover from such a set back even at 14 weeks of age. It must also be noted that the Badeku birds were fed on maize alone for weeks 11 and 12 when no growth was recorded.

Feed sources for this project were mainly local dealers and the feeds were therefore expensive. More work is required to determine the possibility of producing poultry food in the village.

* Two of these were sold to the author at week 13 (87 days) and were an average weight of 1140 g. They were reared free-range on the University of Ibadan campus and at week 18 (125 days) these weighed an average of 1905 g, showing a weight increase of 765 g in 38 days.

d. Health. Vitamin and antibiotic (Terramycin) additives were provided for the first few weeks and no vitamin deficiencies were observed. A coccidiostat* was administered periodically, as was a proprietary anthelmintic.

The birds received intra-ocular Newcastle disease vaccination at the hatchery at one day old, fowl pox vaccine at 2 weeks and intra-muscular Newcastle disease vaccination at 6 weeks. Fowl typhoid vaccination at 12 weeks was also recommended. A Ministry veterinary assistant was brought from Ibadan to administer the last two of these vaccines. The veterinary assistant was taken to the village by the extension staff and had transport for veterinary staff not been provided, this service would not have been available.

Before the project commenced it was thought that disease might be one of the main limiting factors. This has been shown not to be the case in the first production cycle, but a build up of disease may occur with subsequent batches of chicks. There was no apparent spread of disease from local fowl in the village, but every care was taken to avoid contact between the improved birds and local fowl.

The mortality level at week 12 was 10% and the culling rate was 2.5%.

The dry season, between November and March, may prove to be better for broiler production due to the drier weather and higher temperatures. The nights, however, are colder than in the wet season and the sudden changes from humid to dry conditions caused by the Harmattan, can cause respiratory ailments in all livestock as well as man.

e. Economics. A simple summary of costs and profits is given in order to demonstrate the economic viability of village production. The cost of establishing the Jago poultry house is given below.

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* Amprolium (Trade name "Amprol")

TABLE 19. ECONOMIC ASSESSMENT OF THE POULTRY ENTERPRISE

		First cycle	Subsequent cycles
		Naira	
a) Cost of	wood	8-00	-
	nails	3-00	-
	roofing	25-75	-
	carpenter	4-00	-
	wire netting	10-50	-
	cement (2 bags)	8-80	-
	plastic sheeting	4-00	-
	labour	24-00	-
	Total a)	88-05	
b)	80 broiler chicks	32-00	32-00
	waterers	6-00	-
	burner	5-00 (estimate)	-
	food (1st 13 weeks)	96-00	96-00
	vitamin mix	3-00	3-00
	terramycin	3-00	3-00
	anthelmintic (5 cycles)	2-50	-
	coccidiostat (3 cycles)	7-00	-
	fowl pox vaccination	2-00	2-00
	Newcastle disease vaccination	3-00	3-00
	Total b)	157-50	139-00
	Grand Total :	245-55	139-00

At week 13 two of the larger birds, typical of 50% of the flock, were sold for 3 Naira each*. The remaining birds were estimated to be worth 2-50 Naira each. As previously explained, the farmers did not sell their birds until December and the above economic assessment is calculated from the costs and estimated sale prices at week 13.

Profit from sales

35 birds @ 3-00	105-00	
35 birds @ 2-50	87-50	
Total	192-50	
Cost per cycle		139-00
Net profits/cycle	53-00 Naira	

Labour costs were not taken into account, except for constructing the house, because it was provided by the family and was considered to have no opportunity cost.

f. Marketing. Ideally poultry raised intensively in the villages should be marketed locally so that the rural population benefits nutritionally and financially from this production. The farmers were confident that they could sell the poultry raised in the present project, although anticipated markets included traders who supply Ibadan and other large towns.

There is a strict seasonality of demand for poultry and other livestock, related to the timing of religious festivals. In December there is a high demand due to the Moslem and Christian festivals held in that month. At other times in the year, demand is mainly for family ceremonies. Thus it would appear that social customs do not favour village marketing of large numbers of poultry throughout the year. In this respect the situation is analagous to that of turkeys in Great Britain. However, increased standards of living may increase general consumption.

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* It was difficult to determine the exact price for which these birds were sold. The information was given by the farmer's wife after 10 minutes of persuasion. It is considered to be either accurate or an underestimate, as she may have thought that the University wanted a share of the profits. In Ibadan, 3.5 lb chickens were selling for N 3-50 at that time.

In this project the villagers were informed that chickens would be available for sale and they were encouraged to buy in the village rather than elsewhere. Birds are sold by appearance rather than weight, particularly improved and exotic birds (especially Rhode Island Red). The weight of the bird in the hand is also, of course, important in assessing value. Much bargaining takes place and it is difficult to determine the criteria for sale.

One farmer recounted how his wife had taken some chickens to the local market when demand was low and had tried on two consecutive occasions to sell them. She was unsuccessful because at that time of year the price had fallen. He also remarked that people consider that chickens sold at times of low demand are either ill or of poor quality and they will not pay a high price because of this. These problems are magnified for farmers with intensive units who have large numbers of birds to sell at one time.

New channels for marketing, therefore, require investigation. To foster village consumption chickens could be butchered, dressed and sold locally in quarters or halves, appealing to women who normally buy fish or meat from butchers. Chicken, however, would probably be more expensive than the present sources of animal protein consumed day by day in the villages.

The development of an efficient larger scale marketing system could act as an incentive to increase livestock production. In Great Britain, agricultural development in the eighteenth and nineteenth centuries was stimulated by the marketing systems which grew up at that time. Such a system is essential in order to transfer agricultural produce from farm to consumer. With a secure market at fixed prices any time of the year, the farmer will be encouraged to produce more. Linked to this, however, there will be a need to determine the optimum sizes and numbers of intensive units which can be established so as to meet demand without over-production.

Small Herbivore Production

In the villages studied, a small number of farmers kept either rabbits or guinea pigs. Neither of these were kept on a large scale and it was therefore decided to investigate the possibilities of small herbivore production at the village level.

No active extension work has been carried out with guinea pigs in the study, but the methods of production used in the villages will be described. Domestic rabbits were introduced to two farmers in the villages in order to investigate the problems associated with rabbit production and this will be described. Similarly, other extension work involving the African giant rat has also been undertaken.

a. Rabbit Production. Rabbits are the most usual form of small herbivore considered as having potential for large scale meat production for human consumption. They are prolific, quick growing and produce a suitable carcass of 1.5 - 2.0 kg at about four months of age. Due to their vegetarian diet it is considered that they are suitable animals to compete with poultry at the village level. A major disadvantage is that rabbits cannot be reared extensively as can poultry. Food must be provided by the farmer thus requiring more time and attention than extensive chicken production. The food can be collected vegetation, household vegetable scraps or commercially prepared pellets.

New Zealand White rabbits were supplied to one farmer in both Jago and Badeku. In Jago another farmer immediately bought a pair of rabbits and built a cage similar to the one built for the original farmer. The aim of these introductions was to determine problems arising in rabbit production and to demonstrate the methods of rabbit husbandry to farmers.

A simple hutch was designed which combined utility with cheapness. It was made as large as possible and bamboo or wire-netting used for the sides. Although netting was comparatively expensive, it had to be used for the floor, because it proved to be the only suitable material. A wire bottom provided protection from dogs and also allowed droppings to fall through.

The cage built initially in Jago was similar to the one illustrated in Fig. 17 but, at an early stage after introduction, two rabbits were killed by dogs which broke into the cages by breaking through the bamboo. The farmer then modified the cage as shown in Fig. 18.

Young rabbits can be kept in a cage which allows them to feed on vegetation through the wire-netting floor of the run. Fig. 19 shows an example of this type of cage.

Figure 17. Rabbit hutches suitable for village production.

