

# Part I: Setting the scene



# Population pressure, migration and urbanisation: Impacts on crop–livestock systems development in West Africa

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## Abstract

The population of West Africa has risen rapidly in the past 40 years and is expected to continue rising. However, rural population has increased slowly while urban population has grown dramatically. The result has been an increase in demand for cereals and pulses (which produce crop residues for livestock) and a much increased urban demand for livestock products. Grazing land has diminished, crop residues are becoming a more important element in livestock raising, and fattening penned livestock has become profitable. The changes in land use, land tenure and the shift of livestock raising southwards in West Africa are illustrated. Farmers' ability to adapt to changing markets for their products and the factors of production are illustrated with examples from Senegal, Nigeria, Niger and, by way of contrast, Kenya. This rapid change sets new challenges for livestock scientists. The livestock economy has to be seen as part of a national economy in which urban and rural facets interact. Effective policies need to be based on recognition of the capacity of rural people to invest in improving their livelihoods.

**Key words:** Crop residues, economic analysis, livestock, markets, tenure, urbanisation, West Africa.

## Livestock markets and population growth

West Africa is experiencing accelerating change in its population structure and this has had consequences for its farming systems. In this it is not unique, but is following a trajectory already experienced in Europe, North America and Asia. At the beginning of the 20<sup>th</sup> century West Africa had extremely low population densities by world standards, and this imposed an economy oriented towards subsistence, in which farming and animal-raising methods logically took the form of extensive use of the plentiful land, whereas labour and capital were in short supply. Since there were few urban concentrations of population, the major possibility of earning cash through sales lay

with export markets. By 2000 this situation had changed in very large areas of West Africa. The major market for agricultural output is now internal. Because land is becoming scarce in relation to demand, intensive systems of cropping and livestock keeping are required to maintain supply to the growing urban and rural populations. The development of intensive systems requires repeated small investments from farmers, and this in turn requires that governments operate policies that facilitate and encourage farmer investments. The increased scarcity of land means that a market for it develops, in which it can be sold, or rented in and out whatever the legal or traditional customary position. The development of new employment opportunities in towns means that the young have alternatives to the family farm or herding. For reasons discussed below, these changes have a particular impact on livestock rearing. The changes are illustrated by comparative studies of three semi-arid areas in West Africa and one in Kenya<sup>1</sup> carried out by Drylands Research over the past five years to examine the impact of different government policies on farm investments and strategies from 1960–2000. The studies were led by Michael Mortimore with Mary Tiffen of Drylands Research, in co-operation with teams of national scientists whose work is referred to below.

## Population growth and urbanisation in West Africa

The West Africa Long Term Perspective Study (WALTPS) carried out by the Organization for Economic Co-operation and Development (OECD)/Club du Sahel documented population growth and urbanisation in 1960 and 1990 and provided a forecast based on likely trends to 2020. Table 1 shows the results.

**Table 1.** *Population (millions) of West Africa, 1960–2020.*

Year	Total	Rural		Urban		Towns of over 500,000
		Number	%	Number	%	
1960	87	75	86	12	14	2
1990	194	117	60	78	40	17
2020	430	160	37	270	63	51

Source: Cour (2001), Table 1.

Census data for West Africa is not good. Many Francophone countries have conducted only two censuses, in the late 1970s and late 1980s. Earlier data is estimated from samples and figures collected for taxation purposes. Nigeria had no undisputed census between 1952 and 1991 and the 1963 census is now acknowledged to have been inflated. There is the further difficulty that the different countries have adopted different definitions of 'urban' in their censuses. For example, in the Nigerian census of

1. Full details and Working Papers are available from [www.drylandsresearch.org.uk](http://www.drylandsresearch.org.uk).

1991 it referred to conglomerations of over 20,000 people; in Senegal it referred to places with the status of a municipal commune. In the latter case, this meant that the second largest city, Touba, was not classified as urban, because it had the administrative status of a *commune rurale*. These definitions can change between censuses, and boundaries may also vary. Hence, tracing population growth and urbanisation in any given area is not easy. Careful analysis of district-level data in the three West African countries shows the kind of population trajectory that WALTPS depicts. It also enables us to track changing rural population densities, a factor that has great influence on the relative scarcity of land and labour, and on the amount of available uncultivated land that might be used for free grazing.

Table 2 shows that in all three areas the urban population was growing much faster than the rural population. The three districts in question had less than the national percentage of urban population, because they did not include the capital city, yet urban populations are often as much as eight times higher than they were in the 1960s. Urban growth is not confined to the capital. Rural population density has increased fastest in areas like Maradi, where there was vacant land that could be taken up by younger members of existing families, or by incomers.

**Table 2.** Rural and urban population changes in three West African districts and densities/km<sup>2</sup>.

	Total	Urban <sup>1</sup>	Urban (%)	Average density	Rural density
Nigeria					
(Kano Province in 1952, Kano and Jigawa States, 1991)					
1952	3,396,350	335,707	14	79	77
1991	8,685,995	2,516,706	30	200	(Jigawa) 118 (Kano) 169
Niger					
(Département de Maradi)					
1960 (estimate)	561,000	13,500	2	13	13
1977	949,747	44,459	5	23	22
1988	1,389,443	110,739	8	35	33
Senegal					
(Région de Diourbel)					
1960 (estimate)	261,000	NA <sup>2</sup>	NA	60	NA
1976	423,038	117,761	28	97	70
1988	620,197	259,973	42	142	94

1. Urban population in Nigeria and Niger defined as settlements over 5,000 in 1952 and 1960, and over 20,000 in later years. Urban population in Diourbel includes Touba Mosquée.

2. NA = data not available.

Source: Census data and analysis in Tiffen (2001) and Barry et al. (2000).

## Effects of population growth and urbanisation on livestock aspects of agriculture

This growth and structural change has several impacts on livestock raising.

- While the amount of land under fallow or bush decreased (due to larger numbers of farmers), the supply of crop residues that could be used as animal fodder increased, due to cultivation of cereals and pulses to meet increased urban and rural needs. In Nigeria, in the three states of Kano, Jigawa and Katsina, the grain needed for urban consumption increased from 62,000 t in 1952 to 585,000 t in 1991—more than nine times (Tiffen 2001). In this time, the rural population had barely doubled. Farmers had, therefore, strong incentive to increase their output, and to improve yields per hectare and the percentage of land under crops. In addition to grains, there was also increased urban demand for pulses. The concomitant increased production of crop residues provides for a change in animal feeding strategies.
- To the extent that urban incomes are higher than rural incomes, there are also increases in demand for livestock products (meat and milk). This is a common world-wide phenomenon that Delgado et al. (1999) have called the 'livestock revolution'. The increased demand makes labour-intensive feeding methods, such as fattening in pens rather than free grazing, worthwhile.
- To the extent that towns have the facilities for industrial production, there are also increases in demand for industrial raw materials—starches, brewing grains, cotton etc. Some of these produce animal food by-products that farmers can purchase profitably if the market for livestock products is good.
- The existence of viable modern industries in towns increases urban incomes and demand for livestock products. However, as yet, few West African towns support large industrial work forces, unlike towns in Asia which provide a still stronger stimulus to livestock production.

