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# The future of family farms in West Africa

What can we learn from  
long-term data?

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**Michael Mortimore**

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**International  
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What can we learn from long-term data?

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This paper forms part of work initiated by the Sahel and West Africa Club Secretariat (SWAC) and undertaken with IIED on Transformations in West African Agriculture and the Role of Family Farms. This is part of a larger Programme of work being undertaken by the SWAC Secretariat on the Transformation of West African Agriculture. The SWAC provided funding, together with insights and comments which contributed to the development of the document.

### **About the author**

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# Preface

## **The transformation of Western African agriculture: Introductory Remarks by Karim Hussein, Sahel and West Africa Club Secretariat**

In West Africa, agriculture and natural resources continue to provide the majority of the population's income, employment and consumption needs. These sectors generate some 30% of GDP and are still regarded as having strongest potential to be a motor for West African economic development: in principle, they can provide the best opportunities for adding value, generating growth, providing employment and reducing poverty in the medium term. However, distinctive characteristics in West African agriculture need to be taken into account in assessing how it can respond to these challenges. These include the dominance of small family-run farms with diversified livelihoods, the social organisation of production, and access to labour and technological innovation. External constraints and opportunities linked to environmental and climatic variability, legislative and institutional frameworks, access to and integration with regional and international markets also need to be addressed.

Profound processes of structural transformation in West African agriculture have accompanied varying degrees of integration with regional and international markets over the last 10 years. They have affected commodity sub-sectors, geographical areas and various types of farm in different ways. While West African agriculture has successfully adapted to increase production in response to rapid population growth in recent decades<sup>1</sup>, it is now clear that the competitiveness of West African agriculture will have to improve for it to fulfil expectations in the face of international trade liberalisation. However, identifying the levers for improving competitiveness depends on a better understanding of the changes occurring in different sub-sectors, geographical areas and types of farm.

Evidence on the nature of change processes occurring in agriculture at

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<sup>1</sup> See the Club du Sahel's *West Africa Long Term Perspective Study; Preparing for the Future. A vision of West Africa in the Year 2020*. OECD, Paris (1998).

local and national levels does exist, for example in the form of country assessments, case studies and commodity sub-sector reviews. What has been lacking is:

- An up to date, strategic and *regional* analysis of key trends on the ground drawing on available evidence on agricultural change across the region.
- An assessment of the stakes faced by different actors and types of farm in the context of change, with special attention to the role of family farms.
- Identification of the main “winners” and “losers” in this process, and
- A review of the best opportunities to increase value-added and improve competitiveness in West African agriculture given constraints and opportunities in the regional and international context.

It is also critical that the differing visions of regional actors on priorities for agricultural development are better understood in order to identify the key entry points for action. Mechanisms are therefore required to enhance the roles of diverse field level actors in analysis and their voice in decision-making.

Drawing on these observations, the SWAC Secretariat identified six areas in which the debate on West African agriculture needs to be strengthened as a precursor to the development of sound initiatives:

- The nature of diversity in West African agriculture and an operational typology of farms.
- Evidence on the nature of the adaptation of West African agriculture in response to profound transformation processes, the spatial dimensions and sub-regional specificities of changes underway, and the changes according to diverse types of farm.
- Impacts of OECD agricultural and trade policies on prospects for West African producers.
- The roles played by technical innovation processes and how agricultural service providers can better support these processes.
- The stakes faced by key categories of actors concerning agricultural transformation, from producers and their organisations through to agri-business, agricultural service providers, regional organisations and policy makers at the national and regional levels.
- Trade-offs between policy objectives and priorities for action in the sector.

Three forward-looking scoping studies were launched in late 2002 to begin to address these concerns:

1. *Transformations in West African agriculture and the role of family farms* (with Camilla Toulmin and Bara Guèye, International Institute for Environment and Development, London and Dakar).
2. *Technical innovation and the transformation of agriculture and family farms in West Africa. What roles for agricultural research and extension?* (with Jean Sibiri Zoundi, INERA, Ouagadougou).
3. *Support for the Réseau des Organisations Paysannes et de Producteurs Agricoles d'Afrique de l'Ouest (ROPPA) in implementing West Africa Economic and Monetary Union's (WAEMU) agricultural policy* (with Laval Tremblay, agricultural policy specialist, Canada, in consultation with ROPPA, Senegal and Burkina Faso)<sup>2</sup> .

These studies involved consultations both within and outside the region, with regional producer organisations, agricultural research institutes, rural development specialists, development agencies and the OECD<sup>3</sup> .

This was combined with a review of the literature and practice. As a result these papers provide a unique overview of practice, an empirically grounded analysis of structural trends and an outline of current challenges for policy and practice concerning agriculture in West Africa. Each paper begins with an Executive Summary in both English and French, geared to presenting the essential trends and arguments arising from the analysis and key recommendations.

It is hoped that the conclusions of these studies, coupled with consultation of SWAC stakeholders and regional specialists, will provide the groundwork for the SWAC Secretariat's work on agriculture and rural development in the coming years. This will aim to combine strategic analysis of trends on the ground with operational conclusions that can inform the development of concrete initiatives implemented by regional development actors.

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2 Copies of these studies can be obtained from Sylvie Letassey (sylvie.letassey@oecd.org).

3 In addition, drafts of the first two reports were discussed at an internal SWAC Secretariat/OECD feedback meeting in February 2003 supplemented by comments from a former Secretary of State for agriculture in the region; comments from ROPPA were taken into account in finalising the third report.

*To inform our Work Programme, we invite readers to send us feedback on the data and trends presented, the priority actions identified and recommendations for follow up contained in these studies. We would be pleased to receive suggestions on areas where collaboration with specific regional actors would be fruitful and where synergies with parallel initiatives might be developed.*

We look forward to your reactions in due course.

**Karim Hussein, Principal Administrator, SWAC Secretariat** (Coordinator of the Secretariat's prospective studies on the Transformation of West African Agriculture)

For further electronic discussions on this topic please go to:

English: <http://www.sahel-club.org/en/agri/index.htm>

French: <http://www.sahel-club.org/fr/agri/index.htm>

# 1. Introduction

Continuity is a strong feature of West African social and economic organisation and activity. Therefore it is certain that the directions taken in future will be rooted in the past and present. Smallholdings or family farms have until now provided an overwhelming proportion of agricultural output, and until quite recently employed the bulk of the populations of all West African countries. To depart from a smallholder model of agricultural development, therefore, would be to introduce a major discontinuity into the trajectory of agricultural development, with many unforeseeable consequences. However, small-scale family farming which has supported West Africans for thousands of years may be newly vulnerable under conditions of open, competitive global markets and processes of globalisation which transfer economic advantage to the rich nations.

Since the end of the colonial era (early 1960s), long-term data series have evolved relating to many critical parameters of development. The purpose of this preliminary study is to examine some of the series relating to agriculture, with a view to exposing major strengths (or weaknesses) of the 'family farming sector' (i.e., smallholder farming and livestock keeping systems). It is a premise that knowledge of the evolution of these systems – in the 40 years that have now succeeded the ending of colonial rule – is a necessary prerequisite for identifying appropriate policies for the future.<sup>1</sup>

Data collection in tropical Africa has tended to lag behind some other parts of the world both in terms of quality and of quantity. Some of these deficiencies, with experience, have been reduced or eliminated, but there are still problems with some of the data series. It has been customary in some quarters to dismiss such data as worthless and to rely instead either on popular interpretations of change based on 'expert opinion' and anecdotes, or on micro-scale studies which although more accurate, are uneven in coverage and perhaps unrepresentative. The following discus-

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<sup>1</sup> The data used here are derived from the FAO Database (<http://apps.fao.org>), which cover the period 1961-2001 in annual series, supported by selected data from the World Bank Africa Database, 1965-1995. All findings are provisional.

sion does not ignore the existence of data problems, particularly in long series, but accepts the fact that for good or ill, such data will be used to make a case for alternative policies. It is worth asking what they can tell us about the performance of the 'family farming sector' during the past 40 years, while accepting that like any other source, they offer a narrative that requires critique, contextualisation, and confirmation from alternative sources.

The following themes are addressed:

- The case against family farming: increasing food imports and failing agricultural exports
- Variability and trends of change (rainfall, terrestrial environment, political economy)
- Demographic growth and the evolution of the agricultural population
- Land development: investing in land use transformation
- Food sufficiency: meeting domestic demand
- Factor efficiency: evidence of intensification
- Price incentives and competitiveness
- Smallholder livestock production

The following six countries were selected for this survey: Nigeria, Ghana, Côte d'Ivoire, Senegal, Mali and Niger, as representing a variety of conditions, in particular the differences between 'coastal' and 'Sahelian' states, and a number large enough to suggest general findings for West Africa as a whole. The data are available at the national level and apply to the agricultural sector as a whole. The assumption is made in this survey that the agricultural sector is a satisfactory proxy for family farming, which is understood to mean small or medium-sized owner-operated enterprises.<sup>2</sup>

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2 Large scale commercial farms and ranches exist, but in small numbers, compared with those of smallholdings, and many of them modest in size and owner-operated. West Africa never experienced large-scale colonial alienation of land comparable to that in southern or eastern Africa, and while large farms acquired more recently by officials, military or wealthy individuals are widely reported, especially in Nigeria, title to extensive unclaimed land is increasingly hard to obtain.

## 2. The case against family farming

In economic terms, the case against the agricultural sector, and by implication against smallholder farming, in West Africa rests mainly on two foundations: high and increasing levels of dependency on imported food, and a failure in several countries to maintain exports at the levels achieved in the 1960s. Using a long-term approach, what do the data tell us? Are such conclusions valid as a judgement on the economic performance or overall capability of family farming?

*Food imports.* We have no data for food imports separately from total imports of agricultural products; so these values must be taken as proxies for food, not an unreasonable assumption when considering broad trends.

- Imports by value show increasing trends over the period, 1961-2001, as a whole (Fig 1). In general, there were rapid and accelerating increases until the early 1980s, followed by falls: in some countries – notably Nigeria – dramatic ones. By the 1990s, increases had resumed, generally to levels higher (in nominal terms) than those of the early 1980s.<sup>3</sup>
- It is not practicable to convert these values into real terms owing to the lack of a generally applicable deflator. However, in per capita terms, the increases are far less striking (Fig. 2), with the exceptions of Senegal and Côte d’Ivoire, which since the 1980s have been an order of magnitude higher than the others. Nigeria’s much-maligned tendency to import food was brought under control so effectively that its imports per capita fell below those of all the other countries for six years, and remain on a par with those of Ghana, Mali and Niger.
- From the uneven trajectories may fairly be deduced that the primary determinant was policy, acting on the demand for imported food. Nigeria is the most conspicuous example. In the Sahel countries, decisions to import food aid were forced on governments during drought-induced scarcities. During the 1980s, most countries introduced structural adjustment programmes or otherwise intervened. In January, 1994, the CFA franc was devalued by 50%.

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3 Note that values for Nigeria are shown divided by 10, to reduce scale disparity.

- A closer look at three well-known food importation narratives (wheat in Nigeria, meat in Côte d'Ivoire and rice in Senegal) confirms this role of policy (Fig.3). In Nigeria, wheat imports (and also those of rice) were brought under strict control by the Babangida government in 1986, but later relaxed. In Côte d'Ivoire, the dumping of European Community meat is said to have undermined domestic production until a sharp decline after 1991; devaluation confirmed this fall in 1994. In Senegal, more or less continuous policy support for the importation of rice (which many Senegalese prefer to domestically produced rainfed cereals) produced a consistent upward trajectory, accelerating slightly during the 1990s.