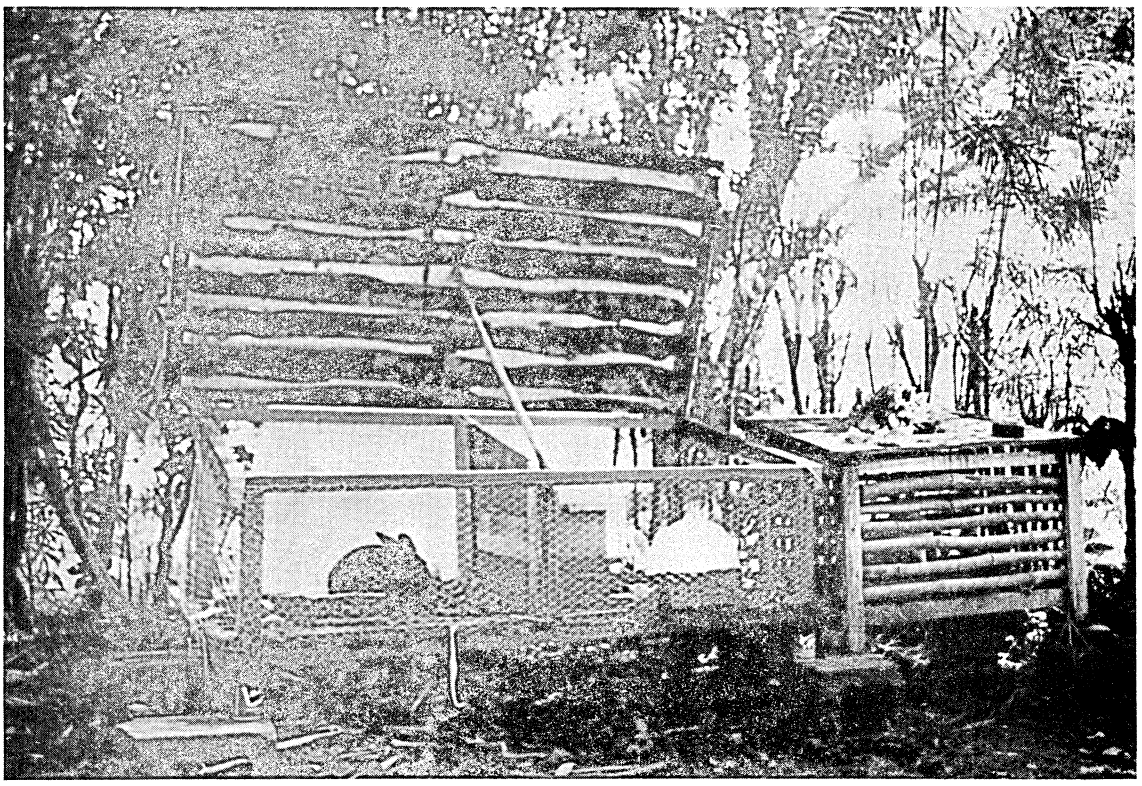


Figure 18. Improved rabbit hutch in Jago village

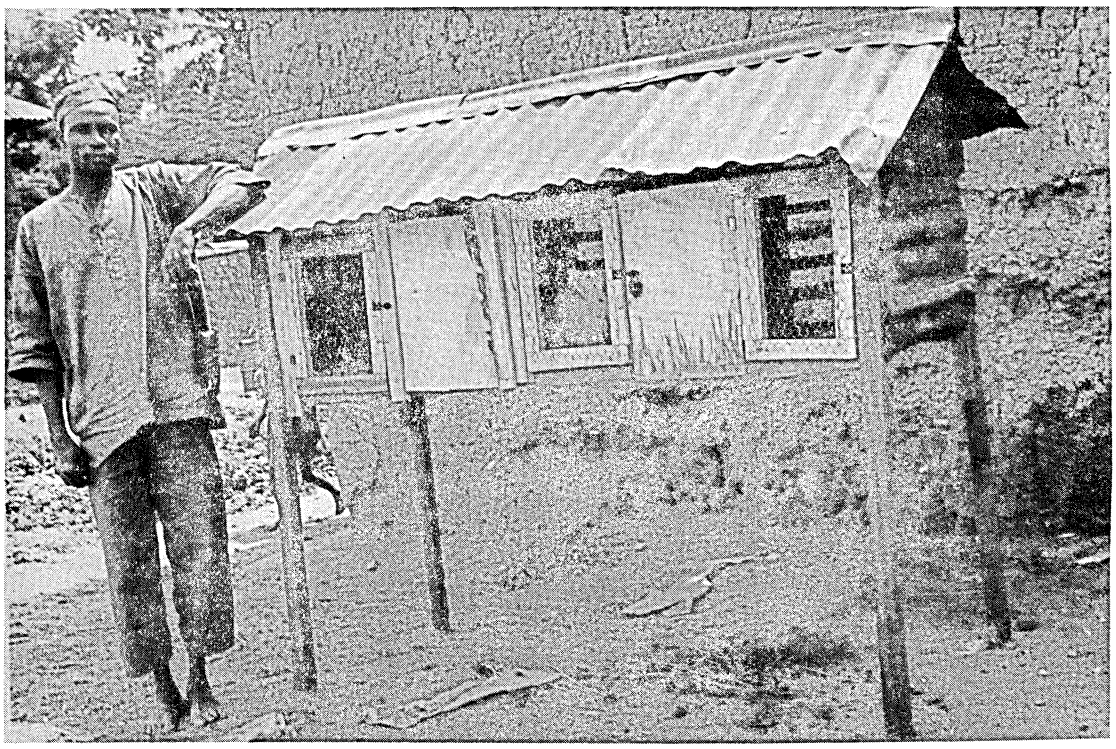
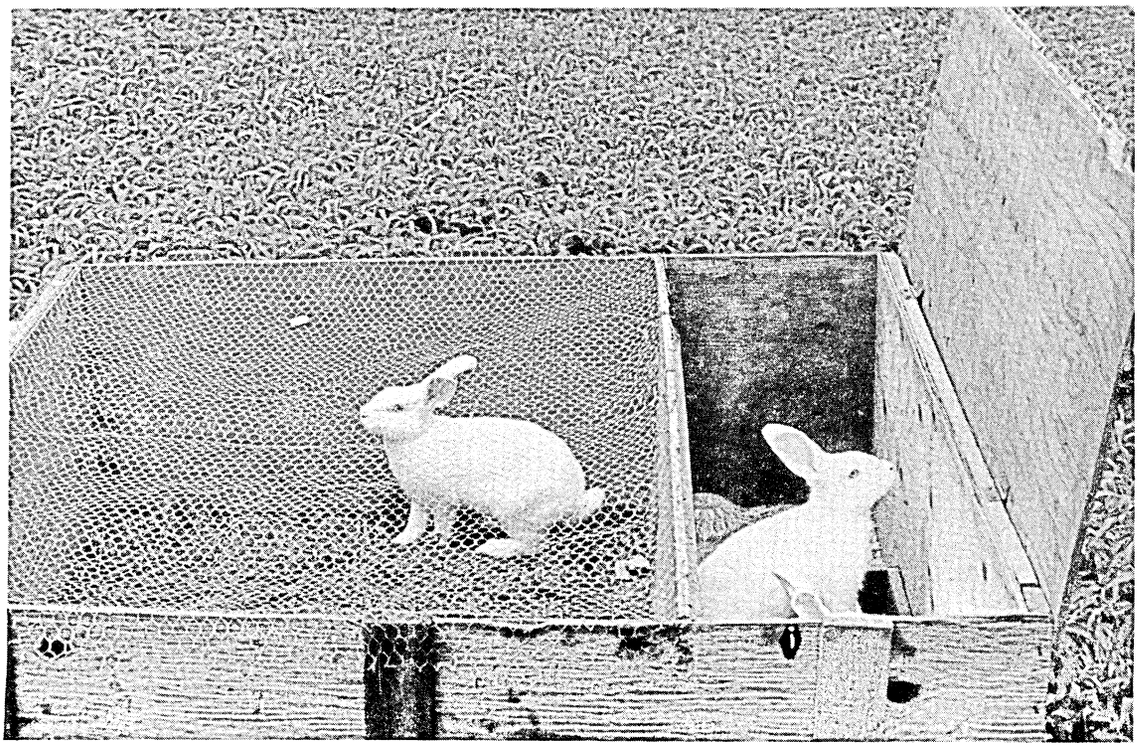


Figure 19. Rabbit hutch suitable for young rabbits.



It was the intention to ascertain whether rabbits could be raised on naturally occurring vegetation in the villages. This was advocated to the farmers as a cheap method of feeding and no concentrate was given in the initial period. During the wet season, natural vegetation is abundant and adequate for rabbits. In the dry season, however, it was found that vegetation of an adequate nature was not available in large enough quantities. About half an hour a day was required for food collection and this task was performed by either the farmers or their children. Local foods which could be used included banana leaves, various herbs and grasses, palm kernal, maize and maize offal.

Serious feeding problems arose on two occasions. One of the farmers give his rabbits cassava sliced with peel in the manner in which it is fed to goats and sheep. This caused the death of the male within a few days and the female a few weeks later. Post mortem showed characteristics of bloat and pulmonary compression, which combined with poisoning, caused death.

The female at the time of death was suckling six young (three weeks old) which eventually also died. This farmer later replaced his rabbits. The second food problem occurred during the middle of the wet season when it was particularly cold and damp. Natural vegetation was being provided, but was very wet due to rain. All the rabbits suffered from digestive disorders which led to the loss of some of the young at 3-4 weeks old. The combination of cold, damp conditions and inadequate nutrition were considered to be the cause of ill-health and mortality. While climatic problems are largely unavoidable, it is considered that they would be less damaging if the nutrition were adequate. This would suggest that some pelleted concentrate should be fed or at least kept in reserve for periods of nutritional stress. When food is scarce in the dry season, the provision of pellets may be the only solution, but such feed is expensive and could remove the incentive to keep rabbits as a cheap source of meat.

Two of the farmers kept their rabbits in an 'outhouse' which proved very beneficial with regard to damp, draughts and protection from predators such as dogs.

On a natural vegetation diet growth rates appear to be satisfactory when adequate food is available. Pregnant does usually increased in weight by one pound or more and on kindling were able to maintain an adequate milk supply for their young. The young increased in weight after removal from the doe at eight weeks and were ready for slaughter at 12-14 weeks (weighing 2kg). Males on a similar natural diet usually ate to maintenance and neither gained nor lost weight over periods of 3-4 months or more.

It is difficult to give accurate figures for the maximum reproductive capacity of rabbits at the village level. From a total of five kindlings during the study period, 33 young were born. The maximum produced in one litter was 11 young. If young rabbits died when still in the care of the mother, it was considered that this was due to faulty management; all evidence suggests that female rabbits are excellent mothers and will raise up to ten young without difficulty. It is considered better for a farmer to have two or more females rather than one in order to off-set the cost of keeping a male. The sharing of male animals between various owners would have some advantages but should be avoided in longer term plans.

Rabbits are prone to various ailments. When they are healthy they are easy animals to rear; once they become ill, however, mortality rates can be high. The main cause of concern in the present work was from rabbit coccidiosis which caused the death of two rabbits. This could be prevented by the administration of a prophylactic drug about once a month. Nutrition plays an important role in good health and poor nutrition seemed to be a prime factor predisposing to disease and mortality. Ear infections, digestive disorders and viral infections could also arise. In fact rabbits seemed to have little resistance to disease and preventive measures would have to be a key part of a larger programme.

The main points which have been brought out by the present study are:

(i) hutches must be strong and protected from wind and rain; ideally they should be raised 3-4 feet from the ground for protection against dogs, or situated where dogs and other predators do not have access; cages should be large and allow 0.5 m^2 per animal.

(ii) nutrition is an essential part of management and some form of supplementary feed should always be available; poor nutrition is considered to be the main pre-disposing factor to ill-health;

(iii) prophylactic treatment should be given for coccidiosis; the normal coccidiostat sold for chickens is acceptable for rabbits.

There may be other problems but the points mentioned above have proved to be the main causes of concern in the present study. Housing and feeding are the two major costs involved and some initial financial input is necessary in promoting rabbit production. Children could have a part to play in collecting food and general care of rabbits.

Rabbit production has a great potential at the village level and could compete with poultry production for efficiency.

In an extension programme, regular assistance must be given to farmers until management methods are understood. If a few farmers are successful, however, there is every reason to believe that many other farmers would take up production.

b. The African Giant Rat. A parallel extension programme to that for rabbits was also carried out with the intention of introducing domesticated African giant rats to a selected group of farmers in Jago village. Giant rats are commonly eaten when caught in the forests.

Figure 20. The African giant rat (Crycetomys gambianus)

It appears, however, that no previous extension work has been carried out with this species in Nigeria. The aims of the introductory programme were to assess farmers' reactions to the animal as a potential domestic meat source, to demonstrate rearing methods and to assess productivity under village conditions. As the giant rat is well known, it was thought that it might be more acceptable to local farmers in the long run than domestic rabbits or guinea pigs.

The project was discussed with three farmers in Jago and it was arranged that they should visit the Livestock Domestication Unit of the Department of Forest Resources Management of the University of Ibadan.

They were shown breeding pairs of rats, suitable cages and feeding methods. The farmers were impressed and requested that one of the cages be taken to Jago for the village carpenter to copy. He made three cages which were almost exact replicas of the original (Fig. 21). The cages were double, with a dark compartment and a light compartment of wire netting. The netting used was found to be too thin since two rats escaped by gnawing. The cages were then reinforced with metal sheeting.

A pair of 14 week old rats was given to each farmer. The food used in the Forestry Department was poultry finisher ration with added green vegetation. This was not recommended to farmers because of the cost and they were asked to experiment with various local foods. They used similar food-stuffs to those fed to guinea pigs, including green vegetation, palm kernels, maize and cooked cassava, on which they appeared to thrive.

Figure 21. Cage built in the village for bush rats.