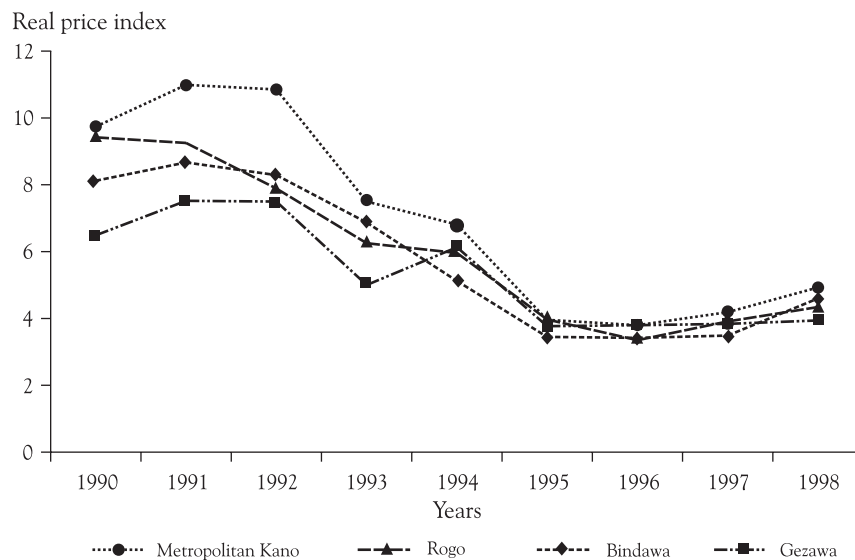
These factors work together for a closer integration of cropping and livestock raising. To take advantage of a growing urban market, when there is less grazing land, farmers need to make better use of crop residues and purchased feed stuffs. There is the possibility of beneficial and rapidly increasing interactions between urban and rural sectors, as seen historically in Europe, America and Asia (Tiffen 2003).

## Responsiveness to market demand

These interactions depend on the existence of market responsiveness amongst livestock producers. The producers are of two kinds: mixed farmers, who grow crops and keep livestock, and specialist herders. Both are responsive to market conditions. However, markets have been distorted in the past. For example, European Economic Community (EEC) subsidies on frozen carcasses were estimated at FCFA 125/kg in 1974, FCFA

355/kg in 1984 and FCFA 345/kg in 1988.<sup>2</sup> This led to falling real prices of beef (Club du Sahel 1990). The price was also affected by the overvaluation of the FCFA, not corrected till its 50% devaluation on 12 January 1994. When the naira (N) was devalued in the mid-1980s, imports of frozen meat into Nigeria virtually ceased (Club du Sahel 1990). Since the FCFA was devalued, exports from Sahelian countries to the coastal countries have increased. Hoffmann (1998) has shown how after devaluation, herders and traders in Burkina Faso increased sales to Côte d'Ivoire, to some extent at the expense of local urban markets. Herders also increase supply, but they took care to retain breeding stocks.

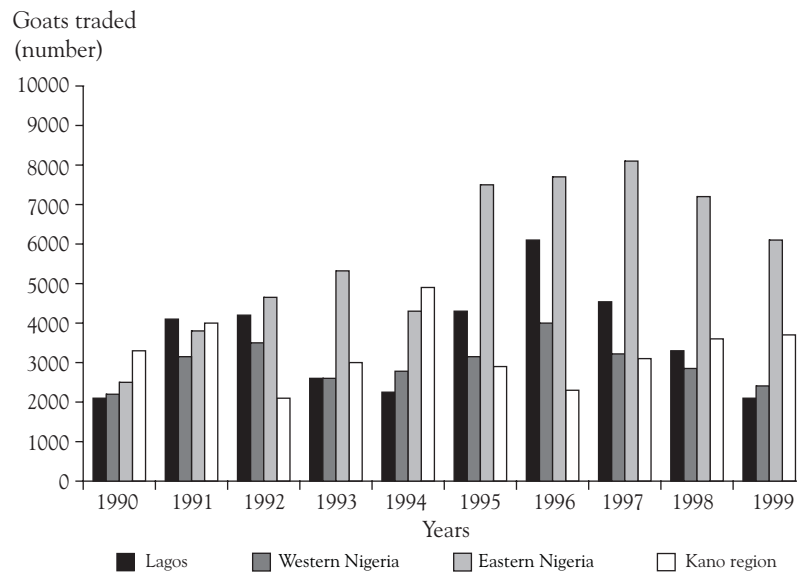
However, the exchange rate is not the only factor in prices. Ariyo et al. (2001) showed that real prices for cattle and sheep fell in Nigeria in the 1990s (Figure 1). This was partly due to increasing poverty in the towns, depressing demand, and disruptions to industry and long-distance trade due to political crises. Higher fuel prices have exerted pressure on trading margins. Since 1997, 36 traders in Kano and its feeder markets have reported falling turnover, illustrated by the pattern shown in the goats they traded (Figure 2).



Source: Ariyo et al. (2001), Figure 34.

**Figure 1.** Real price indexes (base 1985) per head of cattle by year and market, in metropolitan Kano and at three markets in the hinterland, Nigeria (1990–98).

2. Equivalent to US\$ 0.52, US\$ 0.84 and US\$ 1.1 at the current exchange rate with the French franc (FF). (Calculated from US\$/FF exchange rate available on [www.tria.com/archive/exchange-en/html](http://www.tria.com/archive/exchange-en/html), accessed 10/7/2003.)



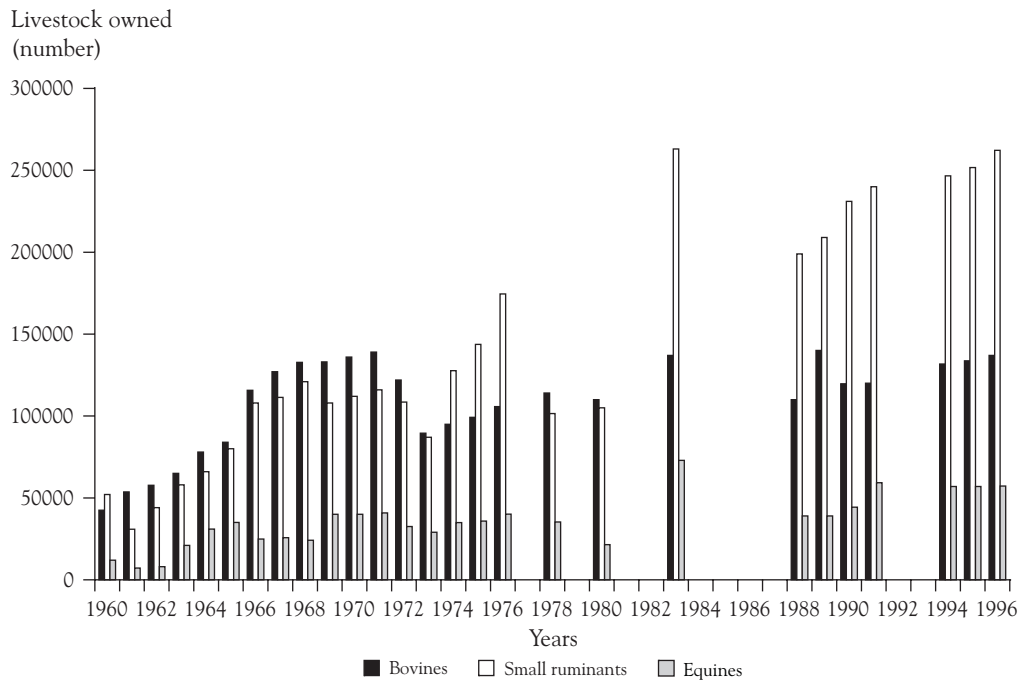
Source: Ariyo et al. (2001), Figure 33.