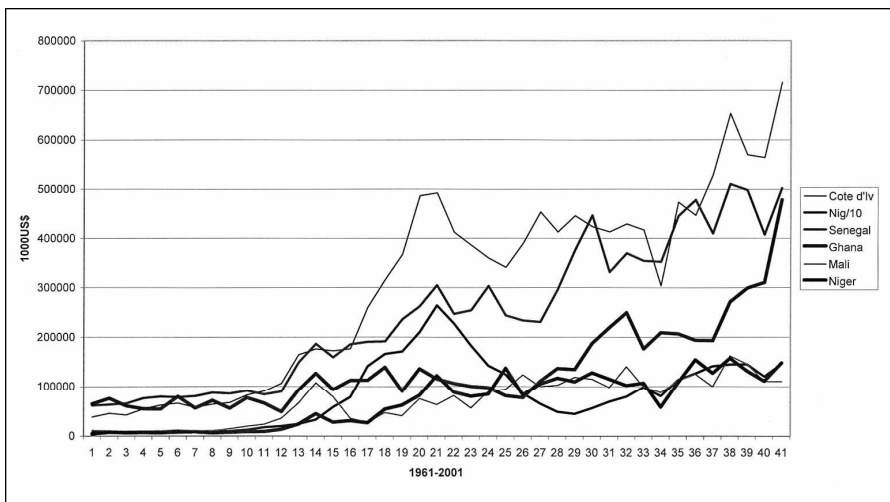
*Agricultural exports.* Rising trends in food imports of West African countries (which are, of course, consistent with world-wide growth in food commodity trading) should give cause for concern at the macro-economic level only if national food sufficiency is a policy objective or (given open market policies) if exports are insufficient to pay for them. In an absence of strong non-agricultural export sectors this means exports of the traditional crops – cocoa, coffee, palm oil/kernels, cotton, groundnuts – to markets outside Africa. Revival of agricultural exports has been advocated in influential donor circles as a prime strategy for sub-Saharan countries.

Among the six countries considered here, Nigeria ceased to depend on agricultural exports for its major revenues as long ago as the 1970s, on account of its oil exports, and Niger enjoyed a short-lived uranium boom during the 1970s. In both countries, governmental concern at rising dependency on food imports (in Niger, much of it in the form of food aid) led to food sufficiency being adopted as an agrarian policy from the later 1970s to the early 1980s (Hamadou, 2000b; Mustapha and Meagher, 2000).

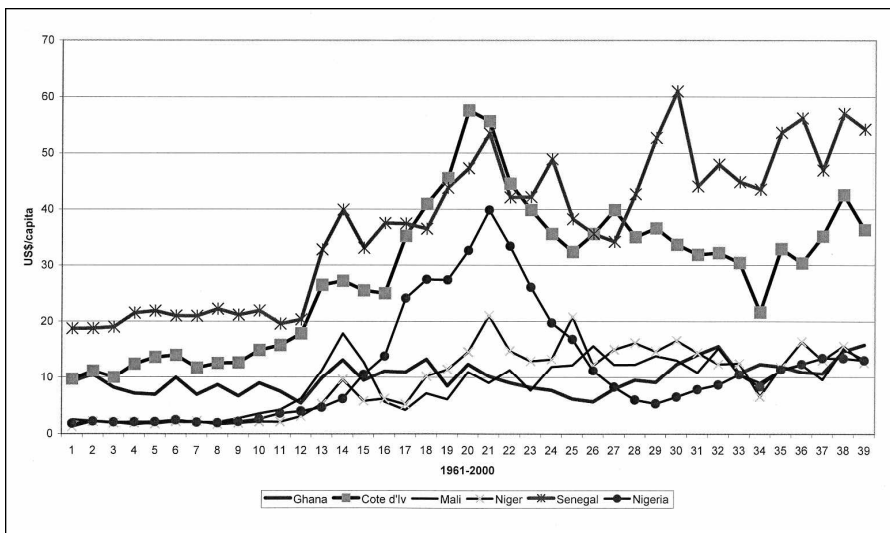
- Only Côte d'Ivoire (Fig 4) sustained export growth consistently throughout the 40 years, and this achievement was mainly due to the performance of cocoa, whose exports increased tenfold from <100,000 in 1961 to a peak of >1,000,000 tons in 1999-2000. Cocoa prices performed better on the whole than those of other West African export crops.

- Ghana's cocoa exports, however (Fig.5), fell erratically until the 1980s, and afterwards recovered, but remain about one-third down on the level achieved at the beginning of the period (c.250,000 compared with c.400,000 tons). The link with Ghana's well-known macro-economic policy failure and recent recovery is suggestive.
- The three groundnut-producing countries (Nigeria, Senegal and Niger) all experienced a collapse of exports of nuts following the Sahel Drought in 1972-74. Thereafter, Niger (Fig 6) followed Nigeria (Fig 7), where exports never recovered, while Senegal (Fig 8), whose economy depends on groundnuts to a greater extent than that of either of the others, survived, as an exporter of oil. This was due to a policy priority of adding value before export. Groundnuts have not ceased to be grown in Niger and Nigeria. Rather, a voracious domestic demand for both oil and nuts, fuelled mainly by the impact of Nigerian oil revenues on personal incomes, through urbanisation and economic growth, offered better prices than exporters could pay.
- Mali depends heavily on cotton exports (Fig 9), and notwithstanding the vicissitudes of drought, strongly interventionist policies in the cotton zone of southern Mali secured a measure of continuity over the period, though growth in exports failed after the mid-1970s.
- Nigeria's complex patterns (Fig 7) show, overall, the slump which followed the loss of global markets for groundnuts, cotton and palm oil/kernels after the early 1970s. Drought hit cotton as well as groundnuts, and thereafter cotton exports were also affected by strong domestic demand. There was a great deal of investment in textile mills during the 1960s and 1970s. Nigeria now exploits regional markets for cotton goods. Palm produce similarly has been diverted to a prosperous and growing domestic market. Nigeria's cocoa exports were sustained, and it may be suggested that factors in the relatively strong performance of cocoa *vis a vis* other export crops are the absence of a strong domestic market, the long-term investment cycle of tree crops, and the beneficial interactions of trees with annual crops in forest farming systems.
- Livestock exports to other countries in the region are particularly important in Niger and Mali, but have not been traced through this summary statistical exercise.

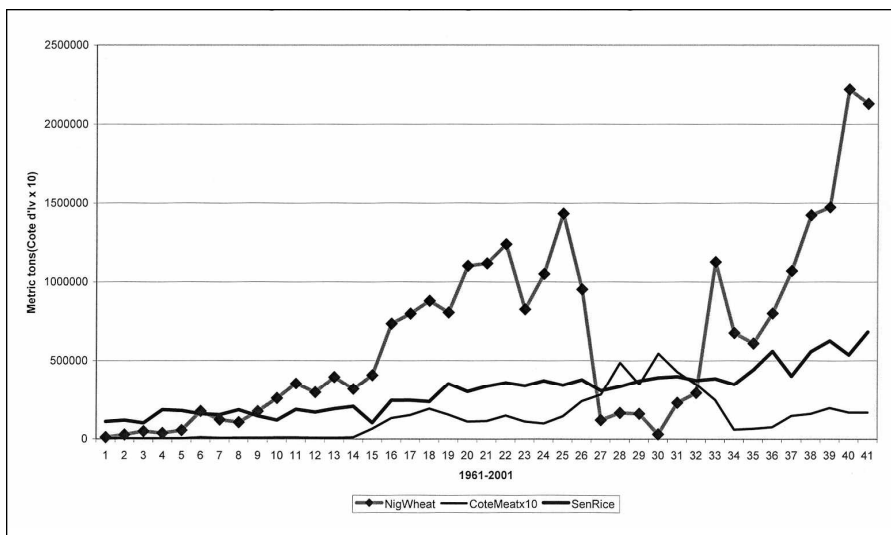
**Figure 1. Total agricultural imports by value**



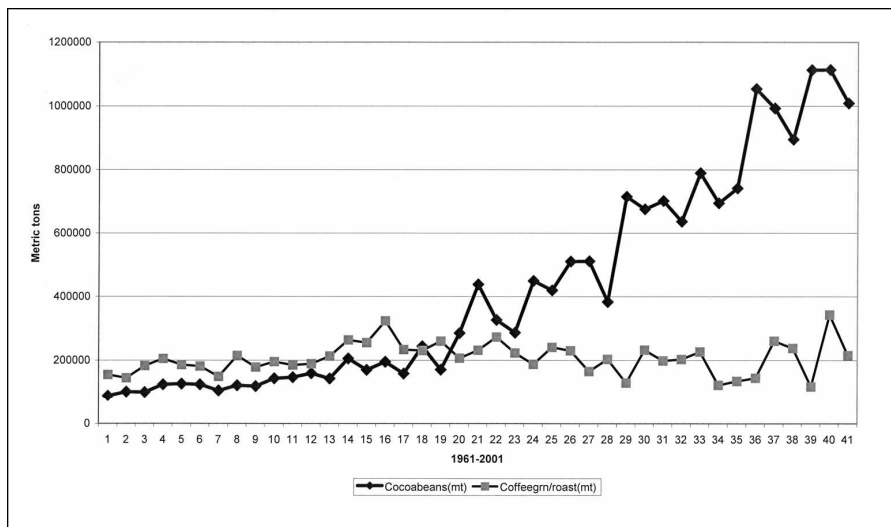
**Figure 2. Total agricultural imports (US\$/capita)**



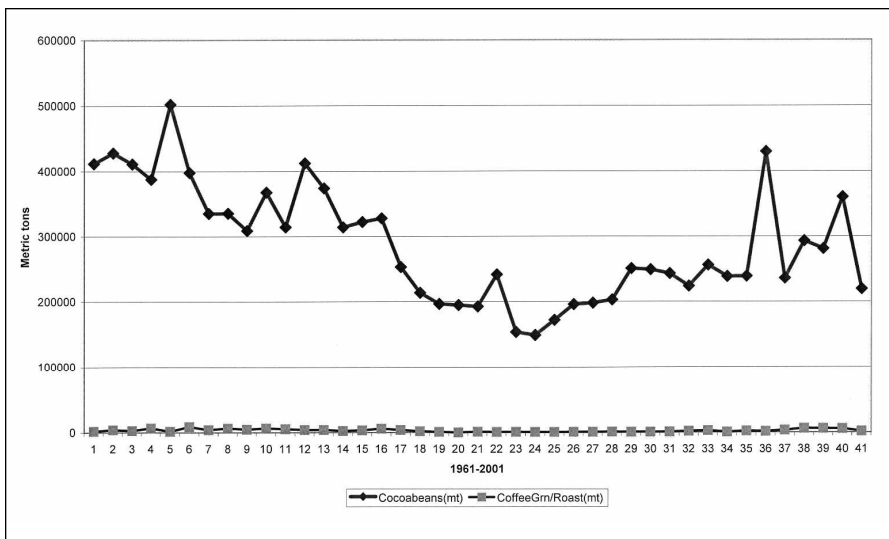
**Figure 3. Selected food imports, Nigeria, Côte d'Ivoire, Senegal**



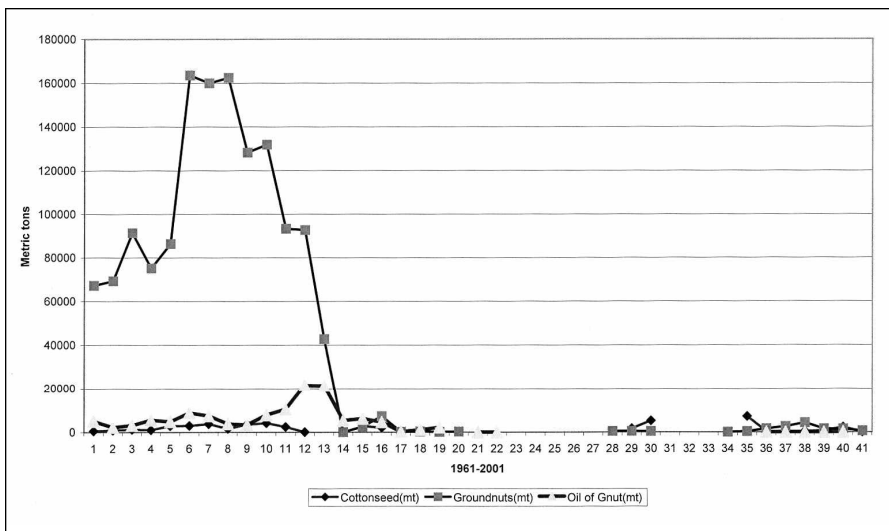
**Figure 4. Cocoa beans and coffee bean exports, Côte d'Ivoire**