The rats were introduced on 12 July 1976 at 14 weeks old. Females mature at 24 weeks and are capable of conception; males seem to mature a little later. The gestation priod is probably about five weeks. Thus the

pairs in Jago should have given birth at an age of 33 weeks (implying male maturity at 28 weeks). Unfortunately, the author left before results could be obtained. At the time of writing, the rats were 34 weeks old and had not yet reproduced. No definite conclusions could be drawn regarding productivity under village conditions, but this work is continuing in the Department of Agricultural Extension Services/Forest Resource Management of the University of Ibadan.

c. The Cane Rat. Another rodent is also noted for its potential as a domestic meat source (Fig. 22). This is the cane rat (Thryonomys swinderianus) known locally as the 'cutting grass' because of its habit of severing the stalk of larger grasses, including maize and other related crops, to which they can cause considerable damage. A domestication programme has begun in the Department of Forest Resources Management and farmers in Jago were asked if they could trap this animal. They were provided with traps but no animals were caught. One farmer, however, managed to catch a female with a wire snare and this was sold to the University. Fig. 23 shows the farmer displaying his snare and cane rat.

Figure 22. The cane rat (Thryonomys swinderianus)

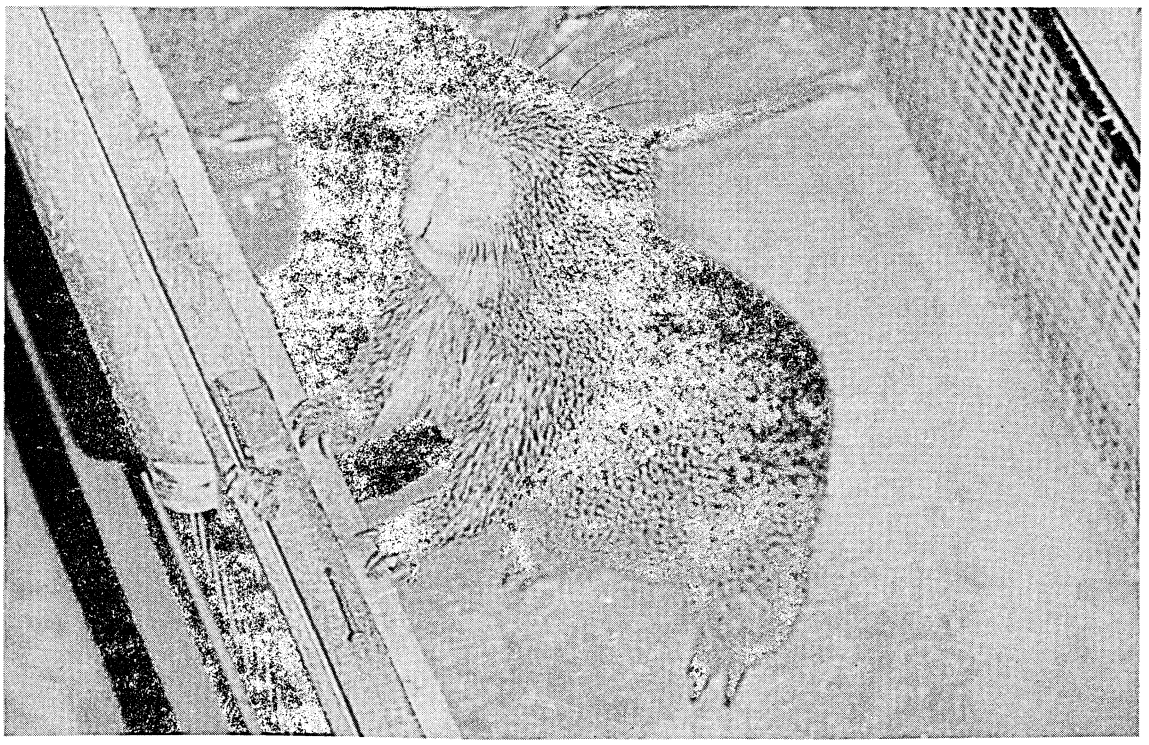


Figure 23. Farmer with cane rat caught in Jago village.

d. Guinea Pigs. Table 8 shows that approximately 10% of households in Jago owned guinea pigs. From discussion with the farmers, it was deduced that all the animals in the village originated from a single introduction by one farmer some years previously.

In some villages cages are provided, but in Jago the animals are allowed to live freely in the main part of the compound where they may be provided with a corner for nesting. They never leave the compound or escape and in this respect are ideally suited to village rearing. This method of production would be more difficult for rabbits which are more active and would be impossible for bush rats which require strong cages to retain them.

In the villages they are fed scraps, green vegetation such as banana leaves, elephant grass and possibly a little maize, cassava or palm kernel. There appeared to be no need to buy special food for guinea pigs.

In quantity, production is low under the present conditions, but inputs are small and the profits in terms of edible protein are, therefore, high. The ease and low cost of production of guinea pigs is an attractive feature to village farmers. Owners report that they kept the animals for eating and that they kill 2 or 3 whenever they have a special guest in the household.

It could be argued that keeping animals freely in the main living quarters of the house is unhygienic and is a hazard to human health. If this were the case, the animals could be caged quite easily; any simple form of box cage would be suitable and would not have to be strong. Alternatively, a mud walled house about 1 metre square with a wood or tin roof, either inside or outside the main living quarter would be equally acceptable.

The success of the present, naturally adopted system of guinea pig rearing is encouraging and it would appear that these animals have great potential as an alternative source of animal protein at the village level. An extension programme aimed at expanding production in these areas would be appropriate.

The relative values of these small herbivore species as sources of meat will be discussed further in Chapter 5, together with an assessment of their potential in comparison with larger farm animals.

CHAPTER FOUR

THE POTENTIAL FOR INTENSIVE GOAT AND SHEEP PRODUCTION AT THE VILLAGE LEVEL IN S.W. NIGERIA

Traditional goat and sheep production is based on an extensive system of free-range foraging and scavenging. Although the level of production is lower than could be obtained under intensive conditions, the efficiency of production is high in terms of returns per unit of input.

Intensification of production would involve a change to a system based on high inputs of time, labour and capital and would require a re-orientation of ideas towards livestock. They would have to become 'active' earners of income, replacing other enterprises in the agricultural system, rather than being 'passive' earners which convert waste or marginal materials into food or saleable products for human consumption.

Increased benefits from improvement must be estimated and evaluated against the increased costs of inputs required. In forest zones, it must be determined whether optimum land usage can best be realised by cocoa production, timber or other forest production, arable crop production, livestock production or combinations of these.

The following sections include an assessment of the potential pasture species suitable for grazing animals and for the climatic and edaphic conditions of the areas. An outline of a suitable production system and appropriate pasture management practices are then suggested as a basis for estimating the initial costs of establishing such a system.

Improved Pasture Production

In Nigeria since 1960, considerable attention has been directed towards the introduction, evaluation and management of improved pasture species (Adegbola et al., 1968). The main grassland areas in Nigeria are situated in the grass savanna regions (the Southern Guinea, Northern Guinea, Sudan and Sahel savannas - Map 1) and it is here that most attention has been

focused on improvement. In recent years more work has been carried out in the derived savanna and lowland forest zones, particularly at the Fashola Livestock Farm, the Universities of Ibadan and Ife and at Moor Plantation, Ibadan and is more relevant to the present study. It has been noted (Adegbola et al., 1968), however, that although the work which has been carried out to date has been of considerable importance to the knowledge of improved pasture species and their value as livestock feeds, the problems and expense of land preparation, procurement of planting materials and establishment and management of pastures make the results of such experimental work of limited applicability to the traditional livestock systems. These authors also consider that it would be unrealistic to replace much of the natural grassland with improved plant species due to the high capital expenditure required. They conclude that improved pastures in Nigeria should serve a supplementary role, for provision of night grazing and dry season feed as silage or hay, and so enhance the utilisation of natural grasslands.

Work on the genetic improvement of suitable grasses in West Africa has been confined mainly to Pennisetum purpureum (Elephant grass), Panicum maximum (Guinea grass), Cynodon and Andropogon spp. (Crowder and Chheda, 1973). In western Nigeria Digitaria decumbens (Pangola grass) and Melinis minutiflora (Molasses grass) are included with these for development (Adegbola, 1964). The following species were listed by McIlroy (1962) as showing wide ecological adaptation to the soil and climatic conditions of the derived savanna and forest regions of western Nigeria.

Lowland Forest	Derived Savanna
Cynodon plectostachyus (Giant Star Grass)*	C.plectostachyus
Andropogon tectorum (Southern Gamba grass)	Agayanus (Northern Gamba grass)
P.maximum	P.maximum
P.purpureum	P.purpureum
D.decumbens	M.minutiflora
Brachiaria mutica	
Axonopus compressus	

* C.plectostachyus is an erroneous name for C.nlemfuensis var.nlemfuensis; Chheda (1974) notes "C.nlemfuensis var.nlemfuensis (is) commonly but erroneously referred to in the literature as C.plectostachyus or Star Grass".

At the Fashola Livestock Farm (derived savanna), A. gayanus and P. maximum have proved to be both productive and palatable, but do not withstand heavy grazing. Similarly P. purpureum is grazed readily and C. plectostachyus forms a dense sward and does withstand heavy grazing (McIlroy, 1962).

A collection of 21 P. purpureum varieties from southern Nigeria has been evaluated at Ibadan and showed a wide range of variation in dry matter (DM) yields (8-12 t/ha annum) under low fertility conditions, and crude protein (CP) from 10-17% (Chheda et al., 1973). On the basis of this work two selections yielding 20 t DM/ha annum of above average nutritive value when cut at 5 week intervals and adequately fertilised have been recommended for cultivation.

Cynodon investigations using over 200 collections belonging to eight species at the University of Ibadan have revealed an enormous reservoir of genetic variability (Chheda, 1971). In the lowland humid tropical environment of Ibadan, Cynodon dactylon vars. coursii and elegans, C. aethiopicus and C. nlemfuensis vars. robustus and nlemfuensis show a high degree of pasture potential with several ecotypes yielding over 15 t DM/ha annum (Chheda, 1974). C. dactylon introductions, though high yielding in the year of establishment show poor persistence and recovery when cut regularly. This grass species has, however, proved to be a highly nutritious pasture grass in many tropical and sub-tropical areas (Okigbo and Chheda, 1966), and information relating to these rhizomatous varieties is extensive. Information is meagre, however, regarding the agronomy and management aspects of the less profusely tillering, robust, tall and non-rhizomatous East African species of Cynodon suitable for tropical pastures.