**Figure 2.** Number of goats traded in Kano markets, by year and destination, Nigeria (1990–99).

The data we collected from three districts suggest increased livestock holdings, despite the impact of droughts and reduced grazing areas. Livestock data are notoriously difficult to collect, and Gefu (1998) quotes FAO data to show a decline in livestock per capita for sub-Saharan Africa (SSA). Within the largest SSA country, Nigeria, the 1990 National Livestock Survey demonstrated that total livestock biomass was greater by 25% as indicated by contemporary Federal Government and FAO figures, and the population according to the 1991 census was 26% smaller than expected, demonstrating the likely unreliability of per capita figures (Bourn and Wint 1994). However, it may well be that small ruminants and, in some countries, equines, form a greater proportion of the whole than previously.

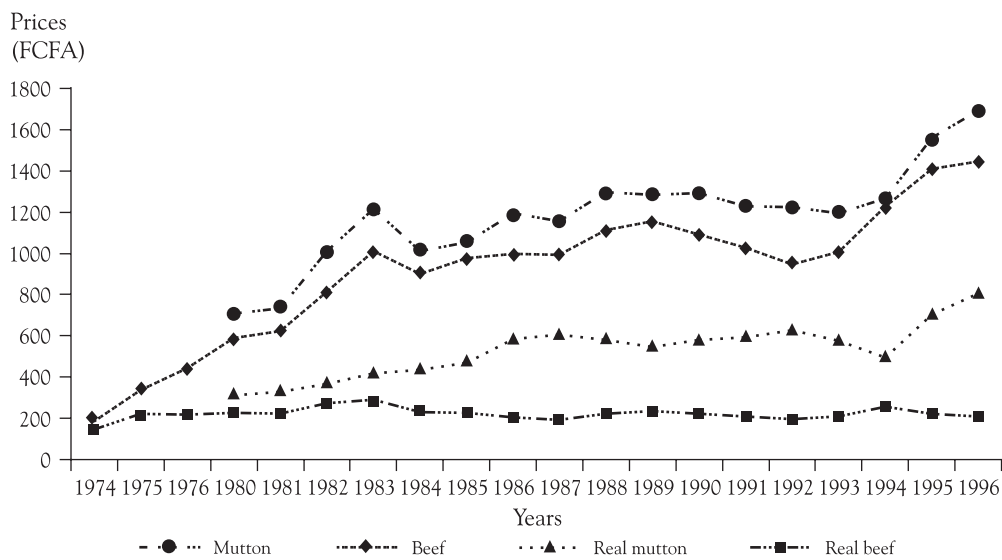
The increased preference for small ruminants, which is illustrated in the Diourbel region in Figure 3, is explicable by several factors. First of all, their meat may have a higher price, particularly as it is in great demand at Muslim festivals. This is shown in relation to real meat prices in Senegal 1974–96 deflated by the cost of living index (Figure 4). Figure 4 also shows the impact of the 1994 devaluation of the FCFA. Secondly, small ruminants multiply quickly, so that when numbers are reduced by droughts, the herd is more quickly reconstituted than are cattle herds. Thirdly, there is less of a capital barrier to ownership, and small-scale farmers and women wanting an independent income can enter into livestock ownership by this route. These small ruminants are extremely important providers not only of cash but also of manure and milk to the smaller or poorer farming households (Hassan et al. 1998; Mortimore and Adams 1999; Mortimore 2001).





Source: Faye et al. (2000), Figure 16.

**Figure 3.** Changes in three types of livestock owned, Diourbel region, Senegal (1960–96).



Source: Faye et al. (2000), Figure 20.

**Figure 4.** Real meat prices (FCFA), Senegal (1974–96).

## The trading environment

Market responsiveness also requires effective traders and market institutions. One of the remarkable things about the livestock trade in West Africa is that it has remained entirely in the hands of indigenous traders, using customary institutions and practices (Ariyo et al. 2001) with, compared to crops, little interference from government.<sup>3</sup> This is true both in Nigeria, Niger (Kerven 1992) and Senegal. Margins are low, distances to be traversed long, and requirements for information about market status in various distant outlets are high. Yet traders have succeeded in keeping the expanding urban markets supplied. In Senegal, where the government took over the trade in groundnuts, imported rice and local food crops from 1965–80, it was the ancient livestock markets that provided the nucleus of a network of rural bulking markets when trade was eventually freed (Ly 2000).

## Changes in land use and land tenure in West Africa

### Increased rural population density and livestock density

The increase in population, the expansion of the farmed area, and the changes in farming practices mean that more animals now live in the enlarged farming zone, and a smaller percentage are in the exclusively pastoral zone. Domestic animals are associated with people's houses (*domus* in Latin) and are part of farming capital (from the Latin, *caput*—head of cattle). The positive correlation between livestock and roof tops in semi-arid areas was shown by Bourn and Wint (1994) using aerial surveys of livestock distribution by tropical livestock units (TLU) in Chad, Mali, Niger, Nigeria and Sudan. (An even more positive correlation was obtained with the percentage of land cultivated). A similar result was obtained earlier for the extremely densely settled zone around Kano where Hendy (1977) found a positive correlation between population density and TLU, but a negative correlation with cattle alone. This situation may have changed since, due to the increased popularity of oxen for plowing and transport.

This process of the association of livestock with settled farmers has been going on for generations in Nigeria. While the popular opinion was that most cattle are owned by pastoralists, many of these have also always maintained wet-season farms, and over the centuries and decades, a growing proportion of them have adopted settled, mixed farming, as can be seen from the records of the former Gombe Native Authority (Emirate), Nigeria, shown in Table 3.

By 1965 the settled Fulani in Gombe had been joined by thousands of Hausa, all immigrants seeking land on which to grow cotton and sorghum, both very profitable at

3. In Nigeria and elsewhere there were some interventions for health reasons by the Veterinary Department, which also had a hand in improving the output of the hides and skins trade (Kerven 1992).