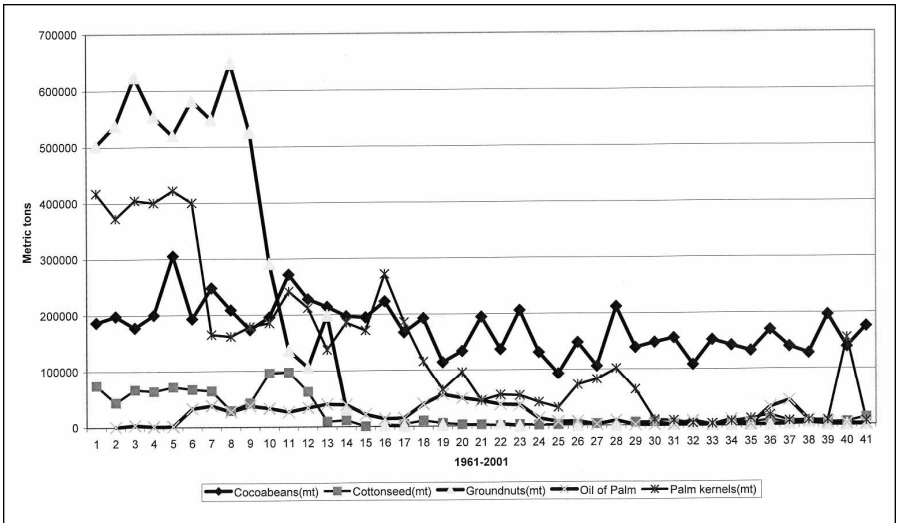
**Figure 5. Cocoa beans and coffee beans exports, Ghana**



**Figure 6. Cotton, groundnut, and groundnut oil exports, Niger**



**Figure 7. Cocoa beans, cottonseed, groundnut, palm oil and kernel exports, Nigeria**



**Figure 8. Groundnut and groundnut oil exports, Senegal**

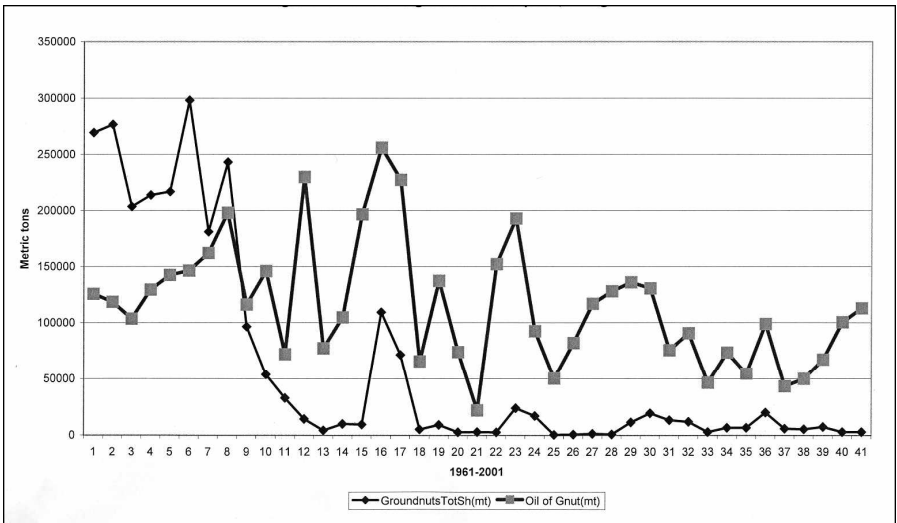
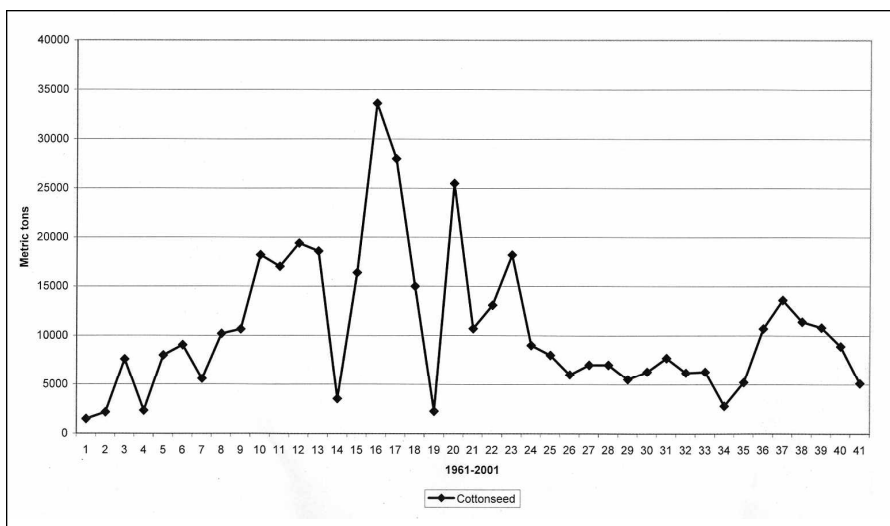


Figure 9. Cottonseed exports, Mali



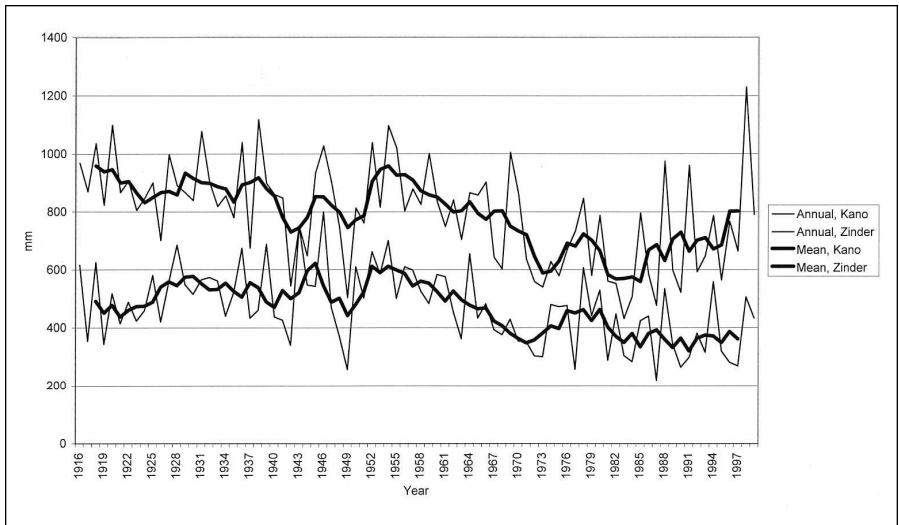
Even without a systematic analysis of policies and their impact at the national level (which is beyond the scope of this survey), our review of long-term trends in agricultural trade offers little or no evidence of any limitations in the productive *capability* of family farming, but plenty of suggestive evidence that *policy and pricing* is a prime determinant of performance. A second determinant, most important in the Sahelian sub-region, is drought, a factor which affects output episodically, whether from family farming or from alternative systems of production.

We conclude, therefore, that export and import of agricultural commodities is more or less entirely at the mercy of global markets and national policy (in turn driven by global trends and the policies of donors). On the basis of past performance, export agriculture offers only limited scope for revival. (The competitive success of Côte d'Ivoire in certain crops will be difficult to scale up to regional level given the sensitivity of global prices to risk of glut.) This brief review of agricultural trade does not offer a valid basis for evaluating the capabilities, either past or future, of family farming as such. Such capabilities are suggested more strikingly by domestic agricultural performance, to which we now turn.

### 3. Variability and trends of change (rainfall, terrestrial environment, political economy)

First it is necessary to review long-term trends in the climatic and demographic variables. Approximately half of the population of West Africa lives under seasonal climatic regimes (Sahelian, Sudanian or sub-humid savanna drylands) that combine some degree of aridity with variability in the amounts of rainfall received during the growing season. Although variability also affects the humid zone, where rainy seasons are more extended, the consequences are less drastic for livelihoods. From the 1960s to the 1990s a prolonged downward trend affected rainfall in the West African drylands, with a proportionate increase in the frequency of drought (Badiane *et al.*, 2000; Hulme *et al.*, 2001; Mortimore, 2000). This is illustrated in the recorded rainfall at Kano, Nigeria and Zinder, Niger (Fig 10). Both variability and decline have profound implications for biomass productivity, which depends on rainfall, and supports farming and livestock-based livelihoods.

**Figure 10. Annual rainfall, Kano and Zinder, with 5-yr mean, 1916-1999**



Environmental degradation in the forms of soil erosion (by water or wind), soil nutrient 'mining', deforestation, salinisation in irrigated areas and industrial or waste pollution in rapidly growing urban areas are claimed to have reached unsustainable or dangerous levels in West Africa (Oldeman and Hakkeling, 1990); *World Atlas of Desertification*, 1994). Notwithstanding a critical debate about process, scale, and definition, these claims have stuck, at least in the orthodoxy driving policy at national or international levels. While the blame for many degradational processes is usually placed on small farmers, from an individual's standpoint, environmental change is largely exogenous and out of his/her control. This issue of agency is an important one needing clarification.

Since the era of independence (1957-60), economic policies at state level have vacillated in many West African countries, reflecting both political ideology and shifting fashions among development economists and advisors. It is not generally appreciated outside the region how significant such swings could be, because of the persistence of a stereotype of 'subsistence' farming in more or less closed systems. In many countries, the 1960s were dominated by essentially 'colonial' policies that relied on maintaining agricultural exports to global markets for a large share of government revenues. Under current orthodoxy, a prioritisation of industrialisation led to a down-sizing or neglect of the agricultural sector, especially where valuable mineral exports came on stream in the 1970s (e.g., oil in Nigeria and uranium in Niger). This often led to unfavourable pricing for primary producers. In response to declining food sufficiency, some governments responded by promoting food production, often with subsidies. These proved financially unsustainable, more especially where falling commodity prices hit the export sector. Structural adjustment programmes imposed at the behest of international financial institutions, with little regard for shocks or unwanted side-effects, led to a very difficult period for livelihood building from the 1980s. Since then there have been further changes, continuing the instability in some countries. Prominent examples were the devaluation of the CFA franc in January, 1994, and the removal and later partial re-instatement of fertilizer subsidies in Nigeria.