In 1968 Cynodon strain IB8 (Ibadan 8) was released for general cultivation. This is a selection of C. nlemfuensis var. nlemfuensis collected from Lake Manyara in Tanzania. It is easy to establish vegetatively, is drought tolerant, is greatly superior to existing Cynodon cultivars in productivity and responds well to increased fertiliser application and improved management conditions. Cynodon IB8 can be grown on soils ranging from loamy sand to almost gravel and varying in pH from 4-7; areas with well distributed rainfall of 880 mm or more per annum are ideally suited to Cynodon pastures (Chheda, 1974). With adequate fertilisation (82-110 kg/ha) and good management in the Ibadan area, DM yields of 15-20 t/ha annum are common compared with yields of 3-4 t/ha annum for local Cynodon cultivars.

C. nlemfuensis has been used extensively in the derived savanna where it forms good associations with legumes such as Centrosema pubescens. It has been tried with P. maximum at Fashola where it tended to suppress the profuse tillering of the grass and it provided a good soil covering around the bunches of grass (Ademosun, 1974).

Pasture legumes have received relatively less attention than have grasses and work on the genetic improvement of legumes was not carried out in Nigeria prior to 1973 (Crowder and Chheda, 1973). Work at Moor Plantation (Ibadan) in 1960 showed that four pasture legumes, Centrosema pubescens (Centro), Stylosanthes gracilis (Stylo), Pueraria phaseoloides and Calipogonium mucunoides, are all well adapted to the ecological conditions of western Nigeria (Ahlgren, 1959; Hedrick, 1961; McIlroy, 1962; Adegbola, 1964).

Legumes are useful both as livestock feeds and as soil nitrogen regenerators. Major factors for consideration in the choice of legume species are ability to fix nitrogen in the soil, palatability, productivity, combining ability, persistence in a mixture and ease of eradication in a rotation. Most of the important pasture legumes are of South American origin, whereas most of the potentially useful grass species are of tropical African origin. It was noted by Adegbola and Onayinka (1966a) that strains of Rhizobium present in tropical soils are largely ineffective and that effective strains still have to be isolated.

At Ibadan, short growing grass-legume mixtures (i.e. Cynodon and Centro or Stylo) have provided about 15 t DM/ha annum as compared with about 25 t DM/ha annum for tall growing grasses in legume mixtures (i.e. P. purpureum and/or P. maximum and Centro or Stylo) (Olubajo and Oyenuga, 1971). On the University Farm, Ibadan, it is the present practice to raise goats and sheep on Cynodon-Centrosema pasture which is grazed and also cut for stall feeding.

Results of pasture legume experiments in Nigeria have shown the superiority of S. gracilis over the three other mentioned legumes in terms of dry season productivity (Adegbola, 1964) and this legume is therefore one of the few that can be used as a dry season feed in southern Nigeria (Hendrick, 1961). S. gracilis can be grown as a pure stand or in a mixture with grasses such as Cynodon species, A. gayanus, M. minutiflora etc., but results have shown that S. gracilis is less palatable than C. pubescens in

grass-legume mixtures (Adegbola, 1964). When grown with any of the taller grasses, Stylo can be used for silage or harvested for hay (Adegbola, 1965) and it therefore has the potential for providing an all season feed for ruminants (Ademosun, 1970b).

At Ibadan in 1959 a sown pasture of C. nlemfuensis var. robusta and C. pubescens was generally superior in productivity and digestibility to four other mixtures of Cynodon nlemfuensis, Centrosema pubescens, D. decumbens, Chloris gayana (Rhodes grass) and S. gracilis (Olubajo, 1974). This pasture yielded 30.4 t DM/ha annum between 1959 and 1962 and 40.0 t DM/ha annum from 1963 to 1967, when rotationally grazed at various stocking rates. There was a general increase in Cynodon in all plots. Chloris gayana was virtually eliminated after the third round of grazing. At the end of the second year of grazing very little D. decumbens remained and the pasture had reverted to a Cynodon/Centrosema dominant sward, but a return of Digitaria was observed at the end of the third year. This grass appears to require higher rainfall than is normal for Ibadan. Analysis in the dry season (March, 1962) showed only 15% legume; it would appear necessary to re-sow legumes in the early rainy season of each year in order to maintain a desirable proportion of about 40% legume in the sward.

DM percentages of most grasses in West Africa do not vary widely up to 6-8 weeks of growth, particularly during the early wet season, and range from 15-20% for tall growing fodder grasses such as elephant grass and guinea grass and 25-30% for pasture species such as star grass (Crowder and Chheda,1973). The following list (Table 20) of DM production for selected unfertilised grass and legume species at Agege, western Nigeria and for unfertilised grass-legume mixtures at Moor Plantation, Ibadan is given by Adegbola (1964).

Crude protein (CP) content of grasses in West Africa is medium to low. Under natural fertility conditions and up to 3-4 weeks of growth after the onset of the rains, CP content varies between 7 and 13% of DM in different grass species. After 3 to 5 months, CP often drops below 4% and in the later stages of the dry season CP levels of 1-2% have been recorded. Miller and Blair Rains (1963) recorded a CP level of 14.4% for Cynodon dactylon cut close and leafy, 7.8% for P. maximum on high fertility soil and 20.0%, 18.4% and 16.0% for three samples of P. purpureum on high fertility plots. Values of two samples of 'bush grass', five samples of A. gayanus, two samples of C. gayana and one sample each of Brachiaria brizantha and Hyparrhenia rufa and two samples of Pennisetum pedicellatum gave CP levels between 3.8 and 7.6%.

TABLE 20. DRY MATTER PRODUCTION OF UNSELECTED GRASS AND LEGUME SPECIES AND GRASS/LEGUME MIXTURES (Adapted from Adegbola, 1964).

	Dry matter production (t/ha)	
	1959-60	1960-61
Andropogon gayanus (northern gamba grass)	14.48	17.74
Pennisetum purpureum (elephant grass)	20.61	8.35
Panicum maximum (guinea grass)	5.56	6.65
Cynodon dactylon (giant star grass)	6.15	3.76
Digitaria decumbens (pangola grass)	4.67	3.41
Melinis minutiflora (molasses grass)	6.30	4.30
Stylosanthes gracilis (stylo)	9.91	5.98
Centrosema pubescens (centro)	4.30	3.93
Pueraria phaseoloides	5.56	5.41
Calopogonium mucunoides	2.64	4.13
A. gayanus + C. pubescens	8.70	19.84
D. decumbens + C. pubescens	4.45	17.10
M. minutiflora + C. pubescens	4.84	14.1
P. maximum + C. pubescens	6.20	19.6
C. dactylon + C. pubescens	5.11	19.27
P. purpureum + C. pubescens	13.29	34.79
P. purpureum + P. phaseoloides	11.84	33.36
M. minutiflora + S. gracilis	7.24	19.77
A. gayanus + S. gracilis	9.36	25.08
D. decumbens + S. gracilis	6.20	15.47

It will be noted that yields in the second year increase substantially in grass/legume mixtures.

The chemical composition of a C. plectostachyus-C. pubescens pasture as determined by Olubajo and Oyenuga (1971) was as given in Table 21.

TABLE 21. CHEMICAL COMPOSITION OF A CYNODON PLECTOSTACHYUS and CENTROSEMA PUBESCENS MIXED SWARD

	DM % at harvest	OM %	CP %	CF %	EE %	Total ash %	NFE %
1965-66	32.0	83.9	11.9	34.5	1.2	8.6	43.8
1966-67	32.1	82.4	12.4	36.8	1.2	9.0	40.7

Thus, it would appear that the grasses most suited to the southern climatic conditions and most able to provide good pasture are Cynodon spp., Pennisetum spp. and Panicum maximum. Andropogon spp., although palatable, do not withstand heavy grazing. These grasses can be grown as mixed pastures with legumes such as Stylosanthes gracilis or Centrosema pubescens which are palatable and enhance the nitrogen status of the sward.

Pasture Management

With adequate fertilisation, yields can be considerably increased. Adegbola et al., (1968) recommended a level of 100 kg N/ha for natural grassland (predominantly A. gayanus) in the derived savanna zone and obtained more than 100% increase over unfertilised plots.

Oyenuga and Hill (1966) studied a pasture comprising Cynodon plectostachyus, sown by root cuttings at 90 kg/ha, Chloris gayana (6 kg seed/ha), Centrosema pubescens (8 kg seed/ha), S. gracilis (16 kg seed/ha) and Oryza sativa (Upland rice sown at 40 kg/ha) sown as a companion crop to prevent soil erosion before the sward became established. The addition of magnesium, all the trace elements and 500 kg superphosphate/ha resulted in an increase of 55% in DM yield over untreated control plots. Treatments had little effect on CP (as % of DM) with a mean of 17.18% for all treatments. This is reasonably high, due most probably to the influence of the legume species. Thus CP was only increased as a result of increased DM production. Treatments had 60% more protein than unfertilised plots (i.e. 55% more DM).

Fodder and forage crops can usually be established without fertilizers, but continuous cropping and removal of residues reduces soil fertility. Applied phosphate and potash are required for grass and legumes and N may be needed to boost early growth. Crowder and Chheda (1973) recommend 100-200 kg P_2O_5/ha and 50-100 kg N/ha as being sufficient for establishment and early growth. Application of N before the pasture is fully established encourages the growth of weeds. Split fertiliser application is recommended and increases N utilisation (i.e. reduces the losses due to leaching and volatilisation) and provides a more uniform production of herbage throughout the growing season. Cynodon IB8 has been found to use N more efficiently when it is applied after about ten days regrowth (i.e. about ten days after grazing or cutting).

The interval of harvest or grazing and the extent of defoliation also have profound effects on herbage production, nutritive value, botanical composition, regrowth potential and survival of the species. In general, an extended period of cutting gives an increase in the % of DM, CF, lignin, and CW, but a decrease in CP, mineral constituents (P, K, Ca, Mg), ash, and soluble carbohydrate and causes a rapid decline in in vivo and in vitro DM digestibility and in voluntary food intake (Crowder and Chheda, 1973). The percentage weed content was found to be less in plots where cutting interval was prolonged and a higher level of N was applied. Cynodon IB8, when grown under high fertility conditions effectively checked week infiltration into pasture plots.

Three strains of Cynodon cut at six week intervals and with 150 kg N/ha gave DM yields of 20 t/ha annum (for strain IB8), 14 t/ha annum (strain IB12) and 8.5 t/ha annum (for strain IB1) compared with yields of 10, 9.4 and 5.5 t/ha annum respectively for these strains cut at four week intervals. With a reduction from 6 to 4 week intervals average CP was increased from 10.5% to 12.9% (Chheda and Akinola, 1971). Thus cutting Cynodon pastures every six weeks during the growing season and allowing a rest during the dry season appears to be a beneficial system for Cynodon pasture management for increasing DM production. Oyenuga (1960) reported that green fodder production increased by 40% when cut at 12 weeks rather than 3 week intervals.

Some important factors responsible for decreased DM production with increased cutting frequency can be summarised as follows (Chheda and Akinola,1971):

(a) the removal of photosynthetic tissue, particularly when pastures are cut low and at frequent intervals;

(b) reduction in the amount of stored reserves necessary for growth;

(c) reduced availability of soil N and other nutrients as a result of accelerated dessication of surface soil due to frequent defoliation;

(d) reduction in root weight and root growth.