**Table 3.** Cattle taxed in Gombe Emirate, Nigeria, 1925–26, 1948 and 1965–66.

Ownership	1925–26		1948		1965–66	
	Number	%	Number	%	Number	%
Nomad	29,060	33.8	14,367	13.4	14,162	12.7
Settled farmer	56,021	65.0	92,177	86.6	91,552	81.5
Trader	1,075	1.2	NA <sup>1</sup>	NA	5,339	4.2
Total	86,156	100.0	106,544	100.0	111,053	100.0

1. NA = data not available.

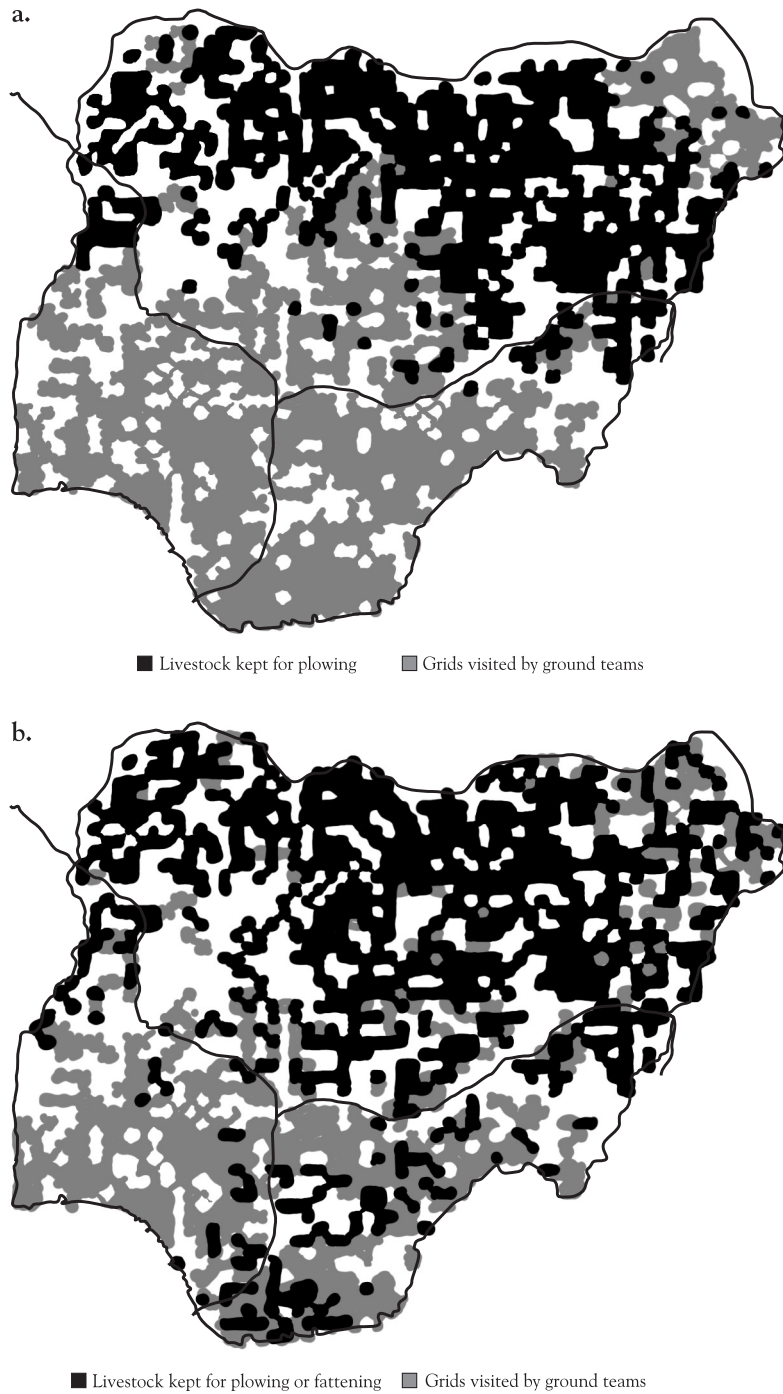
Source: Archival and current reports reported in Tiffen (1976).

the time. The Fulani, other resident tribes and the incoming Hausa found that they could cultivate more of these crops and get higher yields if they adopted the ox plow, and by 1965 this had become common. Plow oxen can be trained quite quickly, and as they are specially fed in the dry season to keep them in condition for the plowing, they fatten up quickly. After two or three years it is profitable to sell them, and start again with younger beasts. Thus, plowing leads to fattening, and sales by farmers not previously associated with the cattle trade (Tiffen 1976). From that point, it is a small step to stall-fed cattle kept for sale rather than work, both by tribes traditionally associated with cattle, and by others. Figure 5 shows the overlap of animal traction and animal fattening as shown by Bourn and Wint (1994).

The same thing happened in Diourbel, Senegal, where feeding methods taught by the extension service for plow oxen were adopted for fattening stall-fed cattle and small stock, both by tribes associated with cattle-raising (the Serer) and by those who had not previously kept them (the Wolof). In Diourbel, formerly a groundnut-growing basin, fattening animals now provides more of the cash income from farming than do groundnuts (Faye and Fall 2000). Further north, in the Louga area of Senegal, a Wolof villager commented, “Even in a bad year you can get something from a cow.” Another said it was better to invest in five lambs than in 500 kg of groundnut seed (Schoonmaker Freudenberger and Schoonmaker Freudenberger 1993). The story was repeated in Maradi, Niger, where cattle are now kept by both Hausa and Fulani (CARE 1997). Former nomads are taking up farming, and Hausa farmers are using transhumance in the wet season, sending an older child to accompany the herder (Banoïn et al. 1996).

## Changes in land use

Examination of aerial photographs and satellite imagery shows that areas like the Diourbel in Senegal were predominantly under cultivation even in the 1950s (Ba et al. 2000). Animals were sustained on the few fallows, crop residues, browse and by putting

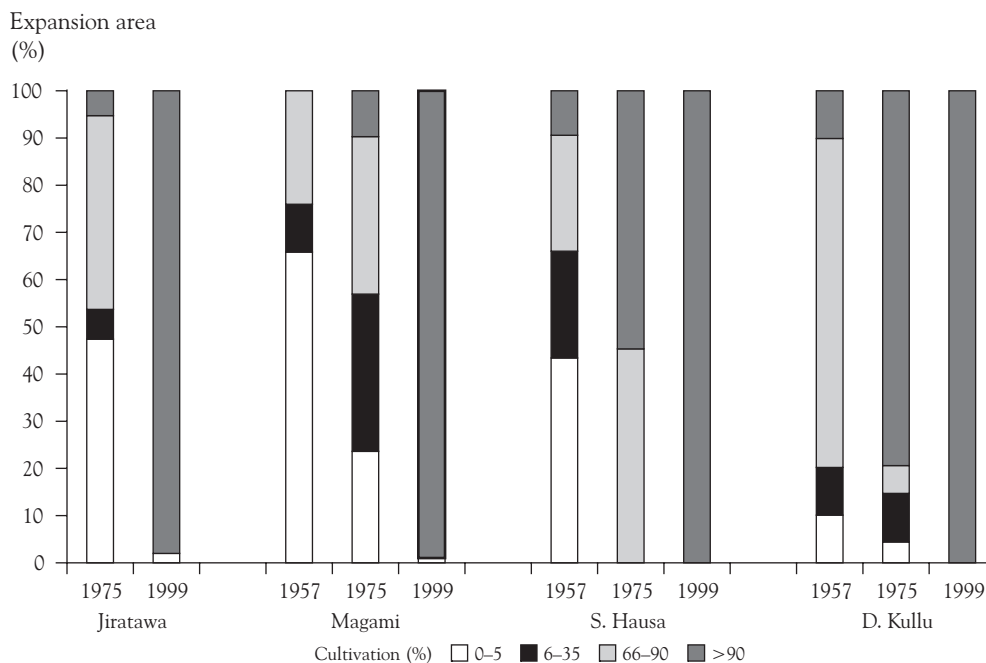


Source: Bourn and Wint (1994), Figures 10 and 11.