The impact of these major drivers of change, and their associated instabilities, collectively constituted an adaptive challenge to smallholder producers comparable in scale to the much better publicised changes faced in the 'transition economies' from the 1980s. This challenge was for long under-estimated by the experts' preferences for a simplistic 'diagnostic-

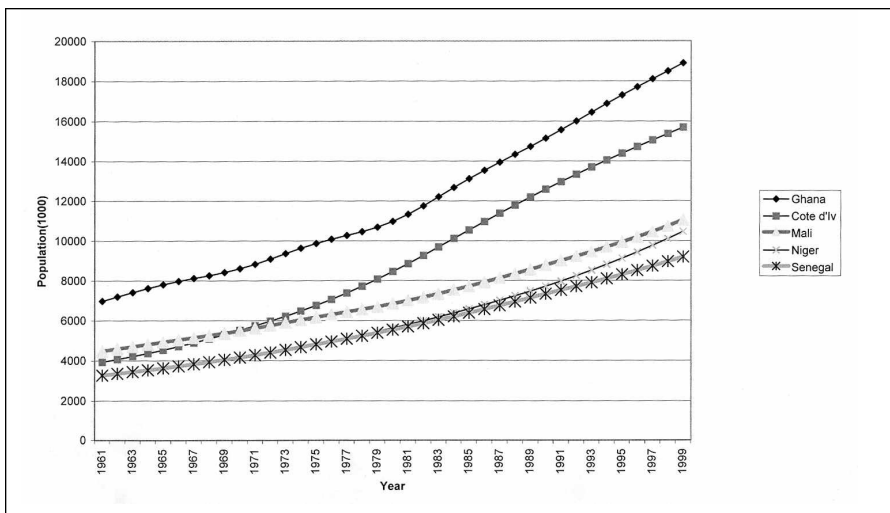
prescriptive' frame of reference in development projects or programmes that downplayed the impact of long-term variability or change. It is impracticable in the present document to go into more detail. But, in relation to our objective, the first point that we stress is that the survival or *persistence* of rural communities and livelihoods throughout this long period of external challenge is itself a strong argument for taking their internal resources seriously. Even in the drylands, where the Sahel Drought of the early 1970s, together with the negative impact of colonial export agriculture, was confidently predicted to bring disaster to several regions or peoples (see, for example, arguments developed by (Copans, 1975; Watts, 1983), many more people are found today than were there in 1960, social continuity having been underwritten by complex adaptive behaviour.

We next look at the nature of the demographic challenge in the six chosen countries.

## 4. Growth of population and of the agricultural population

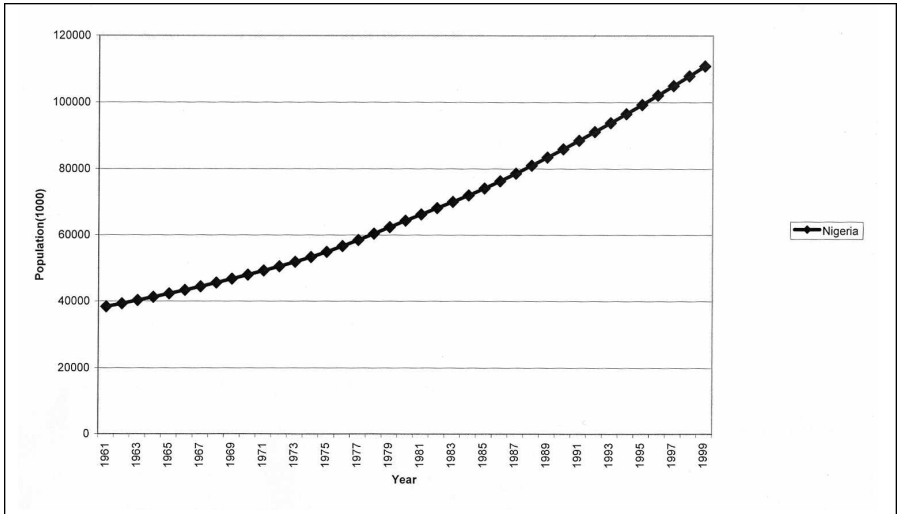
Population census data are discontinuous and sometimes unreliable; the interpolations which are necessary to generate a time series for comparison with agricultural output (or other) variables can, therefore, not only impart a fictitious regularity to the plotted curves but also a misleading slope. Nevertheless it is clear that among the six countries, a strict geometrical curve in the growth in the total estimated population is only proposed in two (Mali and Niger – the second having had only two censuses, in 1977 and 1988) (Barry *et al.*, 2000; Tiffen, 2001). The others admit some indication of the deceleration to be expected in the first stage of a demographic transition (Fig 11a,b).

**Figure 11a. Total population**



The expected transition to a relatively small (and eventually smaller) agricultural labour force, which follows from urbanisation and employment diversification, is apparently further advanced (Fig 12a,b). Using the 'agricultural population' – as defined and estimated by FAO – as a proxy for this variable, we find that (expressed as a percentage of the total popula-

Figure 11b. Total population

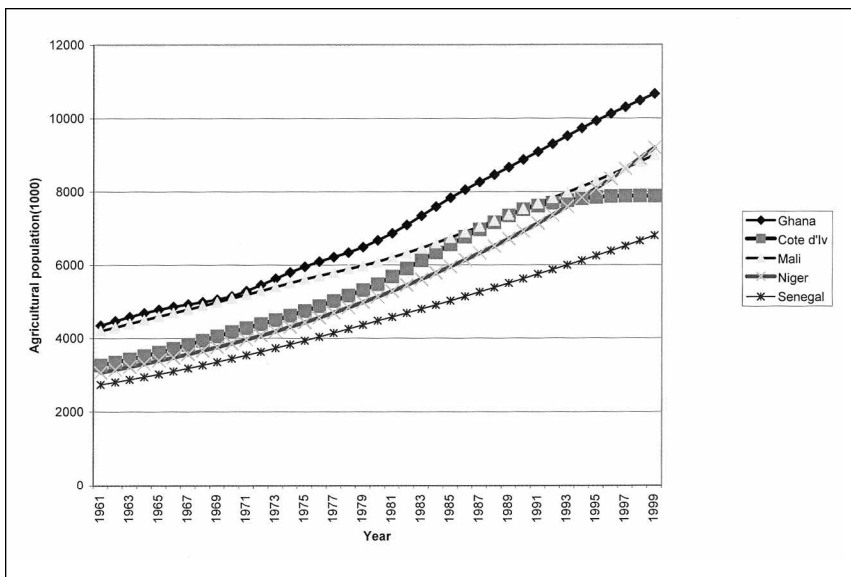


tion), it has grown significantly more slowly in all countries save Mali and Niger. Even there, the visible scale of urbanisation in Niamey or Bamako speaks for itself. The most interesting countries are Nigeria and Cote d'Ivoire, where the agricultural population, as a percentage of total population, is estimated to have already gone into decline, and even in absolute terms, has stagnated since the early 1990s. What is happening today in Nigeria is considered to be likely in future elsewhere (Snrech, 1995).

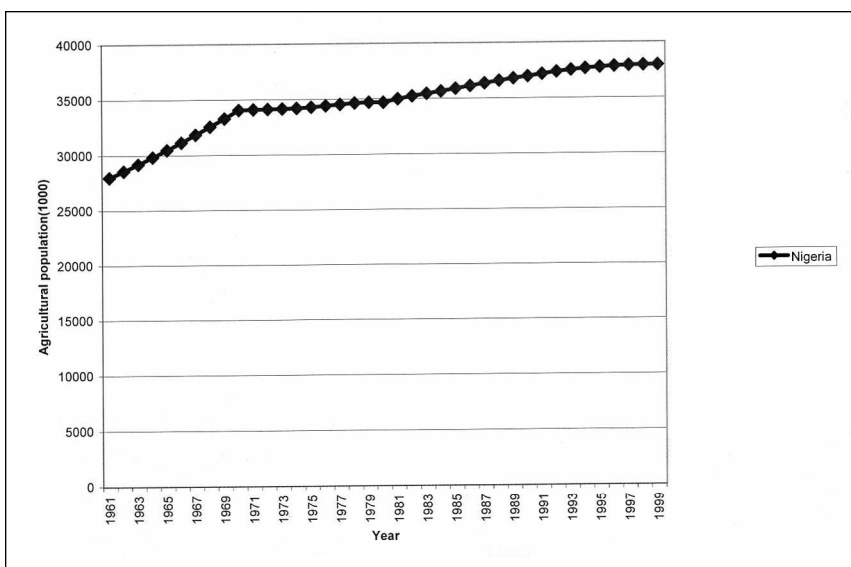
The growth trends, and the *absolute* numbers, define the challenge for achieving food sufficiency in basic staples, in so far as this is a recognised aim of macro-economic policy. The trends in the agricultural population, and its *relative* numbers, in so far as this statistic can serve as a proxy for the agricultural labour force, can on the other hand give an indication of trends in the efficiency of labour use in agriculture. These themes are explored below. In both, it will be seen that crude thinking about 'over-population' does little to advance understanding of the performance of the smallholder agricultural sector.

Before taking up these questions, it is necessary to take a critical look at land development – the process of investing in land use transformation.

**Figure 12a. Agricultural population**



**Figure 12b. Agricultural population**



## 5. Land development: investing in land use transformation

The extension of the cropland area is commonly misrepresented as a form of mismanagement of natural resources, summarised in such pejorative expressions as 'slash and burn' or 'nutrient mining'. Because development projects or programmes, obsessed with the technical 'modernisation' of agriculture, have provided credit to farmers on an assumption that they cannot or do not invest, the value and achievements of private investment in African agrarian landscapes have been consistently under-estimated by outsiders. It is easily forgotten that transforming natural vegetation into farmland costs appreciable amounts of labour or money, often invested in small increments over a period of time. Data are available from micro-scale studies for estimating such costs. At the national level, however, gross estimates would be dangerous and a proxy variable is preferred. The best available (in a long time series) is the growth of the cultivated fraction, as variously recognised in land use classifications (Ba *et al.*, 2000; Mahamane, 2001). This land – in rural West Africa – has almost all been transformed from natural vegetation into some form of agriculturally productive land under small-scale farming using hand technologies. The use of this as an indicator of private investment is unusual practice, but relevant in systems where the greater part of landscape transformation has been achieved by unpaid labour with few or no purchased inputs. It may also be objected that the indicator measures farm investment but not investment in livestock, which traditionally depended on the use of grazing resources in natural woodlands or grasslands. However, under present conditions this objection is weakened by the observed facts that livestock are increasingly dependent today on biomass produced on farms – residues, boundary plants, tree foliage, weeds – and that formerly 'natural' vegetation is increasingly found to be, in reality, managed fallows forming a part of the farming cycle (Harris, 2000; Issaka, 2001).

It is therefore possible to use the cultivated fraction, not as a measure of deforestation (as often assumed) – a negative development indicator – but rather of small private investments in land development over time. (This merely brings evaluation of landscape transformations in Africa into line with what is accepted practice in European economic history.) Even before the beginning of our period (1960), over substantial areas in some

of our chosen countries, over 75% of the surface was under cultivation and short (grass) fallow cycles, in both drylands and humid forests (e.g., in the *bassin arachidier* of Senegal, the Kano Close-Settled Zone of Northern Nigeria, and the oil-palm farmlands of south-eastern Nigeria). 'Saturation' is a word used to describe a situation where no more land can be obtained that is free from private claims. Such a landscape transformation represents an immense investment of effort in clearance, suppression of natural regeneration, re-organisation into fields and holdings, sometimes with permanent boundaries, the protection or planting of useful trees, and experimentation with – and subsequently the regularisation of – soil fertility management. The closing of the land frontier has no less significance in West Africa today than it did a century ago in North America or Australia.

Unfortunately, the FAO data on land use call for considerable caution. No countries have enjoyed detailed, ground-based surveys of land use covering the whole national territory, and even if they had, the parameter of interest to us – change over time – would still present problems. Merely adding up harvested areas for all crops, using projections from sample surveys, risks under-estimation from the withholding of information and over-estimation from double-counting mixed cropping. FAO land use data are based on agricultural sample surveys or – especially for earlier years – estimates or guesstimates, some of which are repeated year after year as if no change had occurred. Remotely sensed data have fewer technical problems. Surveys based on the interpretation of earth satellite data, either selectively or comprehensively sampled, have been carried out in Nigeria. (It is not known at present what is available elsewhere.)

Charting the changes in the cultivated fraction is pointless unless linked to one or more drivers. Many drivers affect land use change world-wide (Lambin *et al.*, 2001). The first one to consider is demographic growth, as it is commonly alleged that too many people result in uneconomically small landholdings – which is portrayed as a major flaw in family farming. Of course it should not be the total population that is considered but the agricultural population (those actually using agricultural land), which can be simply divided by the area found to be under cultivation at the time of surveys, with interpolations in intermediate years. In performing this crude operation, it emerges that each of the six countries has a unique relationship. The differences are instructive.