Successful establishment of most pastures and fodder species is directly related to the extent of tillering prior to sowing (Rains, 1963). A well prepared seedbed (with land turning, harrowing and firming) ensures soil and seed contact and tends to reduce weed competition. Sowing or transplanting at the beginning of the rains ensures adequate moisture during establishment and takes advantage of nitrogen from mineralisation, but also coincides with the period of strongest weed competition and severe rain storms. In the savanna where the rainy season is short, early planting is necessary, but further south sowing or transplanting could be delayed until rainfall is more dependable. In some instances the labour demands for food and cash crops may coincide with those for pasture crops and so influence the time when forage and fodder crops can be sown. Periodic hand weeding can be undertaken to ensure good initial growth.

Protection from grazing after seedlings emerge or after regeneration of growth in the case of vegetative propogation and until plants attain well formed root systems is necessary to ensure good stands. This requires 6-8 weeks or longer after sowing before grazing can be commenced. It has been suggested that grazing of such species as A. gayanus (Rains, 1963) and S. gracilis (Adegbola, 1965) be deferred until the end of the first growing season.

The reduction of DM yield in the dry season has long been recognised for tropical pastures and has been attributed mostly to reduced N and other nutrient uptake from the sub-soil, and to the death of tillers and diminution of tiller size and number. It was concluded by MacKenzie and Chheda (1970) that the greater root activity in the surface layers and the greater depth of penetration are factors which contribute to the more vigorous growth and ability to withstand dry season pressures of Cynodon strain IB8.

Forage Conservation and Supplementary Feeding

The different ecological areas of West Africa presently or potentially suitable for large scale livestock production are characterised by periods of extreme drought ranging from 8 months in the Sudan savanna zone to about 4 months in the savannas of the south. Animals are able to find adequate forage in the wet season but in the dry months of the year they lose weight. Improved animal performance can be achieved by using conserved forage, drought tolerant species (i.e. Stylosanthes gracilis and S. humilis), crop resudues (ground nut, guinea corn, cow peas etc.) or industrial by-products (oil cakes, rice bran, citrus pulp, molasses, brewery by-products, sugar cane tops etc.). More detailed work is required in order to determine the most suitable means of providing dry season supplementation.

Grazing Systems and Livestock Performance

Since little data exist for sheep and goats, comparative data for cattle are used to make assessments of stocking rates and animal performance.

For White Fulani steers continuously grazing unimproved bush savanna at Shika research station (Zaria, northern Nigeria - northern guinea savanna) an optimum stocking rate was found to be 1.6 ha/head giving 15.8 kg/ha annum liveweight gain (LWG) as compared with 11.2 kg/ha annum LWG for a rotational three paddock system when stocked at 2.7 ha/animal (Leeuw, 1971).

Considerably better performances than these can be expected further south on improved and natural pastures. The difference between performance on improved cultivated pastures and unimproved pastures is commented upon by Oyenuga and Hill (1966) who stated that it is becoming increasingly evident that small size, slow liveweight gain and unimpressive mature body weight of domestic livestock in western Nigeria are due mainly to the quality of the herbage on which they subsist. These animals live for practically the whole of the year on natural pasture or bush grazing which lack the nutritive qualities of cultivated pasture. The natural pastures often decline rapidly in nutritive value, becoming fibrous and coarse with age and with the approach of the dry season, since they are neither grazed nor harvested for fodder at the optimum stages of growth. Growth of most of the grasses ceases or becomes dramatically reduced during the dry season.

At Mokwa cattle ranch (southern guinea savanna) a rotational system was superior to continuous grazing (i.e. 104 kg LWG/ha compared with 85.9 kg LWG/ha) when grazed for six months/year and stocked at one head/ha (Leeuw, 1971). Continuous grazing reduced the density of A. gayanus and encouraged the growth of less nutritious species such as Pennisetum pedicellatum and Imperata cylindrica (Spear grass). The latter is considered to be an obnoxious weed which tends to dominate overgrazed natural grassland in the derived savanna zone (Adegbola et al., 1968). McIlroy (1962) considers that continuous grazing leads to deterioration of swards due to under grazing during the rains and over grazing during the dry season. Another serious disadvantage of continuous grazing is the build up of ticks and internal parasites. When young stock graze continuously on the same pasture as older cattle they become heavily infested with helminth parasites and their growth is retarded. Under rotational grazing, the degree of infestation is considerably reduced (McIlroy, 1962).

In the derived savanna on natural grassland (predominantly A. gayanus) unfertilised range plots produced 104 kg LWG/ha (i.e. 0.16 kg/animal day) compared with 133 kg and 223 kg/ha (i.e. 0.17 and 0.31 kg/animal day respectively) on range plots fertilised at 50 kg and 100 kg N/ha respectively during the same growth period, which shows a higher response in natural grassland to fertilizer at higher application levels (Adegbola et al., 1968). These increases indicate that the carrying capacity of natural grassland in the derived savanna zone and the accompanying LWG can be doubled provided that adequate water, mineral supplementation, livestock rotation and appropriate stocking rates are adopted. 33% of forage produced on unfertilised plots was consumed by growing steers compared with 49.1% on plots fertilised at 50 kg/ha and 67% on plots fertilised at 100 kg/ha.

60 young N'Dama heifers at the Fashola Livestock Farm on sown Cynodon/Panicum pastures gained an equivalent of 260 kg/ha annum and up to 1.0 kg/day in the early and mid-rainy season (April-June), 0.22 kg/day during July/October on Cynodon and 0.33 kg/day on Panicum (Ogar and Hendrick, 1963).

For Cynodon pasture, a balance between productivity and nutritive value can be expected when herbage is utilised at about 40 days of regrowth and hence rotational grazing intercepted by 5-6 weeks of regrowth during the

rainy season is preferable (Chheda and Akinola, 1971). Chheda (1974) describes the productivity of a Cynodon IB8 pasture in seven paddocks (one week grazing, six weeks regrowth) with 75 kg N/ha annum in six instalments after each grazing, a basal dressing of 50 kg P_2O_5/ha annum and herbage mowed back to 125-150 mm after grazing. Between April and December this pasture was giving up to 600 kg LWG/ha with average LWG by Zebu steers of 0.25-0.70 kg/day and greatest gains between April and May; during January and February $2\frac{1}{2}$ animals could be maintained per ha without loss of weight (no grazing in March).

As the pattern of growth in the tropics is seasonal, the stocking rates must be adjusted. Chheda (1971) observed that during the peak period of growth, a Cynodon IB8 pasture could carry 7-10 animals (N'Dama - average weight 200 kg) per ha. As this grass is relatively drought tolerant and produces some fresh growth during the dry season, it could support 2-5 animals per ha with some supplementary feeding. The pasture needs to be given a rest period of about 2 months during the dry season to conserve root reserves.

Table 22 shows the results of experiments carried out to obtain information on liveweight gains of White Fulani bulls on good grass-legume paddocks (C. plectostachyus, C. gayana, C. pubescens, S. gracilis and O. sativa) in the humid tropical zone of western Nigeria (Oyenuga and Hill, 1966). Grazing included the dry season when losses were 0.84 and 0.85 kg/day for each year; these were off-set by increases in the wet season of 1.1 kg/day.

The mean LWG of White Fulani steers over 2 years on three pastures (see Table 23) at Ibadan was found to be 0.19 kg/head day and 273 kg/ha annum (Olubajo and Oyenuga, 1971).

TABLE 22. LIVEWEIGHT GAINS OF WHITE FULANI BULLS

	1956-57	1957-58
Av. weight at commencement, kg	373.5	336.2
Av. weight at end, kg	473.2	402.7
Av. gain, kg	99.7	66.5
Number of days grazed	273.0	177.0
Av. daily gain, kg	0.365	0.375
No. ha/head of cattle	0.464	0.372
Liveweight gain, kg/ha day	0.79	1.01

TABLE 23. LIVEWEIGHT GAINS OF WHITE FULANI STEERS

		Mean Liveweight Gain kg/ha annum		Daily Liveweight Gain kg/head day	
		1965-66	1966-67	1965-66	1966-67
(a)	C.plectostachyus-C.pubescens	363	193	0.27	0.14
(b)	S.gracilis + (a)	386	209	0.29	0.15
(c)	D.decumbens-C.pubescens-S.gracilis	285	200	0.20	0.09

The liveweight gains given in the text are summarised in Table 24. The gains achieved in these examples depend on climatic factors, pasture species and management practices such as stocking rates, grazing systems and fertilizer application. The figures apply to cattle and comparable data for indigenous sheep and goats are not available.

Such levels of productivity might not be feasible under small scale conditions if fertilizer application is restricted and if pasture utilisation by sheep and goats is less efficient than by cattle.

System Proposed

On the basis of the information presented above, a system of small scale intensive goat and sheep production is proposed, which could be incorporated into the present agricultural system of the forest and derived savanna zones of southern Nigeria. The practical implications of small scale intensive goat and sheep production will be outlined and an assessment made of the economic viability of the system.

a. Pasture. The most reliable and extensive pasture management data are for Cynodon pasture at Ibadan, and a system based on these data is proposed. A basic pasture consisting of a Cynodon-legume (Centrosema or Stylosanthes) mixture would appear to be most suitable. Pennisetum and Panicum are also productive and well adapted and could be useful along with browse for goats.

TABLE 24. SUMMARY OF LIVEWEIGHT GAINS REPORTED IN THE LITERATURE

Location	Author	Class of livestock	Pasture and Fertilizer (kg/ha)	Stocking density (ha/head)	Liveweight gains (kg/ha)
Shika	Leeuw, 1971	White Fulani steers	Unimproved bush savanna		
			a) continuous grazing	1.6	15.8/an
			b) rotational	2.7	11.2/an
Mokwa	Leeuw, 1971	White Fulani steers	A. gayanus		
			a) continuous	1	86/6 mths
			b) rotational	1	104/6 mths
Derived Savanna	Adegbola et al., 1968	White Fulani steers	A. gayanus		
			unfertilised		113/an
			55 N		145/an
			110 N		243/an
Fashola	Ogar and Hedrick, 1963	N'Dama heifers	Cynodon/Panicum		260/an
Ibadan	Chheda, 1974	Zebu steers	Cynodon IB8 rotational	>1	655/Apr-Dec.
			82 N		
			55 P_2O_5		
Ibadan	Oyenuga and Hill, 1966	White Fulani bulls	Grass/legume pasture	0.4(1956-57)	259/273 days
				0.3(1957-58)	170/177 days

Certain Cynodon strains and Cynodon-legume mixtures have yielded over 15.5 t DM/ha annum with improved management. Pennisetum purpureum and/or Panicum maximum and legume mixtures under improved conditions can produce up to 25 t DM/ha annum. At the optimum growth stages, CP levels are high (14%) for improved Cynodon pastures and even higher (up to 20%) for P. purpureum.