**Figure 5.** Distribution of livestock kept for a) animal traction and b) fattening in Nigeria (1990).

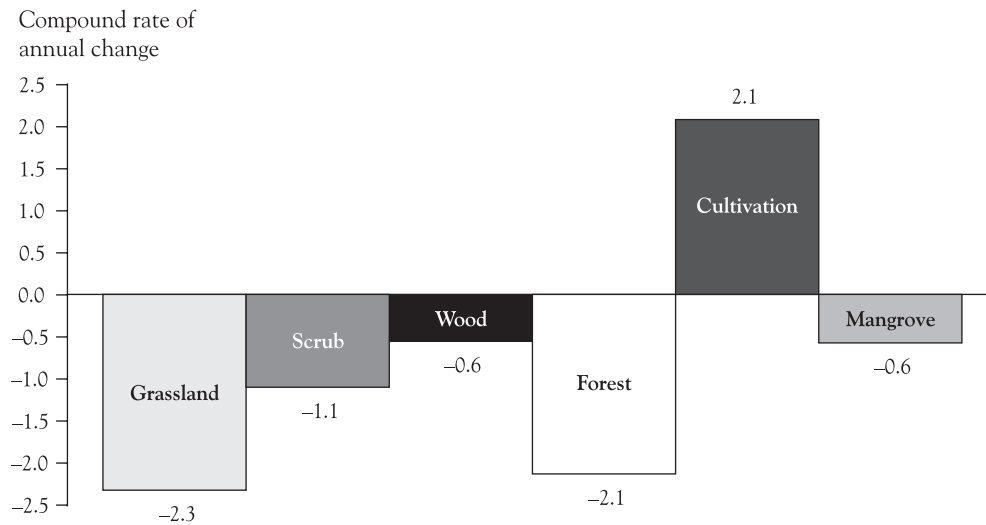
them in the care of transhumant herders for part of the year. However, there are parts of West Africa where the expansion of land under cultivation has been more recent. This is the case in the northern and central areas of Maradi, in Niger, where Figure 6 illustrates the expansion of cultivation in northern villages like Dan Kullu, on the borders of what is officially regarded as the pastoral zone. Due to the expansion of cultivation there is less land available for free grazing within the village territory.

In Nigeria, the compound rate of change in vegetation cover from 1976–90 is shown in Figure 7. Bourn and Wint (1994) noted that the large increase in cultivation and reduction in grassland, scrub and woodland had the further effect of reducing the habitat of the tsetse fly, enabling cattle to be kept far further south, in parts of the middle belt that had hitherto been inhospitable. Farmers settling in Gombe in the 1960s made the same remark, that when they first arrived they had to consign their cattle to Fulani herders to keep in northern Gombe, but that as the bush was cut, they could bring them to their farms in south Gombe (Tiffen 1976). Bourn and Wint quote the Federal Government’s Resource Inventory and Management Survey of 1992 as showing that almost half of Nigeria’s cattle population of some 14 million head was resident in the subhumid zone throughout the year.



Source: Mahamane (2001), Tables 5, 7, 9, 11.

**Figure 6.** Expansion (area %) of cultivation in four cultivation frequency classes in four villages arranged from south to north, Maradi Department, Niger (1957–99). Note: No data are available for 1957 in Jiratawa, where an irrigation system was established in 1981.



Source: Bourn and Wint (1994), Table 7.

**Figure 7.** Compound rates of annual change in Nigerian vegetation cover (1976–90).

Naturally, cultivation varies by area. Jigawa State experienced a small increase from 78% cultivated in 1976–79 to 81% in 1993–95, whereas in the less densely populated Adamawa State that was probably still attracting immigrant farmers, cultivation increased from 49% to 55% (Mortimore 2001).

## Changes in land tenure and custom

Accompanying this growing scarcity of land are parallel changes in rights to land and its products. Farmers privatise their crop residues, either by hoisting them into trees, fencing or adopting other measures to preserve them for their own use. Similarly, if they leave a field fallow (increasingly unlikely in the high-density areas) they regard the weed growth as private pasture for their own animals. This process is easily observed in Maradi (Boubacar 2000). For a variety of reasons, the land claims of the cultivator are stronger than those of the nomadic herdsman, even if the latter sometimes cultivates in the wet season. In Gombe Emirate in the 1960s village heads were asked what happened to the land if a family left the village. The replies varied according to the state of demand for the land. In an area with very low density, unattractive to immigrants, the answer was, “Nothing. Nobody cares about it.” Elsewhere, village heads gave it out to a new family after seven, three, or one years. A one-year interval endangered a semi-settled Fulani family who might or might not want to return to the plot they had cultivated. In the most densely settled, market-orientated villages, the reply was, “Naturally, they sell it before they go” (Tiffen 1976). As Mortimore (2001) observes ‘The grazier’s rights to land are only safe when he is also a farmer.’

This situation has led to conflicts between farmers and pastoralists. In Nigeria, where there are links between elite Fulani in powerful positions and their herding kinsmen, some attempt was made to create grazing reserves. However, less than 1% of the area originally intended was so gazetted (Gefu 1998). Within what is reserved, pastoralists are using some land for farming (Mortimore 2001). It seems unlikely that grazing reserves provide a future for livestock in Nigeria. The more likely future scenario is of mixed farmers, some of whom will be ex-pastoralists, who combine crop production and livestock raising in an integrated system.

### **The diminishing future of the pastoralist sector**

Mortimore (2001) argues cogently that 'The future of livestock producing systems rests with enabling closer forms of integration with farming, rather than with attempting to stop the inevitable.' He sees this as having already happened in northern Nigeria today, and as the future of the rest of the Sahel. In fact, pastoralism may well survive for several more decades in the low population density parts of the Sahel (less than 20 persons/km<sup>2</sup>) where it is a logical response to large land resources and few marketing points. However, slowly growing rural populations are likely to nibble away at any land that has the potential for crop production, which gives higher returns per hectare. And growing towns, particularly if they can develop productive industries, are likely to continue to attract some ex-pastoralists as urban workers.

## **Changes in West African crop–livestock systems, 1960–2000**

The growth of rural populations and the burgeoning of urban markets from 1960–2000 have led to enormous changes in West African agriculture. Farmers have shown great ability to adapt and change, in order to continue to earn a livelihood despite the decrease in farm size. To increase productivity, they have had to make a multitude of small investments in crop inputs and equipment, granaries, livestock, livestock inputs, hedging and fencing etc. They have also had to work harder and more efficiently, despite losing younger family members to urban occupations. The evidence of farmers' achievements and capacity to invest and adapt is shown below.