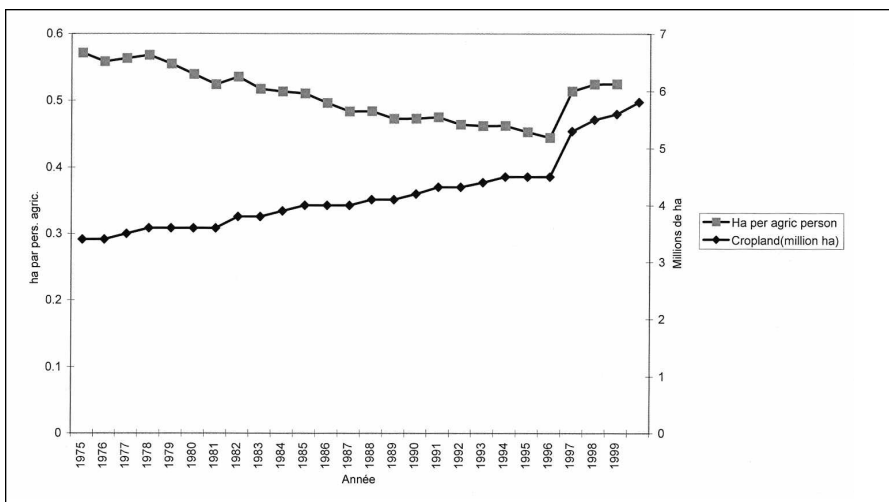
## Ghana model (Fig 13)

The class 'cropland' combines the FAO's two classes of arable land under temporary crops – mostly annual or shorter season crops, and land under permanent crops – mostly trees or shrubs. A comparison of **Fig 13** with the trajectories of growth in Ghana's total population (**Fig 11a**) and agricultural population (**Fig 12a**) – which are similar, according to the estimates – suggests a simple relationship between rapid and sustained population growth, on the one hand and much slower growth in cropland, on the other, producing a decline in the number of hectares of cropland per agricultural person, apart from an inflexion in 1997 when an upward revision in the estimating procedure for cropland distorted both trajectories. The data before 1975 cannot be used with confidence because they assume an unchanged area of cropland 1961-75, which is improbable. The 'Ghana model' appears to illustrate a primordial relationship between demographic factors and land use change – 'not enough land to go around' in neo-Malthusian terms. It implies a need for a rising trend in productivity per hectare, if the rising agricultural population were to provide its own needs, let alone those of the non-agricultural population. But why did not cropland increase faster? There are two possible answers – either there was not enough cultivable land available, or the economic incentives were inadequate for agricultural investment. The first can be excluded (at a national scale, though there were – and are – severe local shortages), as cropland, according to these data, occupied only 14.5% of the national space in 1961, and 25.5% in 1999. The residue is not, all of it, likely to be uncultivable. An hypothesis that the decline in cropland per agricultural person was due to weak investment incentives, however, accords with the under-performance of the economy as a whole – from the mistakes of prioritising industrialisation and state farming in the 1960s up until revival occurred in the later 1990s.

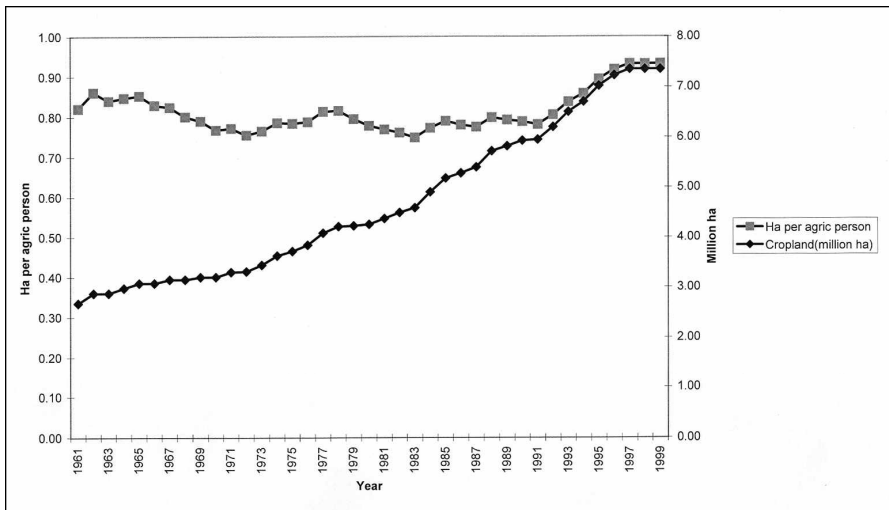
## Côte d'Ivoire model (Fig 14)

A plausible upward trend in cropland, sustained over the entire 40 years, gives ground for confidence in the data for Côte d'Ivoire. The trajectory of average cropland per agricultural person did not decline, as in Ghana, except for short periods (the longest being 1965-1973). This was despite an equally rapid growth in the total population (Fig 11a). It even increased notably – by more than 10% - between 1991 and 1997, ending significantly higher than in any previous year. A glance at Fig 12a shows that in the 1990s, growth in the agricultural population is considered to

**Figure 13. Cropland and agricultural population, Ghana, 1975-1999**



**Figure 14. Cropland and agricultural population, Côte d'Ivoire**



have ceased, reflecting increased urban migration and a parallel decrease in the rural population. The 'Côte d'Ivoire model' suggests strong investment incentives in agriculture during most of the period, though leveling off in the later 1990s. This is consistent with the country's reputation for prosperity and sound economic management during most of the period. Cropland increased from 8.5% to 23.5% of the national space between 1961 and 1999, and appeared set to continue to increase.

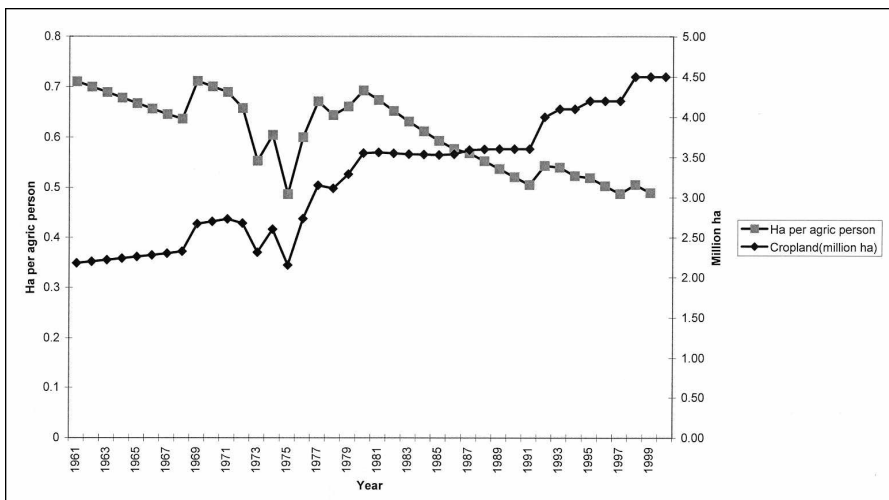
### **Niger model (Fig 15)**

Niger – whether or not the geometrical demographic trajectories portrayed in **Figs 11a,b** and are reliable – experienced rapid growth in both variables during most of the period. The conjunction of cropland area and of cropland per agricultural person appears classically Malthusian. The overall increase in cropland was similar in scale to that in Côte d'Ivoire, though fictitious 'flats' appear where fixed estimates were used (1961-1969; 1981-1991). Average cropland per agricultural person trended remorselessly downwards (ignoring some upward inflexions caused, as elsewhere, by revisions of the land use estimations). Two features distinguish this Sahelian trajectory from those of both Ghana and Côte d'Ivoire. The first, visible in the graph, is the violent oscillation recorded at the time of the Sahel Drought (1973-1975), when there is known to have been a withdrawal of cultivation from marginal areas. (An absence of similar oscillation in later drought cycles is explained by the use of fixed land use estimates). The second, not shown in the graph, is the operation of an ecological barrier to farm investment (the dry frontier of rainfed arable farming), reinforced by administrative prohibition (the *zone pastorale* north of the 250mm rainfall isohyet is banned – not always effectively – from cultivation). This sets a lower limit to available cultivable land and makes it meaningless to compare cropland with the national space. The Niger or 'desert edge' model, therefore, questions the role of biophysical limits of agriculture on the desert edge, and the possibility of raising productivity on existing cropland is correspondingly urgent.

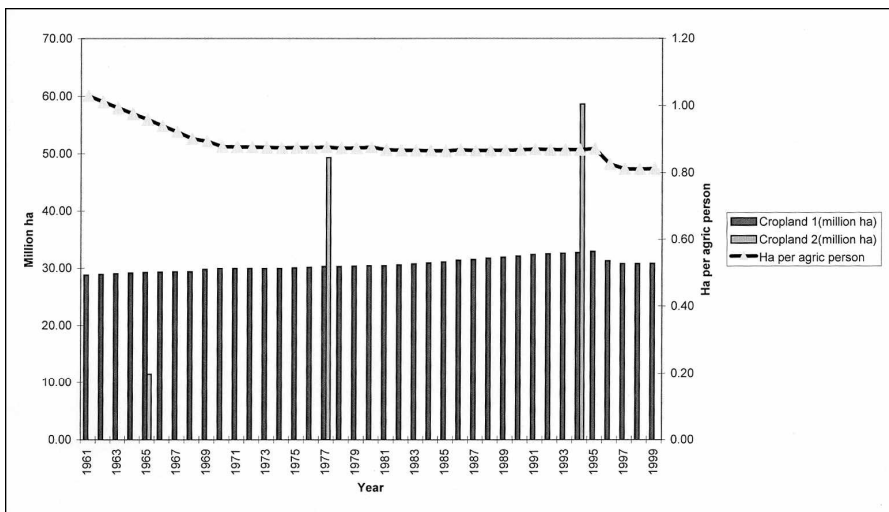
### **Nigeria (Fig 16)**

Unfortunately, the Nigerian land use data provided by FAO are difficult to reconcile with independent sources, both in terms of the trajectory slope and of absolute levels. The record of population growth (Fig 11b) and the estimate of the agricultural population (Fig 12b) are of considerable interest in suggesting the earliest, and now most advanced transition to a lower, and now stagnant agricultural population. But contrary

**Figure 15. Cropland and agricultural population, Niger**



**Figure 16. Cropland and agricultural population, Nigeria**



to all conventional wisdom, field observations, anecdotes and recently the most extensive earth satellite data analyses in West Africa, the cropland estimate ('Cropland 1' in Fig 16) assumes a nearly flat trajectory from 1961 to 1995, from 28.8 million ha in 1961 to 32.5 in 1991, followed by a surprising fall to just over 30 million ha.

Independent estimates are shown as 'Cropland 2' in Fig 16. For the mid-1960s, best estimates of land use published in the *World Atlas of Agriculture* (Mabogunje *et al.*, 1977) put arable land, fruit trees and orchards at 11.5 million ha. They were made up from separate estimates, carried out in Northern, Eastern and Western Nigeria, of arable land and of fruit trees and orchards, and sum to about 12.5% of the national space. This is unlikely to have been under-estimated by 60%, as the FAO series suggests! In 1998, a national survey of land use and vegetation change was carried out for the two periods, 1976-78 and 1993-95 (Geomatics International, 1998). (This was mainly based on Landsat Multispectral Satellite data (for the first period) and SPOT Multispectral data for the second (Geomatics International). This study produced data for 34 classes and harmonised for the two three-year periods. Adding together those classes that include agriculture (intensive, extensive, floodplains, tree crops and some minor types), we obtain totals of 49.3 million ha in the first period and 58.6 million in the second. These are respectively some 64% and 80% above the FAO estimates for the years in question.