The possibilities of introducing a grass fallow into cropping systems in the forest and derived savanna zones has not been examined. The growing of selected grass and legumes rather than allowing a forest/bush fallow could reduce the interval between crops and regenerate or maintain the soil nutrient status.

Many authors (Williamson and Payne, 1965; Devendra and Burns, 1970) comment on the unsurpassed ability of goats as foragers and on their wide food spectrum. When maintained on a grass pasture only, however, they do not do as well as sheep (Ademosun, 1970). A system which depends on the use of pasture grass-legume mixtures will be most suitable for cattle and sheep. For goats it is generally considered that a mixture of compatible browse and forage species seems more appropriate and further work is needed on how to provide such optimum grazing facilities for goats.

b. Management. From the previous information, fertilizer application of 100-200 kg P_2O_5/ha annum and 50-100 kg N/ha annum are recommended in three instalments applied after 10 days regrowth. These levels of fertilizer are probably higher than necessary, however, and may prove too expensive for small scale village enterprises. For the economic assessment, half these levels are taken. Grazing at 40 days regrowth gives optimum utilisation, productivity and nutritive value and therefore a system of 6 weeks rotational grazing is considered optimum with a two month rest period in the dry season. Nitrogen application at the end of the rainy season initiates a flush of growth which can provide a 'standing hay' of reasonable quality to maintain animals at a subsistence level during the early part of the dry season.

The fencing of such a pasture would usually be necessary for grazing goats and sheep, but tethering animals in the pasture would be a possibility at the village level. The cost of fencing is given below, but cheaper fencing could be utilised at the village level, if this proved strong enough to restrain the animals. Bamboo fencing would be one such possibility.

c. Stocking Density. Optimum stocking densities can be determined from a knowledge of pasture productivity and the DM requirements of the livestock concerned. DM intake and requirements vary with breed, size, stomach capacity, palatability and digestibility of forage, rate of passage through the rumen and the level of productivity and energy demand of the animal.

Devendra and Burns (1970) give DM intakes of 3 kg/100 kg LW (Jumnapari goats) and 2.75 kg/100 kg LW (Kambing Katjang goats), while French (1944) gives figures of 3.1 kg/100 kg LW (for 59 kg goats), 3.53 kg/100 kg LW (for 41 kg goats) and 4.0 kg/100 kg LW (for 27 kg goats). MacKenzie, D. (1967) quotes recommended figures of 5-7% LW for DM intakes for goats; he concludes that the minimum appetite of the goat is about 5 kg DM/100 kg LW and that well bred productive goats can extend their intake capacity to over 8.5% of LW. Voluntary food intake (VFI) has been shown to be controlled in part by the level of productivity and it has also been shown that ruminants adjust VFI to their energy demands (Baumgardt, 1970). Thus in high producing animals, VFI will be higher than in lower producing animals. VFI is also depressed by high ambient temperatures which accounts in part for lower food intakes in all classes of livestock in the tropics. Open grazing might cause problems of heat stress in both sheep and goats in southern Nigeria, especially in the dry season when solar radiation levels are higher. Adequate shade facilities should therefore be made available.

The maintenance requirement of the goat for digestible protein is approximately 0.06-0.08% of live weight. For a 25 kg goat this equals 15-20 g/day, which is similar to the requirement for sheep (Devendra and Burns, 1970). At levels of 7-13% CP (typical values for improved tropical pasture species) and VFI's of 4 kg DM/100 kg LW day, 70-130 g of CP would be provided per day. The biological value (BV) of protein to the ruminant is 65-70% which would provide 46-85 g (i.e. about 3 times the requirement) of utilisable protein per day at optimum growth stages. In the growing season, natural forage can therefore provide sufficient protein for maintenance and production. In the dry season when growth is minimal CP intake might become insufficient, both due to reduced CP content and reduced intake due to lower palatability.

On the basis of pasture production of 15 t DM/ha annum and a DM intake of 1 kg/day for a 25 kg goat or sheep this would allow a constant stocking rate of 42 animals/ha if production were constant throughout the year. This indicates that at the height of the growing season, DM production will

exceed the requirement for 42 animals/ha, but will provide sufficient for conservation. Stocking densities of 7-10 N'Dama cattle/ha at peak Cynodon growth are possible, which on the basis of six goats or sheep to one 180 kg steer would be an equivalent of 42-60 goats or sheep/ha at the most productive part of the growing season.

These figures are for optimum production conditions and for animals weighing 25 kg. For calculating productivity and profit from such a system it is assumed that 25-35 reproducing females can be kept per hectare. Thus a one hectare plot could support 25-35 reproducing females and their off-spring for fattening to 15 months.

d. Housing. Shelter similar to that shown in Figs. 11 and 12 may be suitable for both goats and sheep and is used at the University Teaching Farm, University of Ibadan. The wire netting (or bamboo) shown in these Figures would not be necessary, but the floor and walls would require concreting to a standard suitable for larger livestock than chickens. The size of the house would depend on the number of animals being kept. The type of housing used, however, requires further investigation.

Shade may have to be provided, but this could cause severe over grazing of the shade areas, and if possible should therefore be avoided. A separate Billy Pen will also be necessary.

e. Economic Assessment. Table 25 sets out the estimated cost of setting up a goat or sheep production unit.

For a stocking rate of 25 females per ha, with 3 parturitions in 2 years, a 150% kidding or lambing percentage and 10% pre-weaning mortality, the following income would be obtained:

- 13 kids or lambs sold at 22 kg liveweight at 15 months;
- total off-take per annum = 286 kg LW
- sold at ₦ 0.44 per kg LW (1976 prices) = ₦ 125.80
- with 3 parturitions in 2 years = ₦ 188.70/annum
  = ₦ 157.25/ha annum

For a stocking rate of 37 females per ha and the same productivity per female, the income obtained would be ₦ 233/ha annum. A probable time scale for developing such a unit would be as follows:

Month					
	1	Clear bush			
	2	Sow pasture			
	5	Begin grazing			Year 1
	6	Females pregnant			
	11	1st parturition			
	12				
	13		1st young weaned		
	19	2nd parturition			
	21		2nd young weaned		Year 2
	24				
	26			1st sales	
	27	3rd parturition			
	29		3rd young weaned		
	34			2nd sales	Year 3
	35	4th parturition			
	36		4th young weaned		
	37				
	42			3rd sales	
	43	5th parturition			Year 4
	45		5th young weaned		
	48				
	50			4th sales	
	51	6th parturition			
	53		6th young weaned		Year 5
	58			5th sales	
	59	7th parturition			
	60				
	61		7th young weaned		
	66			6th sales	
	67	8th parturition			Year 6
	69		8th young weaned		
	72				
	74			7th sales	

Thus, the first returns would not occur until month 26.

TABLE 25. EXPENDITURE INVOLVED IN THE ESTABLISHMENT OF AN INTENSIVE GOAT AND SHEEP PRODUCTION UNIT

	Expenditure*			
	Capital costs	Reduced village costs I	Reduced village costs II	Annual costs
Clearing Secondary Bush (1.2 ha)				
37.5 man days/ha @ ₦ 2-10/man day	94-50	0-00	0-00	0-00
Ploughing and discing (1.2 ha)	16-50	0-00	0-00	0-00
Seed provided by M.A.N.R.	0-00	0-00	0-00	0-00
Planting	6-30	0-00	0-00	0-00
Fertilizer P_2O_5	29-85	29-85	15-00	15-00
Nitrogen	18-00	18-00	9-00	9-00
Weeding	6-30	0-00	0-00	0-00
Fencing (900 m)				
Poles	37-50	0-00	0-00	0-00
Labour	28-26	0-00	0-00	0-00
Barbed wire (18 rolls)	522-00	522-00	0-00	0-00
Wire netting (for goats)	312-00	312-00	0-00	0-00
Housing	150-00	150-00	150-00	0-00
Labour (stockman) @ ₦ 2-10/day	767-00	0-00	0-00	0-00
Veterinary costs (36 animals)	72-00	72-00	72-00	72-00
10 ewe lambs or kids	150-00	150-00	0-00	0-00
TOTAL	2210-10	1253-80	246-00	96-00

* Interest charges have not been included, but these may be relevant if credit is obtained to cover initial expenditure.

In Table 26 four cash flows are shown, for four systems of production, as follows:

Line 1 - Reduced village costs I (see Table 25) at 25 reproducing females/ha
Line 2 - Reduced village costs I at 37.5 reproducing females/ha
Line 3 - Reduced village costs II at 25 reproducing females/ha
Line 4 - Reduced village costs II at 37.5 reproducing females/ha

Profit is shown as a negative quantity in this Table.

TABLE 26. CASH FLOWS FOR INTENSIVE GOAT AND SHEEP SYSTEMS

Year	Line	Revenue	Expenditure	Cumulative total net expenditure			
1	1	0-00	1253-80	1253-80			
	2	0-00	1253-80		1253-80		
	3	0-00	246-00			246-00	
	4	0-00	246-00				246-00
2	1	0-00	96-00	1349-80			
	2	0-00	96-00		1349-80		
	3	0-00	96-00			342-00	
	4	0-00	96-00				342-00
3	1	374-40	96-00	1071-40			
	2	576-00	96-00		869-80		
	3	374-40	96-00			63-60	
	4	576-00	96-00				-138-00
4	1	187-20	96-00	980-20			
	2	288-00	96-00		677-80		
	3	187-20	96-00			-27-60	
	4	288-00	96-00				-330-00
5	1	374-40	96-00	701-80			
	2	576-00	96-00		197-80		
	3	374-40	96-00			-306-00	
	4	576-00	96-00				-810-00
6	1	187-20	96-00	610-60			
	2	288-00	96-00		5-80		
	3	187-20	96-00			-397-20	
	4	288-00	96-00				-1002-00

CHAPTER FIVE

DISCUSSION AND CONCLUSIONS

In southern Nigeria, livestock are of secondary importance to crop production and a major factor in livestock development is the question of optimum land utilisation. There is no special allocation of land to livestock production in the south. Any major intensification programme would, therefore, require reallocation of land and consequent changes in labour and other resource use. It could even imply changes in social structure and would certainly involve new marketing patterns.

Maximum animal productivity can theoretically be obtained when the animal functions at the level of its genetic potential under optimum environmental conditions. In assessing livestock production systems, therefore, the factors of prime importance are those which affect the genetic potential of the livestock, or the environment in which production takes place.

The livestock species and breeds now found in southern Nigeria are well adapted to the prevailing environmental conditions of the humid tropical zone. They have overcome environmental difficulties by evolution and adaptation and are able to maintain maximum levels of productivity for the prevailing conditions. In this respect, local animals have a gene pool which may have much to offer in producing a cross-bred animal, which would have a combination of adaptation and high productivity in the F_1 generation. They are also evidently suited to the low input conditions of extensive village production.