### **Senegal**

The Diourbel region became the centre of the groundnut basin of Senegal early in the 20<sup>th</sup> century. By 1960 its two eastern departments, Diourbel and Bambey, were fully occupied. Groundnut was the main crop and cash source. Farmers also grew pearl millet for their own consumption, but government policy encouraged the import of broken

rice for urban households. The Serer, who had difficulty in expanding their farms as they were surrounded by Wolof, already practised an integrated agriculture in which fertility was maintained by cattle and smallstock manure and the protection of *Faidherbia albida* trees that also provided browse. The Wolof kept few cattle and tended to meet expanding family needs for land by establishing new farms in the western department, Mbacke. They were also noted traders, and their reliance on non-farm income was already evident in 1960. Both their trade networks and their new farming establishments were facilitated by membership in a religious brotherhood, the Mourides, whose leaders accumulated capital not only for commerce but also for urban developments in their headquarters, Touba, and in Dakar. Table 4 shows changes in structure of incomes in sampled Serer and Wolof villages between 1960 and 1999.<sup>4</sup>

**Table 4.** Source of income (%) in Serer and Wolof villages, 1960 and 1999, and rice purchasing power.

Source of income	Serer 1960	Serer 1999	Wolof 1960	Wolof 1999
Market crops		21		15
Groundnut	50	17	37	8
Cowpea		2		4
Other crops		2		3
Subsistence crops	30	27	12	23
Livestock	2	21	2	16
Non-agricultural	18	31	49	47
Local activities		4		19
Migrant activities		23		28
Gifts		4		15
Total	100	100	100	100
Purchasing power, rice kg/person	201	191	434	276

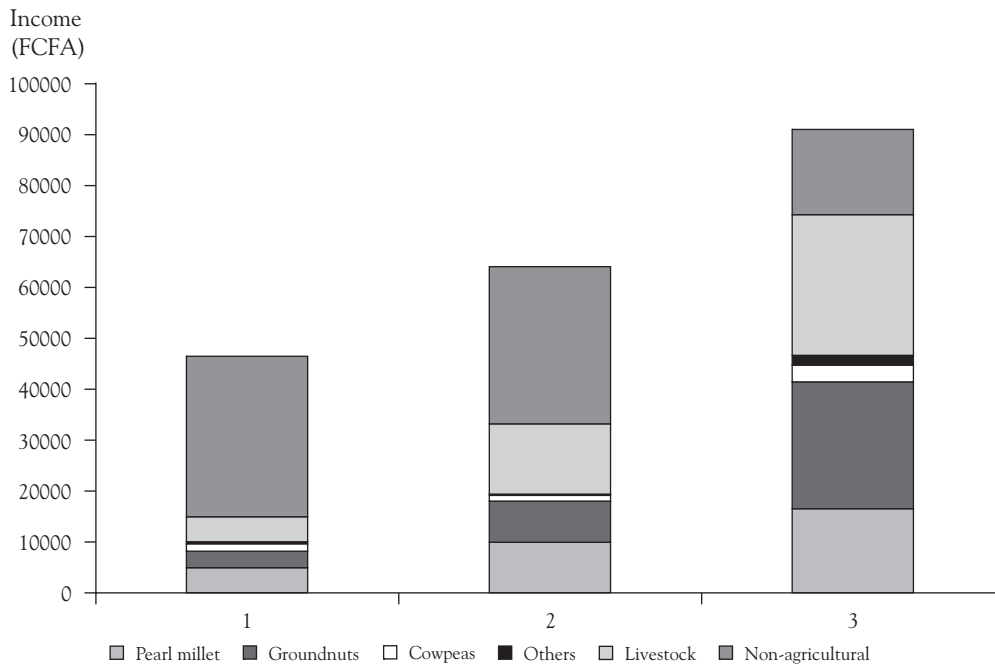
Source: Faye and Fall (2000).

Soon after independence, the government took over the French trading networks and tried to drive groundnut output upward by compulsory co-operatives, providing inputs on credit and an intensive extension–research system. However, they kept the producer price of groundnuts at a level they felt just sufficient to encourage production, in order to pay the expenses of an expanding bureaucracy, and to subsidise fertiliser and rice etc. In bad years the peasants were unable to repay their credits and the system was bankrupting the state organisations. Hence, during 1980–85 Senegal was driven reluctantly into structural adjustment, but the overvalued exchange rate that had encouraged imports was only corrected in 1994.

By 2000 local urban migration and remittance incomes were the main cash source for many rural families, followed by livestock fattening for those with the capital to enter this area. Those who have to buy most food are shortest of capital (Figure 8).

4. Note that the samples are small, and that the total incomes of people the head considers as part of his household, who contribute to his income, are not included. This probably distorts purchasing power in rice/kg per person. See Faye et al. (2001).





Source: Faye and Fall (2000), Figure 2.

**Figure 8.** Incomes (FCFA per capita) for three types of farm in Diourbel, Senegal (1999–2000).

Groundnut haulm hay had become an important tradable commodity, along with other fodder sources and groundnut meal. Groundnuts were still produced, but more were going to internal markets as locally processed oil and meal. When farmers invested, they invested in livestock and livestock inputs, rather than in crops and crop inputs (Table 5), but migration abroad was seen as the best hope for their sons.

## Maradi, Niger

In Maradi, the government never had the same control over trade as did the Senegalese government, due to closeness to the Nigerian border. As in Senegal, the main source of cash was groundnuts in the 1960s, but by 2000 it had become a variety of grains, pulses and livestock for the Nigerian market, including a new crop, tiger nut or *souchet* (*Cyperus esculentis*). Early expansion of production was by opening new farm land, but recently in the south there have been signs of a change to a more intensive type of agriculture, with manuring and the privatisation of crop residues. A land market has developed. Fertiliser was used until its price increased. As in Senegal, heavy ox-drawn equipment and fattening techniques were introduced, and credit provided, under the *Projet de Développement Rural de Maradi*, 1978–84, but fattening and increased use of draft animals increased after 1994, despite the cessation of most credit, as farmers found

**Table 5.** Use of money income according to type of household (annual percentage).

Expenditure	Type of household <sup>1</sup>		
	1 (%)	2 (%)	3 (%)
Buying			
Pearl millet	16.9	7.5	5.4
Rice	15.2	13.1	10.3
Other food	22.0	11.7	26.6
Other products	5.6	2.7	3.2
Clothing	14.3	19.2	9.0
Equipment	0.5	0.6	2.1
Animals	0.8	12.0	18.9
Animal food or medication	1.1	4.4	2.9
Crop inputs	1.9	1.9	2.4
Payments			
Services	1.6	1.8	2.0
Health and education	3.6	4.1	2.7
Ceremonial expenses	16.6	21.0	14.5
Total	100.0	100.0	100.0

1. Types: 1. Farm provides less than six months cereal needs.  
 2. Farm provides 6–11 months cereal needs.  
 3. Farm provides 12 months or more of cereal needs.

Source: Faye and Fall (2000), Table 13.

their own resources once the devaluation of the FCFA had made farming more profitable (Table 6).

**Table 6.** Year of acquisition of new capital equipment in four Maradi villages.

Date	Plow oxen	Ox cart	Heavy plow	Light plow	Bicycle	Motorcycle
Pre-1994	1	8	10	4	2	0
Post-1995	18	9	2	34	6	4

Source: Hamadou 2000.