The last two surveys undoubtedly include much fallow land (under 'extensive agriculture'), which forms a part of cultivation cycles, as well as plots on boundaries, river banks, etc., too small to identify separately. But a generous allowance for such land – say 25% of the whole – still leaves estimates 23% and 35% above the FAO series for the relevant years. These must cast serious doubt on the FAO's series, which reaches 30.2 million in 1977, and only 32.7 million (close to its all-time peak) in 1994. They suggest an entirely different narrative.

The FAO series thus fails completely to chronicle *possibly the most outstanding* feature of Nigerian agriculture over the four decades in question: a spatial expansion that accords well with all known observations, and represents a truly colossal aggregate investment especially in labour (for although mechanisation was introduced to several farm operations on a significant scale, it made very little impact on the labour-intensive activities of clearing and developing land).

## Mali and Senegal

Data questions discourage any use of the cropland estimates for these countries. For Mali, fixed estimates were employed for long periods and violently adjusted after 1992 on a scale that invalidates the earlier trajectories, while in Senegal, cropland apparently did not change in extent from 1961 until after 1999! Such 'estimates' gravely impede the adoption of sensible land use policies.

Some space has been given to land use questions as it will no longer do for analysts to ignore the absence of quantified data in a category that is agreed to be essential for agricultural planning in countries outside Africa. On the other hand, it remains a mystery why data that are critical for assessing productivity, sustainability and *investment* have been allowed to remain erratic, incomplete and unstandardised. The argument here is that this lacuna prejudices the case for smallholder farming, since the single most important category of farm investment (taking a long-term perspective) is thereby discounted. There is a partial solution to this problem: in Nigeria, and possibly in other countries (Senegal), there are known to be alternative data sets and/or representative local studies from which a broader picture can be constructed. This is an urgent priority but would require more resources than are presently available for this study.

## 6. Food sufficiency: meeting domestic demand

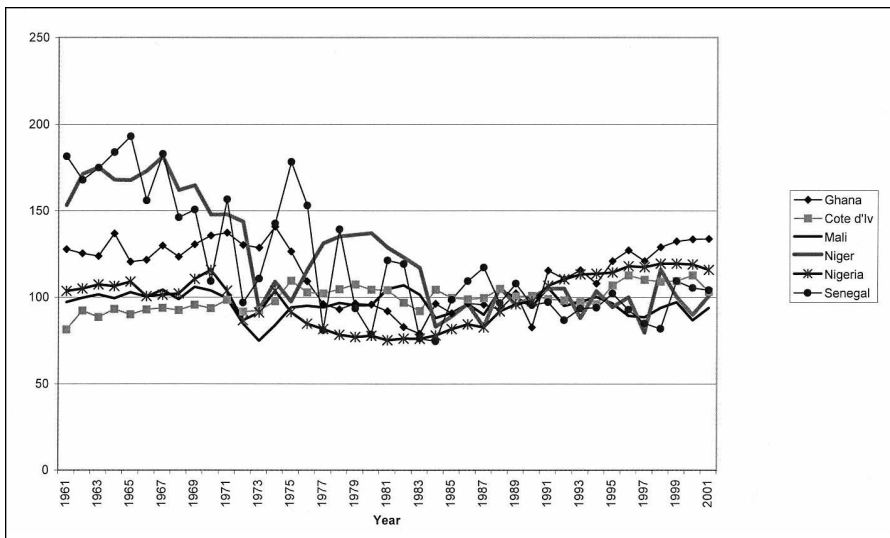
In this section, we compare production estimates on a per capita basis of the total population, as a guide to the extent of food sufficiency achieved at a national level, for the major food crops. This is done in two series: (a) cereal crops (paddy rice, maize, sorghum and millet), and (b) root and forest crops (cassava, yams and plantain). With the first group is shown a composite FAO index for cereals. Most countries produce both groups in large quantities (Nigeria, Ghana, Côte d'Ivoire) but the drier Sahelian countries produce less of the second group, or virtually none (Niger). The human energy requirements from these groups are of a different order, and to combine their production into a simple indicator is rather complex. A composite FAO index for 'food net' (of imports) per caput is employed for this purpose. In these series, a failure to achieve national food sufficiency in the long term is expected to be shown in a downward sloping trajectory. A level trajectory (in the absence of large-scale imports) suggests average sufficiency, maintained against population growth. Fluctuations in production per capita imply scarcities, usually induced by climatic events. An upward slope would not occur unless there were large-scale exports of staple food commodities.

The diversity between countries is again conspicuous. However we begin with the FAO's composite food index (Fig 17). There are three types of trajectory shown: the indices for Ghana and Nigeria fall to a trough in the early 1980s recovering later and showing an overall improvement; those for Senegal and Niger display a resolute downward trend unaffected by shorter term fluctuations; and those for Côte d'Ivoire and Mali are more or less level overall, with weaker signs of a trough in the early 1980s and with greater fluctuations in Mali.

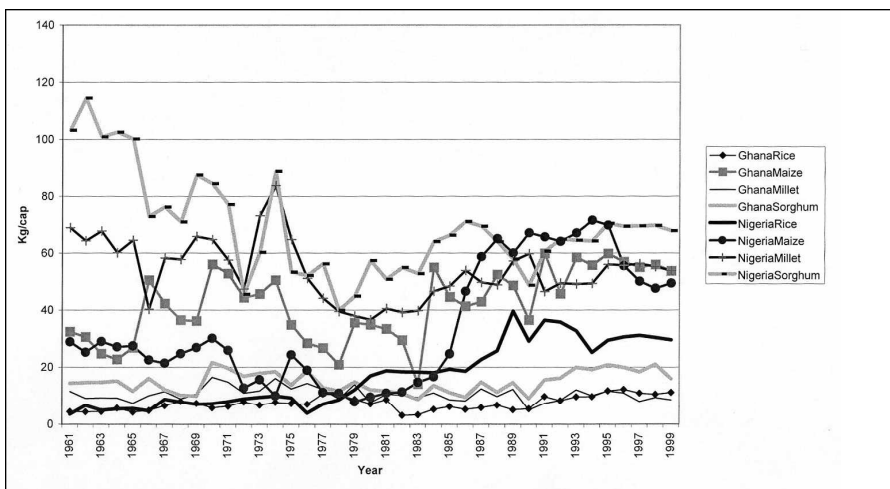
### Ghana-Nigeria model (Figs 18, 19)

Behind the simple trajectories of the FAO food indices, there is much diversity. The cereal crop production graphs for both countries suggest, after 1965, fluctuations in the 1970s, decline to a trough in the early 1980s, recovery to a peak around 1995, and thereafter a plateau or slight decline. Of the main cereals, rice and maize achieved significant increases which began in the early 1980s, when new varieties, fertilizers, and rapid increases in demand took effect in Nigeria (and possibly Ghana?). But

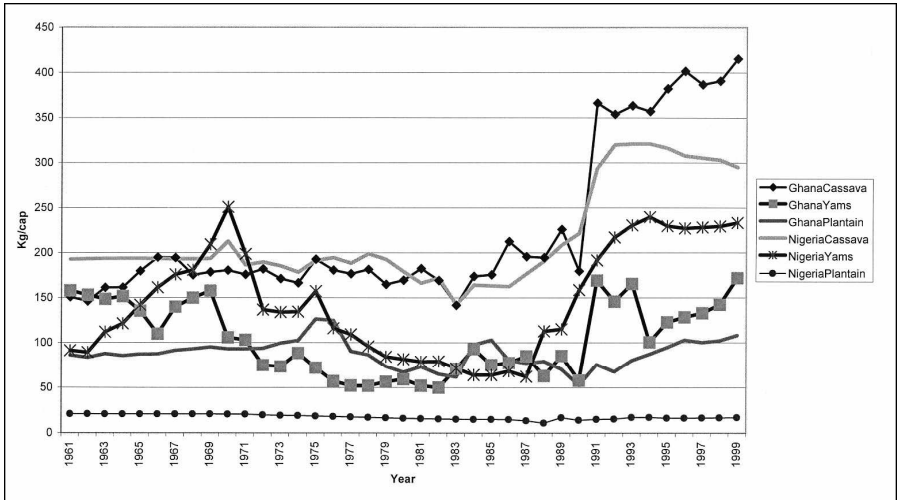
**Figure 17. Food (net) per caput indices**



**Figure 18. Cereal crop production, Ghana and Nigeria**



**Figure 19. Root and forest crop production, Ghana and Nigeria**



millet and sorghum, the Cinderellas among cereals, stagnated in terms of per caput production. They have proved to be less susceptible to new technology and yet remain dominant among cereals in terms of food supply. Total production per capita of these four crops increased over the 40-year period by 62.6% in Ghana and decreased by 1.2% (which is not a significant change) in Nigeria (Table 1).

The production of yams and cassava per capita increased abruptly in both countries during the late 1980s/ early 1990s, the main difference being that Nigeria also had an earlier 'yam boom' in 1965-70, and did better than Ghana with yams in absolute terms. Plantain, however, was produced in much larger quantities in Ghana. Output per capita of the three crops combined was 60.2% higher in Ghana and 56.7% higher in Nigeria at the end of the 40-year period (Table 1).

The most relevant characteristic of the Ghana-Nigeria model for present purposes was a strong recovery from a deep trough in the early 1980s, a trough that led at the time to gloomy prognostications of failing agriculture and intensifying dependency on imported food. What changed was not the capability of family farms to produce, but the quality of macroeconomic policies. Renewed policy uncertainty in the later 1990s may have been responsible for signs of hesitation in this recovery.

**Table 1. Change in per capita production of major food crops, 1961-63 to 1997-99 (percent)**

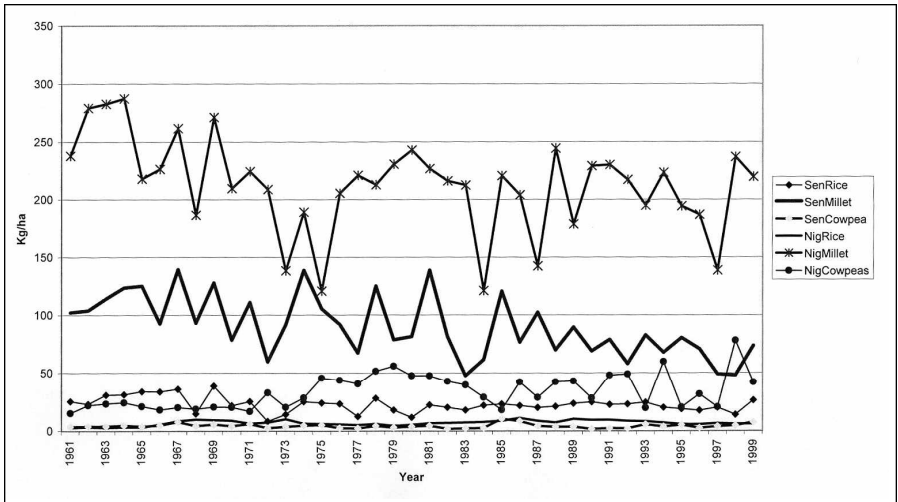
Country	Cereal crops	Root and forest crops	Change
Ghana	Rice, maize, millet, sorghum		+59.8
		Cassava, yams, plantains	+66.3
Nigeria	Rice, maize, millet, sorghum		- 1.2
		Cassava, yams, plantains	+76.3
Mali	Rice, maize, millet, sorghum		- 2.6
Niger	Rice, millet		-24.2
	Cowpeas		+131.2
Cote d'Ivoire	Rice, maize, millet		+30.5
		Cassava, yams, bananas, plantains	- 28.5
Senegal	Rice, maize, millet, sorghum		- 41.2
		Cowpeas	+ 33.3

## Senegal-Niger model

In neither of these countries are root or forest crops important relative to the cereals, and in both of them the food indices (Fig 17) tended downwards, though less conclusively in Niger, where after 1985 the decline halted, though without being reversed. Consistently with these images, recent studies at the district level in central Senegal and eastern Niger confirm that Senegalese agriculture remains in crisis, while Maradi Department in Niger is showing strong signs of increasing output per capita and suggestive evidence of improving yield trends (Faye *et al.*, 2001; Mortimore *et al.*, 2001). The production per capita of individual crops (Fig 20) exemplify the violent fluctuations characteristic of Sahelian production systems, obscuring the longer term trends. In Senegal, these fluctuations appear to have been quite regular, but in Niger, on the other hand, there was a peak in millet and sorghum production in 1979-81, following a steady fall from the 1960s to 1973.