Although small, local livestock have a relatively high reproductive rate which is looked upon as a good measure of adaptation to environmental conditions. Local fowl in traditional village conditions are capable of hatching 3-4 clutches per year, each of 8-9 eggs, and more clutches could be raised with improved management. The preliminary extension work carried out on poultry production suggests that certain intermediate management practices may have value in the extensive system. In theory, more radical

improvements could be made to the productivity of local birds by the introduction of management methods aimed at reducing chick mortality, reducing generation intervals and improving growth rates. Such methods are discussed in Appendix IV.

Many farmers in the villages studied have indicated that they would prefer to raise improved varieties of chicken, but that the disease and general health problems associated with improved stock, and the high food prices, are inhibitory. The qualities of local fowl, as outlined in the text, indicate their potential for village production under improved conditions. It is considered, however, that if farmers are going to raise poultry under improved conditions of health and nutrition, it is likely that they will choose improved varieties rather than local stock. Poultry improvement, by upgrading village fowl with improved varieties, should be further investigated in Nigeria, with more rigid control and co-operation from villagers, including women, who are also important livestock owners. Similarly, the potential for ducks, geese and turkeys for village production deserves future attention.

From the intensive broiler production work, the following conclusions can be drawn:

(a) Many farmers are open to new ideas and are willing to accept and participate in change.

(b) Intensive broiler production at the village level can be economical at those times of the year when there is a high demand for poultry meat and prices are high.

(c) Marketing is a problem at certain times of the year.

(d) With adequate precaution, disease levels can be kept low; the joint mortality and cull rate in the demonstration project was 12.5%.

(e) Further work is required to fully realise the potential of intensive village poultry production, which should also include egg production.

(f) Training programmes and demonstration units should be established by the extension services in "key" villages.

(g) The potential of local fowl for intensive broiler production at the village level should be investigated further.

From the evidence presented in Chapter 3 it would appear that small herbivores can act as an alternative source of meat. The newly demonstrated indigenous species have wide social acceptance and more work is required to establish their role as domestic meat producers.

The development of poultry and small herbivore production can proceed relatively rapidly due to the small capital expenditure required and the short reproductive cycles and growth periods involved. Similarly, the systems of production do not demand great inputs of time and labour and do not compete with other forms of agricultural production for land resources. These factors are of greater significance, however, when considering methods of goat and sheep development.

As was noted for chickens, the reproductive rates of small ruminants are relatively high; sheep have lambing percentages of 115% while a kidding percentage of about 150% for local goats is normal. Both sheep and goats are capable of three parturitions in two years and commonly produce twins, and occasionally triplets or quadruplets.

The reproductive cycle of goats and sheep require some comment. The total village population can be considered as a single, interbreeding herd or flock to which little control of breeding is applied. In this way, the extensive system has certain advantages and disadvantages. One advantage is that even though individual farmers own only a few animals, the ratio of male to female animals can, and is, kept low in the village herd as a whole (i.e. one male to 10-20 females). This allows all surplus males to be sold and makes it possible for the system to support more productive females. Livestock owners in southern Nigeria do not derive status from having large numbers of animals.

The major disadvantage of the system is that breeding cannot be controlled; mating occurs at random, there being no opportunity to choose sires or the timing of mating; young female goats and sheep mate as soon as

they are sexually active although not physically mature, and adult females mate as soon as they regain oestrus after weaning their young. A second consideration is the fact that young animals remain with their mothers until her milk dries up. This is a typical practice where meat animals are concerned and has the advantage that it gives the young the maximum benefit of the dam's milk. Delayed weaning is disadvantageous, however, for the following reasons:

(a) The efficiency of conversion of food nutrients to milk declines in the latter stages of lactation.

(b) As the young animal grows older, the efficiency of conversion of milk to meat declines.

(c) Rumen development is delayed.

(d) The recurrence of oestrus is delayed, with consequent prolongation of the kidding/lambing interval.

Such inefficiencies in the reproductive cycle could be rectified by changes in management practice, but this might alter the system to such an extent that some of the advantages of extensive production might be lost. If animals were housed and movement and grazing controlled, then the time of mating, choice of sires, kidding and lambing intervals and weaning age could be controlled more precisely. This, however, would probably necessitate that a greater number of males be retained, as individual farmers would not be able to depend on the males of the extensive village herd. Animal off-take could be reduced as a result and feeding costs would increase. Another drawback of such a policy is that the animals would be deprived of their natural food supply.

The nutritional aspect of the extensive system is in fact one of its major advantages. The characteristics of traditional production as described in Chapter 2 show it to be a low input system utilising the natural resources available in the village environment. The most important of these is the natural forage and scavenge which form the main food of village animals. It is considered that improvements to the traditional system should aim at maintaining the benefits of these natural food resources, at the same time as introducing compatible methods to raise the level of production. In utilising natural food resources, the system is performing

an important role in converting nutrients which would otherwise have no value to man into high quality animal protein for human consumption. It is considered, therefore, that the system has an important role to play in meeting the country's future nutritional requirements for meat and animal products.

In further, more detailed, studies it should be possible to quantify the limits to which the traditional system could be intensified without the need for fundamental change. Only then will it be possible to determine whether larger scale and more intensive systems, which do upset traditional patterns, are justified.

Related to the natural food supply is the question of the effect that increasing the number of animals would have on the traditional system. Although the carrying capacity for extensive production using natural food resources is difficult to assess, it would appear that at the present time, the village livestock populations are not putting undue stress on the available resources. Increased production could therefore be achieved by encouraging farmers to keep more livestock.

Certain benefits could be gained from providing nutritional supplements to livestock and especially to young livestock such as chicks, kids and lambs. This would help reduce mortality, increase growth rates, and allow young animals to become independent of their mothers at an earlier age, thus reducing the length of the reproduction cycle.

Related to nutrition is the general question of health, and it is considered that the establishment of regular village veterinary services is an essential pre-requisite of general improvement in terms of both traditional and intensive production.

Little attention is paid by farmers to animal health, although most farmers recognise ill-health and mortality as being a major cause of loss. Under extensive conditions, the frequency of mortality and disease is high, the spread of disease between animals is facilitated, and the transmission of parasites to man is unavoidable. In particular, intestinal parasites and skin infections are a problem in this latter respect.

At the present time, veterinary clinics are available in the urban areas and veterinary staff will visit villages on request.

Alternatively, farmers can take their livestock to these clinics, but the time and travel costs are usually so inhibitory that health coverage tends to be far from adequate. Another disadvantage is that re-infection of treated animals would be inevitable, because many farmers would not take the trouble to have their animals treated.

Thus, a more regular and reliable service is necessary. This could take the form of either village or area clinics to which farmers could take their animals with little or no difficulty, or mobile clinics which regularly visit the villages. Increased contact would also be beneficial in that veterinary and other specialist staff could offer advice regarding general animal husbandry and production practices as a complement to the livestock extension services. Increased health care of livestock would also reduce the risk of infection being passed on to the human population.

The assessment of the potential for intensive goat and sheep production showed that if capital costs of establishment could be kept low, then production would be profitable. Such a system, however, would compete with crop production for land. The possibilities of introducing a grass fallow into the cropping system should therefore be investigated. Rather than construction of expensive fencing, animals could be tethered in improved pasture, and their position changed once or twice a day. This may cause problems of overgrazing, eating out of particular species, but would aid the optimum utilisation of less palatable species, particularly in the early dry season.

The consideration of sowing improved pasture also raises the question of the genetic improvement of livestock. The local livestock are well adapted to scavenging and foraging around villages, but an improved breed or an upgraded crossbreed of the local type may be more efficient at utilising improved pasture.

Such a system as proposed in Chapter 5 could be used for growing or fattening rather than breeding goats and sheep. Young animals could be bought in from local villages and farmers, thus relieving the pressure on village food supplies and allowing more adult breeding females to be kept in villages.

A possible adjunct to village goats and sheep production, therefore, would be the establishment of commercial fattening farms which could take

weaned kids or lambs for fattening to slaughter weight. This would constitute a split-production system which removes the task of finding enough food for fattening in the village, and would provide a ready market for young animals.

A reliable market would enable young animals to be removed from their mothers at an early age, thus allowing a shorter reproductive cycle and greater productive efficiency. The removal of young could also allow more care to be given, thus reducing post and pre-weaning mortality.

Traditional goat and sheep production would therefore remain virtually unchanged in nature, but would be used simply for the breeding stage of the production cycle. The breeding stock could then be increased without any adverse effects to the natural food supplies.

The work on small ruminants is being continued in Badeku village by a team sponsored by the International Livestock Centre for Africa (Addis Ababa) in co-operation with the Nigerian government.

The prospects for the expansion of livestock production in the villages of southwest Nigeria may be summarised as follows. Poultry have an important role to play, both as a component of the extensive system, where a reduction in mortality levels is required, and in intensive systems of broiler and egg production. Other species, such as small herbivores (which do not compete with man for their food requirements) could be introduced as alternative sources of animal protein. Sheep and goats have their limitations in intensive systems in the south, but are fulfilling an important role as meat producers in the extensive village system. There is much scope for all found improvement in animal production techniques, but development should be based on an integrated approach, taking into consideration all facets of agricultural production.

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APPENDIX I

Department of Agricultural Extension Services

University of Ibadan Pilot Project on Rural Development

Livestock Survey 1975-76

Name of Farmer ..... Number of household .....

Name of Village ..... Date .....

Name of Interviewer .....

A. Poultry

1. Number of chickens owned in household
   a) Cocks .....
   b) Hens .....
   c) Young* .....
2. Number of hens sitting on eggs .....
3. Number of eggs in each clutch a)..... b) ..... c) ..... d) .....
4. Number of hens with chicks+ .....

   For each hen with chicks:

   how many eggs incubated a) ..... b) ..... c) ..... d) .....

   how many hatched a) ..... b) ..... c) ..... d) .....

   how many still alive a) ..... b) ..... c) ..... d) .....
5. Number of adult/young chickens dead since last Ileya† or Christmas (i.e. in 1975)

   number .....

   cause of death .....
6. How many ill at present time .....

   Name of disease .....
7. Do you eat your own eggs ..... how many per week .....
8. Do you sell eggs ..... how many per week ..... where .....
9. Do you buy eggs ..... how many per week ..... where from .....
10. How many chickens killed for eating since last Ileya or Christmas (i.e. in 1975)

    number .....

    on what occasion .....
11. How many chickens sold in 1975 .....

    where sold .....

---

* 8-16 weeks + 0.8 weeks

† Ileya (Moslem festival)

12. What breeds of chicken owned .....

13. What other breeds kept in past .....

14. What foods fed a) ..... quantity per day ..... cost per day .....
b) ....
c) ....

15. Is any food bought .....

how much .....