These changes have also affected the pastoralist element. Sakabal, in northern Dakoro *arrondissement*, had only one pastoralist well until 1973. It has now become a sizable village, with an important livestock market and cropped fields (Hammel 2001). Hammel also notes that in the wetter southern zones of Maradi, agro-pastoralists are farming land near classified ‘forests’, which they try to keep as their particular home grazing area, even though the law gives them little protection.

## Nigeria

A major change in the past 40 years in Kano State has been the adoption of ox plows that were almost totally absent in the 1960s although they were adopted in the adjacent

Katsina State much earlier, in the 1950s and 1960s (Anthony et al. 1979; Anthony and Johnston 1968). Associated with this change is the increase in cattle keeping by a large minority, while sheep and goats are kept by the great majority. Table 7 shows livestock ownership in Kano State in 1984. Amongst a sample of farmers with *fadama* (low-lying land) interviewed in 1994, 78% said they held more livestock than 10 years previously (i.e. an increase over the position shown in Table 7). Only 15% said they had less livestock (World Bank, Operations Evaluation Department 1995). Farmers with *fadama* are probably better able to invest in livestock than those without the high-value crops that can be grown there in the dry season. However, this finding gives no grounds for thinking there would have been a decrease in livestock holdings elsewhere.

**Table 7.** Proportion of households (%) keeping livestock in Kano State, Nigeria, 1984.

Household livestock owners (%)	Zones			
	NE	NW	SE	SW
Total livestock	93	95	92	83
Cattle	22 (8) <sup>1</sup>	39 (7)	29 (7)	41 (6)
Sheep	75 (7)	81 (8)	73 (6)	78 (7)
Goats	86 (8)	88 (8)	82 (7)	81 (8)
Poultry	73 (18)	71 (14)	68 (14)	63 (12)
Donkeys	36	39	38	25

1. Numbers in parentheses indicate mean numbers per keeper.

Source: World Bank, Operations Evaluation Department (1995), Table 3.8, quoting Kano State Agricultural and Rural Development Authority (1986).

Evidently, in the densely settled, closely cultivated Kano State farmers are able to keep livestock, despite a shortage of communal grazing. Although only 20–40% kept cattle in 1984, numbers owned per household were quite high at 6–8. Almost all households kept goats, sheep, and poultry.

A study of the use of crop residues by 54 *fadama* farmers and 11 pastoralists in Sokoto and Zamfara States was made by Baba and Magaji (1998). They found 93% of the farmers owned livestock, and 49% had cattle. Farmers maintained 0.6 and 0.37 TLU/ha in the two study locations (using 1 head of cattle = 0.68 TLU). All farmers and pastoralists used crop residues, sorghum straw being the most common, followed by cowpea hay (81%), groundnut hay (44%), rice straw (39%) and some others. Pastoralists used a slightly different mix—rice straw was used by 100%, cowpea hay (45%) groundnut hay (27%) and pearl millet straw (18%). All pastoralists purchased rights to use crop residues on the farms their animals grazed, at a price of N 1250–N 1879/ha.<sup>5</sup> Bundles of crop residues are also sold in markets. Cowpea and groundnut hays realise considerably higher prices per kg than sorghum straw, but prices varied by location. Transport costs

5. The official exchange rate then was US\$ 1 = N 21.895, so the rates were equivalent to US\$ 57–86.

are high for these bulky products, so the markets are not well integrated. Farmers felt prices were rising.

Caring for livestock penned for fattening or to prevent crop damage consumes a lot of labour time. Mortimore and Adams (1998) compared labour expended on livestock and crops during the farming season in two dry Sahelian villages with relatively low population densities and two Sudanian villages with much higher population densities. Far less labour was spent on livestock in the Sahelian system, where a few small children could take the animals to graze on common pastures. When animals are stall-fed in the wet season on weeds and hedge-cuttings that have to be gathered daily, the work load is much higher. In the extensive Sahelian farming system, caring for livestock in the cropping season took only 20 units of labour/week compared with other farming tasks that peaked at 280 units/week. In the intensive system, livestock care took 30–70 units in some weeks, which had to be combined with other farming tasks taking 80–160 units.

Crop residues are used even when grazing is relatively available. In the Zamfara reserve in north-western Nigeria, herders take sheep and goats to graze daily in the wet season, but in the dry season browse is supplemented with crop residues and bran. Amongst the most frequently mentioned residues were groundnut hay (19.4%), followed by cowpea husk, cowpea hay, pearl millet bran, and sorghum bran (16–11% each). Enquiries were not made about purchased fodder (Hassan et al. 1998).

## Kenya

The fourth study was Makueni District, in Kenya. Like Maradi, it is an area of recent settlement but there is a contrast in livestock development, partly due to topography and partly to policy and different tenure traditions. Local custom allowed people to claim exclusive grazing areas by marking trees and establishing a cattle post, and with the push towards land demarcation and registered land titles since the 1950s, the new settlers have established farms that include both cropping and grazing areas (Tiffen et al. 1994). As time goes on, people have gradually improved these with terraces for crops and hedges or fences for the grazing areas, which may also get selective bush cutting, and some grass replanting (Gichuki 2000; Gichuki et al. 2000). The cropped area receives attention first, as it gives better returns. As there is no longer any unclaimed land, neither is there any free-access grazing.

A minority of settlers own cattle, but most have goats. If anything, cattle ownership has declined in recent years, but people blame this on disease rather than on droughts. The government Veterinary Service does not seem to have the resources to combat disease, and the area is too poor to attract a private veterinarian, although many shops now sell veterinary medicines. Since the collapse of the monopolistic Milk Marketing Board in the early 1990s private dairies have sprung up and milk sales have become more profitable. In the slightly better areas, topography allows the building of small dams and ponds, in which some farmers have invested. These farmers have then upgraded to

cross-bred cattle, protecting them from parasites with their own spraying equipment. There is a market for everything—farmers rent in or out grazing, buy bull services to improve their stock etc.

The poor cannot take part in the dairying industry, because of the high initial costs and high disease risks, but chickens and goats are extremely important to them both financially and as providers of manure. Small stock enable people to meet expenses like school fees (that are an absolute parental priority) and they can be sold when the harvest fails (Fall 2000). Unfortunately, the chickens which are often the poor person's first step in building up livestock holdings are at risk from Newcastle disease.

## Challenges posed for natural and social scientists in crop–livestock development

Population growth and urbanisation are driving a livestock revolution. Mixed farming systems are the present and the foreseeable future of West African livestock systems, with concurrent changes in livestock feeding systems and the role of grazing, fodder and penning. Urbanisation and the market changes it brings are accelerating. The world is changing, and farmers have understood this and have adapted. Researchers need to do likewise. They need to put aside old stereotypes and understand what present-day livestock keepers are doing and why, and to work with them on solving their problems. There are many areas where scientists need to improve their methods or to change their priorities. Some of them are listed below.