Owing to high values at the beginning of the period, Niger finished up with an overall decline of 24% in cereal production per caput, only just staying above the 200 kg/cap level required for average food sufficiency in a predominantly grain-consuming population (Table 1). This failure was, however, compensated by a significant increase in cowpea production.

**Figure 20. Grain crop production, Senegal and Niger**



Senegal on the face of it gives cause for concern. Notwithstanding a diversified ecology (compared with Niger), its sub-humid zone does not contribute significant quantities (per caput) of the root crops; indeed cassava declined from over 40 kg/cap to less than 20 during the 40 years, to the point of being sometimes overtaken by cowpea (a crop not normally produced in impressive weight), which managed a 33% increase over the 40 year period - less dramatic, however, than in Niger (Table 1). Most noticeable is a clear downward trajectory in millet production per caput (Fig 20), and a low absolute level, averaging barely half of the notional 200 kg/cap requirement in the 1960s and only a third of it in the 1990s. Maize and sorghum did rather better, but the quantities were small. The importation of cheap rice – a colonial policy which had an irreversible effect on food preferences – in quantities substantial enough to undermine the market for local substitutes (millet or cassava, but not cowpea) is responsible for this clear-cut failure of the agricultural sector in terms of food sufficiency.

## Côte d'Ivoire and Mali

These countries have rather little in common apart from a similarly level trajectory in their food indices (Fig 17). In Côte d'Ivoire, per caput production of the three cereal crops (rice, maize and millet, the last having minor importance) was 30% higher at the end of the period than at the beginning, while that of root and forest crops (cassava, yams, bananas and plantains) was 28% lower (Table 1). In terms of the individual crops (Fig 21), the decline of yams production was particularly striking. The FAO's cereal index remained above its base throughout the 1960s and 1970s, but slipped below in the 1980s up till 1995, when a strong but short-lived peak reflected higher rice production. Côte d'Ivoire farmers, however, produce a wider range of crops than their Sahelian counterparts, so a comparison with Mali or Niger in terms of key indicator crops is not necessarily meaningful. The FAO's food production index shows a more or less steady improvement over the 40 years. This appears to have been achieved through adaptation and diversification, in which a shift away from roots and forest crops into cereals seems to have played an important part.

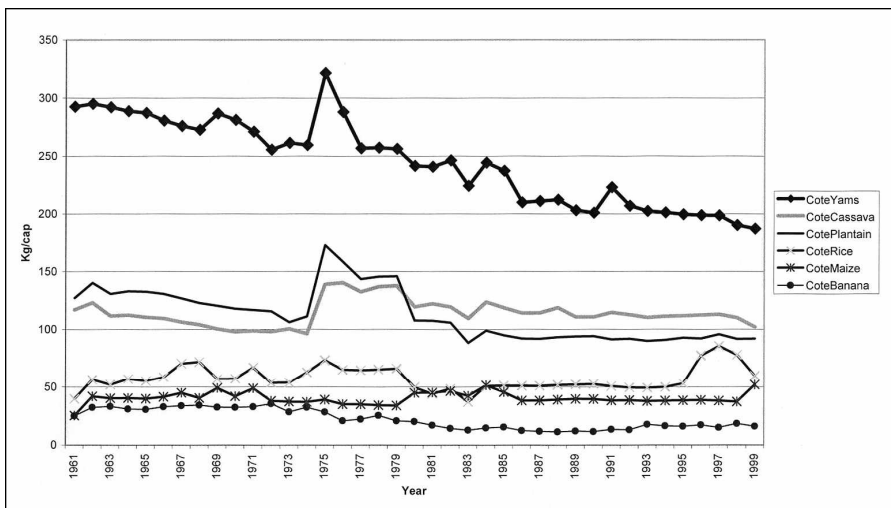
In Mali, all four cereals (rice, maize, millet and sorghum) recovered strongly from a trough in 1981, but whereas this recovery continued to the end of the series for rice and maize, that of millet and sorghum faltered in the 1990s. They cancelled each other out, so that production per capita of the four crops remained where it was at the beginning of the period. However, from 1981 to 1989 there was impressive recovery in all four crops, and for rice and maize this momentum continued until the end of the series (Fig 22).

The picture of these two countries revealed by the data is one of very different production systems both adapting to changing conditions – whether economic (Côte d'Ivoire) or environmental (Mali), where farmers have been resilient in face of rainfall variability and – though in this respect less than in Niger – by scarcities of high potential land (such as floodplains where rice can be grown).

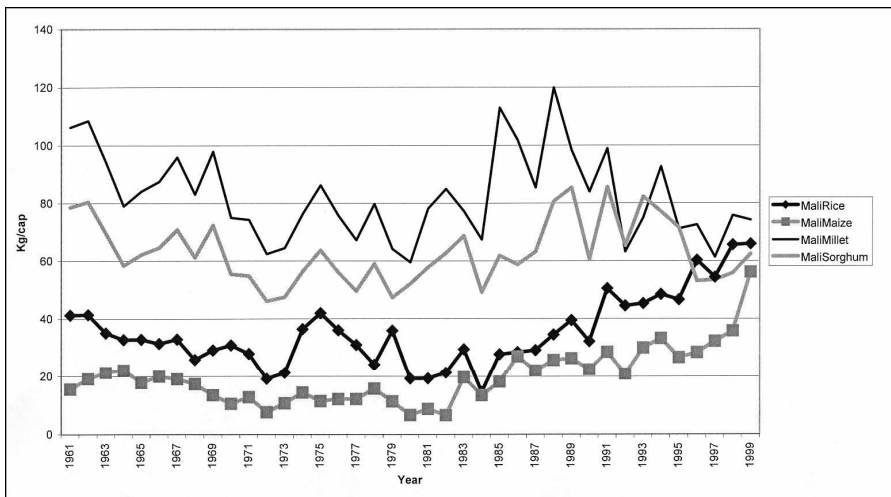
What can we learn from these trajectories, as confusing in their detail as they are diverse in their directions?

- Four of the six countries (the exceptions being Senegal and to a lesser extent Niger) have maintained food production per capita in terms of a 'basket' of staple food commodities, or improved it, and some have

**Figure 21. Crop production in Côte d'Ivoire**



**Figure 22. Crop production in Mali**



recovered from deep crises in the early 1980s, to levels comparable to or better than those of the early 1960s. Only in Senegal did the indices decline from the beginning to the end of our 40-year period; in Niger decline was arrested (though not reversed) after 1985.

- The performance of major crops, or of groups of crops, has often differed within the same country. An overall 'food sufficiency index' must take account of grain-tuber energy equivalents, and we assume that this has been done in the FAO's 'food net' index. There is room for adaptive swings in crop preferences, both of consumers and of producers.
- Fluctuations, clearly attributable to rainfall variability (especially in Niger, Mali and Senegal), translate in per caput terms to a threat to food sufficiency at a national level, which increases the likelihood that food *security* comes under threat in poorer households, including those of many producers, who may de-capitalise their productive potential afterwards.
- There appear to be many adaptive strategies at work as producers shift among crops and (though not exposed in this brief analysis) diversify in response to food marketing opportunities. This process has been noted in Senegal where the traditional crops are most under threat.
- Since the production of food per capita only rarely correlates either with the growth of the total population or with the growth of the agricultural population, a simple demographic mechanism must be discounted in the food equation.
- Much more important is policy and the global economic environment, which better explain the widespread decline in food sufficiency that occurred in many countries during the 1980s, and the subsequent recovery in most of them.

## 7. Factor efficiency: evidence of intensification

For family farms working under a severe capital constraint, labour- or land-saving technologies are only selectively and gradually adopted. A view of farm investment which is confined to ‘lumpy’ technological innovations, often financed by credit, is inappropriate for understanding capital management by poor farmers, men or women. For example, in livestock keeping, the growing importance of goats relative to large animals shows poor peoples’ need to invest incrementally in small units, with an assured output market. Much expenditure in crop production takes the form of one-off labour hiring, small quantities of inorganic fertiliser, hand tool repairs and replacements at the local blacksmith’s workshop, or other transactions. These are not usually picked up in surveys. As argued above, the conversion of a natural landscape into farmland and villages, created by labour spent over (perhaps) several generations, is a process of adding value. It is misleading to represent it as a form of degradation.<sup>4</sup>

When permanent farming replaces fallowing or shifting cultivation, and where livestock are grazed increasingly on the farm instead of in natural woodland or grassland, the extent of investment can no longer be gauged from the size of the cultivated fraction. Maintaining land at optimal productivity depends on manuring, composting, multiple cropping, higher planting densities, intercropping, and weed suppression – all labour-intensive activities, for which the possibilities of substitution by capital are restricted. Analysis of this process of incremental intensification through capital creation and substitution can best be conducted at the local scale (for an illustration from Maradi, see Annex).

The long-term series may offer insights on three perspectives of intensification: (a) trends in crop yields per hectare, (b) recorded consumption of inorganic fertilisers, and (c) indices of the value of output per hectare. For evidence of intensification in livestock keeping, see below.

### Yield trends per hectare

The FAO database has three linked series on harvested area, yield per hectare and total production for each crop. It is understood that in submitting data to the FAO, national sources are encouraged to use yield as

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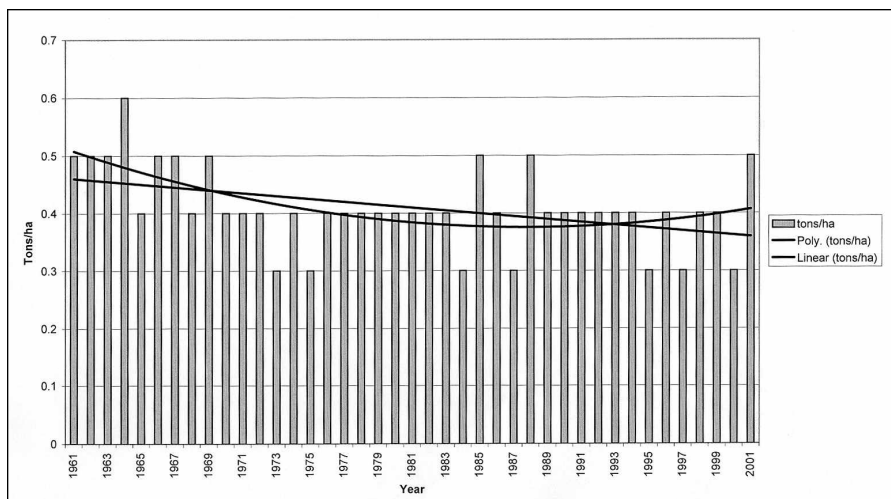
<sup>4</sup> In an ecologically comparable area of Nigeria, an experimental study found that total production of plant biomass on farmland equals or exceeds that produced by natural vegetation according to a model based on rainfall (Mortimore *et al.*, 1999).

either a dependent or an independent variable. Without detailed information on sources, we cannot judge whether yields were estimated from primary sources or simply deduced from production by harvested area. For some crops, the yield estimates contain wide ranges between countries, whose understanding calls for location-specific data on cultivation and fertilisation practices. For example, millet yields in Nigeria are claimed to have been more than double those obtained in Niger from 1982 onwards. Yields are known to vary, between regions, agro-ecological zones, localities and even farms and fields within the same village, so large international differences are not inherently implausible. For present purposes, the yield estimates are accepted at face value.

Figs 23-25 show the long term trends in estimated yields for three major crops (millet, maize, cassava), each grown in all six countries. Comparisons between the countries reveal differences both in trajectory and in yield levels.