16. What provision is made for water .....

17. Is any housing provided for chickens .....

B. Goats/Sheep*

1. Number owned per household a) adult male .....
b) adult female .....
c) young .....

2. Age of adult males .....

3. With regard to adult females:

Age Female+ a) ..... b) ..... c) ..... d) ..... e) .....

Number kiddings/lambings* a) ..... b) ..... c) ..... d) ..... e) .....

4. Number of adult females with suckling young .....

In each case how many:

born dead Female+ a) ..... b) ..... c) ..... d) ..... e) .....

male born alive a) ..... b) ..... c) ..... d) ..... e) .....

female born alive a) ..... b) ..... c) ..... d) ..... e) .....

died since birth a) ..... b) ..... c) ..... d) ..... e) .....

cause of death a) ..... b) ..... c) ..... d) ..... e) .....

5. What will you do with each young animal when weaned:

Number will sell ..... where .....

Number will keep for breeding .....

Number will kill for eating .....

6. Number of adult females pregnant or without suckling young .....

In each case, at the last kidding/lambing*, how many:

born dead a) ..... b) ..... c) ..... d) ..... e) .....

male born alive a) ..... b) ..... c) ..... d) ..... e) .....

female born alive a) ..... b) ..... c) ..... d) ..... e) .....

died since birth a) ..... b) ..... c) ..... d) ..... e) .....

cause of death a) ..... b) ..... c) ..... d) ..... e) .....

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* Delete as necessary

\+ In questions 3, 4 and 6 column a), b), c), d) and e) refers to the same female in each case

7. How many sold after weaning Female a) .... b) .... c) .... d) .... e) .....
   kept for breeding a) .... b) .... c) .... d) .... e) .....
   killed for home consumption a) .... b) .... c) .... d) .... e) .....
8. Number of adult goats/sheep sold since last Christmas or Ileya (ie. in 1975)
   number .....
   where .....
9. Number of adult goats/sheep bought in 1975 .....
10. Number killed in 1975 (for home consumption) .....
11. Number of adult goats/sheep died in 1975 .....
12. Are any goats/sheep ill at the present time .....
   what disease .....
13. What food is fed to goats/sheep a) ..... quantity per day .....
   b) ....
   c) ....
14. Is any food bought ..... cost per day a) .....
   b) .....
   c) .....
15. Is drinking water provided .....
16. Where do goats/sheep stay at night .....
   and is housing provided .....

C. General

1. What other livestock are owned (ducks, turkeys, rabbits, guinea pigs, rats etc) (for duck use poultry questions)

2. Any other sources of meat?
   a) Butcher
      a) meat ..... amount/day
      b) meat ..... amount/day
      c) meat ..... amount/day

b) Bush meat

a) trapped ..... how many .....

b) caught ..... how many .....

c) hunted ..... how many .....

c) Tins of meat bought .....

Baby food .....

Milk powder .....

Other sources of animal protein .....

3. Have you ever used the veterinary services? .....

when? .....

what for? .....

4. Have you ever had animals vaccinated? .....

when? .....

Against what disease? .....

5. What are the reasons for which you keep livestock?

6. Who in the household looks after the animals and how much time is spent each day? .....

7. How many people are there in the household? .....

8. What is the main occupation of the Head of household and of his wife?

APPENDIX II

Animals slaughtered at the Ileya Festival in Badeku Village, December 1975

In the southern regions, many of the animals slaughtered at festivals such as Christmas, New Year and Eid-il-Kabir are imported from northern Nigeria. In a survey of the numbers and breeds of animals killed in one village (Badeku) in the forest zone at the Ileya festival in December 1975, it was found that 35 sheep and 74 goats were slaughtered. Of these 33 (94%) sheep and 69 (93%) goats were of the northern variety, with only a minority of local animals being slaughtered. These figures represented approximately one animal slaughtered per household in the village, which was mainly Moslem.

The various techniques of slaughter and preparation were also noted during the survey. Devendra and Burns (1970) commented on the popular practice (in Ghana) of burning the hair of the goat rather than skinning it, which it is claimed improves the flavour of the meat; they noted, however, that this was not the practice in the case of sheep slaughtered for human consumption. In southern Nigeria, it was found that the same practice of scorching the hair was used for goats, but in these areas sheep are also subjected to the same practice.

In Moslem families, when a sheep is slaughtered, the hide is often removed in order to make a 'prayer mat'. When one enters a Moslem household it is often easy to tell how many animals have been slaughtered in the past few years by the number of prayer mats hanging from the rafters. If the hide is not required for this purpose, however, the hair is burned off in the same way as is usual for goats. The scorching is carried out over a wood fire into which the animals are placed immediately after slaughter and draining the blood. The carcass is turned and held in the flames and paraffin may be applied to ensure an effective removal of hair. This is rubbed into the fur beforehand or during burning. When all the hair has been burnt off, the carcass is removed from the fire and washed with soap and water to remove the charred remains. It is then cut up for subsequent cooking.

The whole of the animal is utilised and none wasted. The viscera are cleaned immediately by the women and cooked on the same day; the rest of the carcass may be kept for one or two days before eating, depending on the occasion.

APPENDIX III

The following is a breakdown of carcass components of goats in order to determine the edible percentage. This will be used to calculate the total off-take from village sheep and goats in southern Nigeria, in terms of edible protein/human adult/annum.

Component weights of live goat carcass

(Numbers in parentheses are percentages of liveweight)
Adapted from Owen, J.E., 1974. A note on the carcass evaluation of the indigenous Malawi goat. (Table 1). Trop. Sci. 16, 2, 75-83.

Animal number	1
Sex	Male
Age approx (years)	5
Liveweight	31.6 kg
Carcass, hot	14.05 kg
Carcass, cold	13.52 kg
Hindquarters, cold	3.27 and 3.10 kg (47.12)
Forequarters, cold	3.55 and 3.60 kg (52.88)
Head	2.42 kg (7.66)
Feet	0.69 kg (2.18)
Skin and tail	2.34 kg (7.40)
Lungs and trachea	0.40 kg (1.27)
Liver, heart and kidneys	1.14 kg (3.61)
Gut, full	7.68 kg (24.30)
Gut, empty	2.59 kg (8.20)
Testes sac	0.25 kg (0.79)
Blood, fresh	1.13 kg (3.58)
Carcass weight loss (hot/cold)	0.53 kg
Components, total	30.10 kg
Recovery percentage	95.25

Muscle, fat and bone composition of left half of mature male Malawi goat

Adapted from Owen, 1974. (Table 2).

	Weight kg	Half carcass %
Total left half of carcass	6.700	100
Muscle	4.883	72.88
Bone	1.432	21.37
Fat and connective tissue	0.227	3.39
Cutting loss	0.158	2.36

From these figures the edible percentage is as follows:

	kg
Muscle (4.883 x 2)	9.766
Fat and connective tissue (0.227 x 2)	0.454
Brain (estimate)	1.000
Skin (estimate)	2.000
Liver, heart, lungs	1.140
Gut, empty	2.590
Testes sac	0.250
	17.200

Edible percentage $= \frac{17.200}{31.600} \times 100 = 54.43\%$

Calculation of edible protein off-take from sheep and goats in 100 hypothetical households

i) Goats

50% of households have goats	= 50 households
Average of 3.5 goats/household	= 175 goats
60% of total goats are adult female	= 105 adult female goats
Assume 150% kidding percentage and 3 kiddings in 2 years	= 225 kids born/annum
Replacement requirement equals 15% of adult females	= 15
Pre-weaning mortality = 15%	= 34
Therefore, total kids weaned and available for sale	= 176 kids
These slaughtered at 10 kg	= 1760 kg LW
Assume 54% edible protein	= 950 kg
Mean family size equivalent of 4 (i.e. 2 adults and 4 children)	
Thus, in 100 households	= 400 adults equivalent
Therefore, total off-take	= 950 kg/400 adults/annum
	= 2.4 kg/adult/annum
	= 45.2 g/adult/week

ii) Sheep

25% of households have sheep	= 25 households
Average of 2.5 sheep/household	= 63 sheep
66% of total sheep are adult female	= 42 adult females
Assume lambing percentage of 115% and 3 lambings in 2 years	= 72 lambs/annum
Replacement requirement equals 15% of adult females	= 6
Pre-weaning mortality = 15%	= 11
Therefore, total lambs weaned and available for sale	= 55 lambs
These slaughtered at 15 kg	= 825 kg LW
Assume 54% edible protein	= 445 kg/annum
Total off-take	= 445 kg/400 adults/annum
	= 1.1 kg/adult/annum
	= 21.4 g/adult/week

Therefore, sheep and goats together contribute

45.2 g + 21.4 g edib protein/adult/week

= 66.6 g/adult/week

APPENDIX IV

Intermediate Management Practices:

A Note on the Use of Brooding and Rearing Arks in Villages

Under the present free-range system, a hen is able to raise about four clutches per year, though many hens in fact probably lay fewer then four clutches. Chick mortality is high due to predation, disease, accident, climatic factors and nutrition (including dehydration in the dry season). Thus, confinement of the hen and chicks on hatching would allow many of the above constraints to be reduced. The main disadvantage of confinement of birds previously reared in a free-range system is that food provision becomes more of a problem. This can partly be overcome, however, by the system adopted, and some food supplementation could be recommended in order to improve growth and ensure quick attainment of market weight.

Brooding and rearing arks can be used to achieve these ends and should be investigated at the village level. The brooding ark consists of a covered roosting box attached to an open wire netting run with no bottom. This allows scratching and the utilisation of any food materials which are available. The ark can be moved two or three times a day. The hen and chicks can be kept in the ark for 3-4 weeks and then the chicks transferred to a larger rearing ark until they reach market weight. The period of time which the hen is with the chicks is therefore reduced to 3-4 weeks, thus allowing 6-7 clutches to be reared per year.

Food can be provided for both the hen and the chicks in the brooding ark, and a means can be devised to allow only the chicks access to food if required. It would also be possible to design an ark so that the hen, but not the chicks, could leave in order to search for natural foods.

Advantages of the ark system include:

a) reduction of mortality loss from predation, climatic factors, accident, spread of disease between birds, poor nutrition and lack of adequate water;

b) the possibility for greater control and attention to individual birds and the possibility for the isolation of infected birds;

c) lowered 'stress' and general activity of birds, leading to increased performance and weight gain;

d) greater off-take per annum due to the greater efficiency of the reproductive cycle.

The system could meet certain difficulties in the villages of S.W. Nigeria, which lack much vegetation and in which individual farmers have no right over communal village land. The placing of arks would therefore present difficulties. Such a system could easily degenerate into a fixed system of 'caged' poultry rearing, which all the same, would be beneficial.

An advance on the system would be to remove the chicks from the hen at one day old to be reared artificially with paraffin or electric brooders.

The brooding ark system is based on greater inputs than the present free-range system and could, therefore, be superimposed on the existing system. Again it should not be seen as an alternative to the present system of free-range village production, but it has certain advantages to offer over the present system.

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