- **Better understanding of livestock economics.** As we were carrying out historical studies, we needed to search out previous reports on farming systems and farm economics in order to track change. Regretfully, we found that the livestock element in a farming system was almost always very cursorily treated compared to the cropping element. For example, livestock income was often given in terms of sales made in the previous year, without regard to input costs and without testing if such sales represented a drawing down of the capital stock or were taken from the natural increase. Frequently, there was not even a reference to the state of the rains in that year, although in semi-arid areas farmers in bad years may get cash mainly from sales of livestock (depleting capital), whereas in good crop years they may deliberately not sell the whole natural livestock increase in order to rebuild capital. Milk income, whether home-consumed or sold, was generally ignored. Studies seldom reported how the livestock were fed and how feed sources differed between seasons. With regard to crops, the value of crop residues, whether used as inputs or sold, was ignored.

There appears to be a gulf between those who study the declining number of pastoralists, who often do look at matters like milk sales and seasonal feeding systems, and those who study the increasing number of farmers who incorporate livestock in an integrated farming system, who ignore these matters. There are very

few studies of fattening economics, or the current market value of crop residues etc., or of changes and payments that occur in such things as access to stubble on farm land. In our own studies in Senegal, our livestock economists had to acknowledge that they had been unable to take account of the value of groundnut hay, although it is undoubtedly traded and its weight is not insubstantial in relation to the nuts themselves.

There are earnings from animal draft power, both for plowing and for general transport. How long is the working life of a draft animal and what is the optimum age at which to sell an ox? All these matters require attention if we are to understand farmers' strategies and their likely reaction to some suggested interventions or new technologies.

- **Reducing the disease risk under structural adjustment policies.** While animals provide insurance against crop risk, they are themselves subject to risk from disease and drought. In Zambia in 1992 many farmers had no cattle to sell when drought struck because they had died the previous year in a tick-borne epidemic (Tiffen and Mulele 1994). The preventative dipping system had broken down. The question of how to finance veterinary services given reduced government resources has attracted some attention, particularly in such areas as the training of para-vets. Farmers may well be willing to pay more for effective vaccination services but are they asked about this? What are the priorities for a reduced veterinary service? It almost certainly is not an artificial insemination service, at least in Kenya where farmers find private bull services cheaper (costs vary according to the perceived quality of the bull).

What can we do to help poor men and women make a more risk-free start with poultry?

- **Practical methods of increasing the utility of manure with inorganic fertilisers seen as additives rather than main source of replacement nutrients for the soil.** These methods will have to take into account the limited labour availability in the farm family.
- **Practical preserving and processing methods for meat and other livestock products to increase their market range.** In southern Africa dried meat is popular; in the Middle East yoghurt is popular. Both can be manufactured at household level, and do not need to await rural electrification. Are we doing any market research, and involving women, who may be the ones most interested in such processing activities?
- **Are current recommendations adapted to the current distribution of livestock?** This paper has dealt with livestock in the semi-arid zone of West Africa. However, in the past few decades more people and livestock have moved into the subhumid zone to the south. Have technical recommendations developed for the semi-arid and pastoral zones been modified as necessary?
- **If crop residues are becoming more important in livestock feeding, are researchers doing enough to develop practical methods of improving their nutritive content and their storage?** Practical means taking into account costs, access to materials (e.g. urea) and labour availability.

- **If fodder is becoming more important in livestock feeding, is enough consideration being given to developing multi-purpose fodder crops that would fit into existing farming systems and meet market needs?** Market needs include both crops that supply fodder and human food (e.g. certain legumes) or fodder and substitutes for expensive fertiliser. However, the latter aim must be pursued with care, taking into account the annual revenue that the farmer needs to derive from his land. For many farmers it is not practical to put land under a crop that yields neither food nor cash in year 1, even if it improves yields of the crop grown in year 2. None of the suggested forages for reducing poverty and the degradation of natural resources in a recent review appeared to meet the needs of the semi-arid areas of West Africa (Peters et al. 2001).
- **Watering—is it a problem and what are the practical solutions?** This may or may not be a problem in the context of fattening and dairy development.
- **Breeding—how should farmers take advantage of the spread of fattening techniques?** One of the drawbacks of an open grazing system is that it makes control over breeding difficult. If cows, sheep and goats are increasingly kept in enclosures, what are the implications for breeding? Are farmers already developing a market in the services of good sires, as in Kenya? Are research services taking advantage of this development?

## Livestock in the context of rural livelihoods and town development

Change is inevitable and will probably occur at an increasing rate, mainly due to the impact of increasing urbanisation. These changes will be led by the farmers who have proved themselves experts at adapting their systems to changing circumstances in the past. Their livelihood systems, as illustrated here in the case of Senegal, include more than farming. They often incorporate dry-season migration for trade or to earn income in the distant towns. In some cases, there are local towns that provide alternative or supplementary income-earning opportunities. Socially, this is more desirable than migration by males unaccompanied by their wives. For many farmers in the risky semi-arid environment having children or other relatives in urban employment is an even better insurance strategy than owning livestock.

The most desirable policies for agriculture are those that work for farmers and enable and encourage their private investments and ability to adapt. It makes sense to seek complementarity between government investment and services and private investment, when most governments are facing reduced public resources per capita (Drylands Research 2001). Encouraging private investment requires both moderate taxation regimes (otherwise private households are left without resources of their own to invest) and good management of the economy, since private investors cannot make wise

decisions in the face of unpredictable inflation or sudden changes in exchange rates. It also means concentrating government interventions on those areas where private investment and market incentives are insufficient, for example in veterinary services to combat disease or in providing rural roads and some types of water supplies. It means disseminating information, but leaving farmers to make their own judgements on whether to follow or modify it. It means improving rural people's judgement by appropriate schooling as well as by extension services. Kenyan farmers send all their children to school, at least for primary education, and if possible for more, because they appreciate its utility for both non-farm and farming jobs. As one Makueni farmer said: "Do not expect your son to get any kind of job unless he is educated. These days even herd boys have to be able to read to feed cattle well." For some reason, the utility of education offered by state schools in West Africa appears less apparent to rural parents.

Increasing the prosperity of the rural sector also requires the development of the urban sector which provides its main market (Tiffen 2003). The symbiosis between the two is currently more evident in Asia than in Africa. Some effort is required from central and local governments and community-based organisations (CBOs) to increase both the productivity and market pull of a network of small towns. This may do more for farming than direct intervention, because all the evidence shows that farmers are very capable of responding to profitable new opportunities and markets. Productive towns require such infrastructure as electricity, water and telecommunications, and so do villages that are in a position to grow into towns. All need to be linked by a good transport system.

This may seem to be straying far from the needs of the livestock sector. However, livestock are an integral part of the national economy. Research into fattening, breeding for fattening, processing, and disease prevention are all needed, to help farmers meet the challenges of rapid change in their markets and in the rural/urban balance. Some research can be done as small-scale experiments assisted by non-governmental organisations (NGOs) and CBOs. Some will be done by farmers themselves, exchanging information with traders and neighbours. Others need to be carried out by scientific institutions. However, no experiment, whether carried out by a farmer, an NGO or an international research organisation, will have lasting results unless it generates good profits under the labour, financial and climatic constraints under which people are operating. Farmers have to be good businessmen and if they are not, they are apt to end up as landless labourers.

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