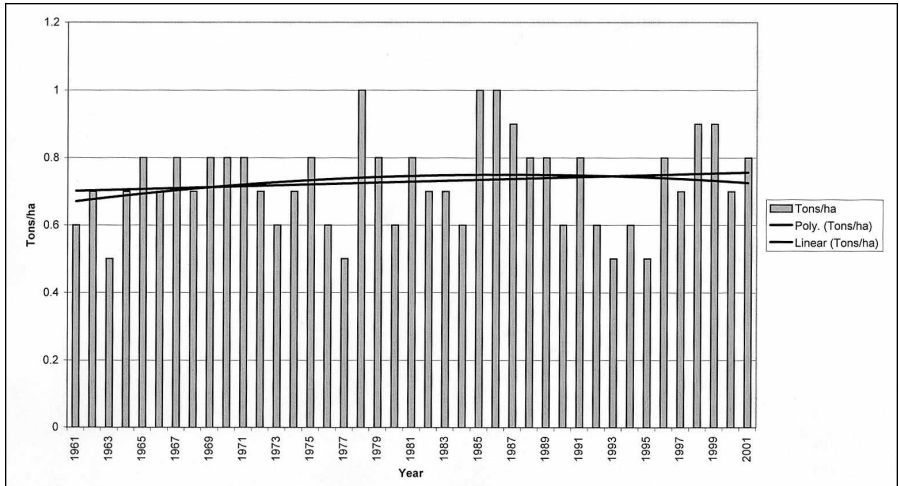
*Millet* (Fig 23). Millet is a 'traditional' food crop whose hardiness in drought-affected areas of poor soil has proved difficult to improve on. Yield trends should show the extent to which the 'traditional' food crop sector can improve its performance under family farm conditions. All six countries began in 1961 with average yields around 0.5-0.6 tons/ha, so the differences between them are in the rate and extent of improvement subsequently claimed in the data. Only Niger appears to have declined; even its Sahelian counterparts, Mali and Senegal, achieved improvements,

**Figure 23a. Millet yields, Niger**

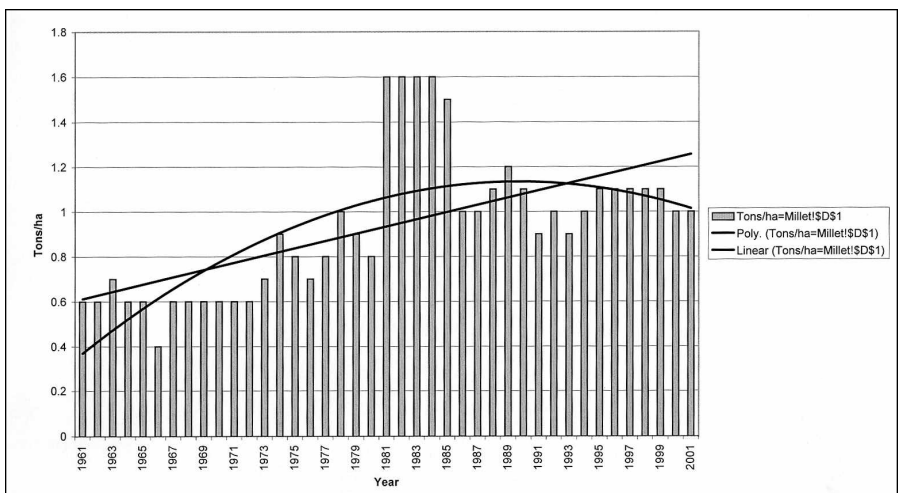


notwithstanding the effects of drought. There is independent evidence from Senegal of improved yields per mm of rainfall (ref.). The ecologically diversified countries all improved, Côte d'Ivoire only slowly (though millet is an unimportant crop) and Nigeria with impressive rapidity, and to an impressive extent, taking account of the large numbers of farmers involved, and the fact that millet, even in ecologically diversified countries, is only grown in the driest areas.

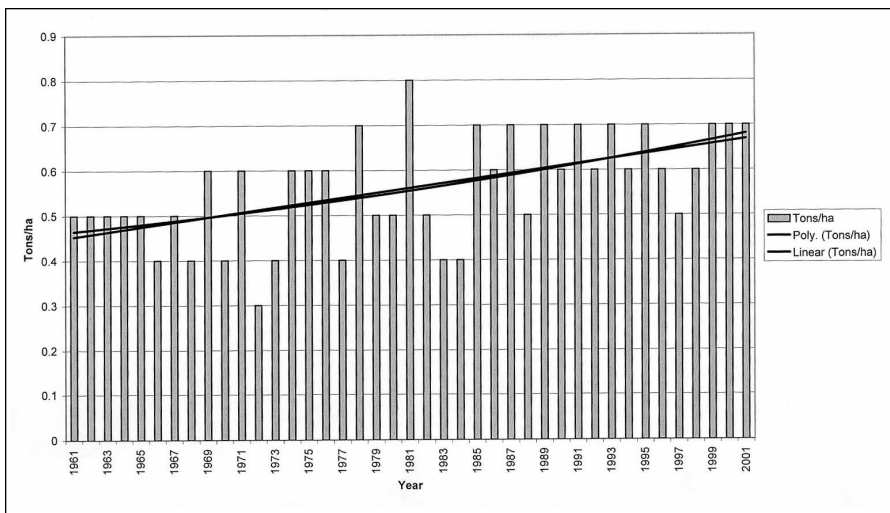
**Figure 23b. Millet yields, Mali**



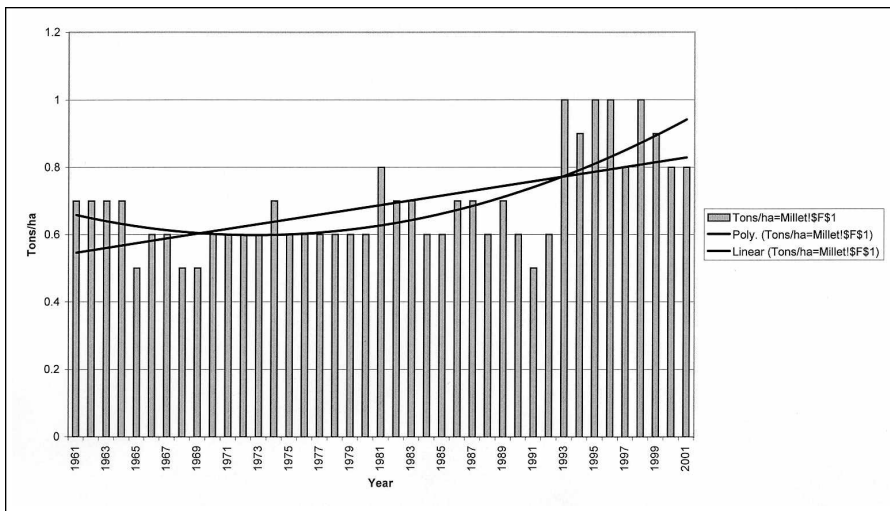
**Figure 23c. Millet yields, Nigeria Tons/ha**



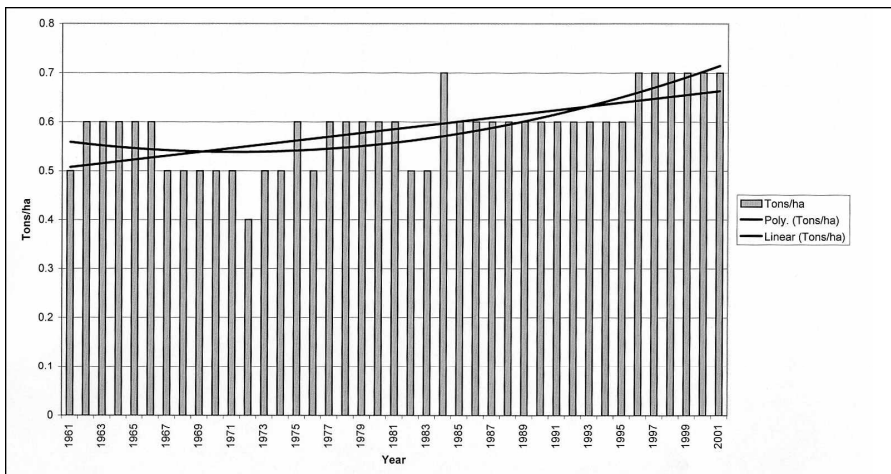
**Figure 23d. Millet yields, Senegal**



**Figure 23e. Millet yields, Ghana**

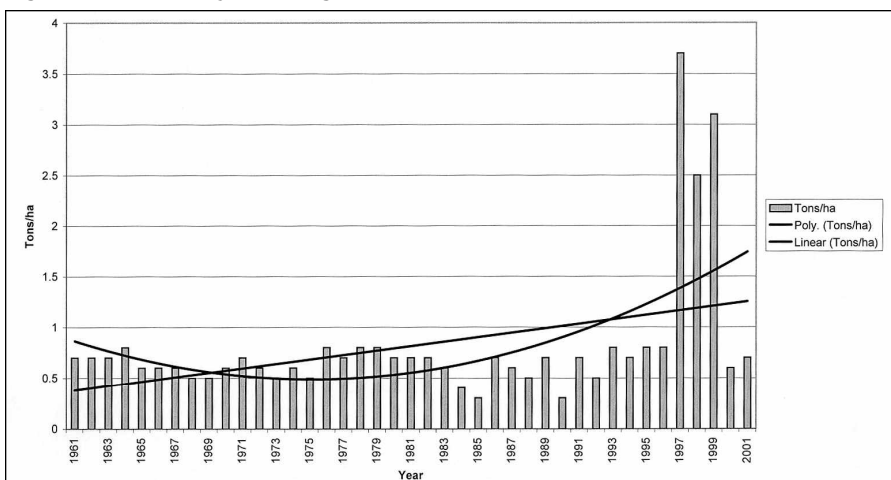


**Figure 23f. Millet yields, Cote d'Ivoire**

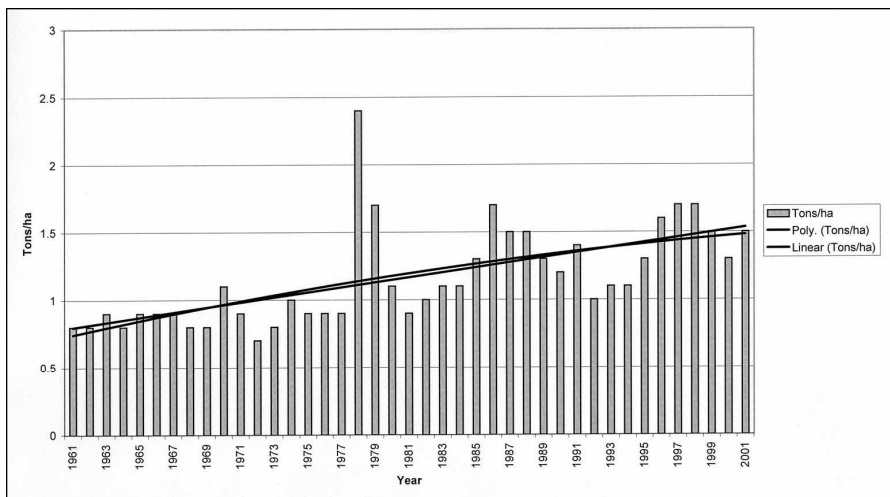


*Maize* (Fig 24). This crop has been targeted by research and extension interventions, as a crop with increasing markets. It would be expected to perform better than millet, and serve as an indicator of family farming systems' capability to adapt to new opportunities. All six countries claim improving yield trends, though in Niger the improvement is recent and perhaps fragile. In Nigeria, it can easily be seen how maize yields could have been affected by the promotion of new varieties with subsidised fertilisers in 1976-89. Ghana also appears to be well ahead of some of the other countries.

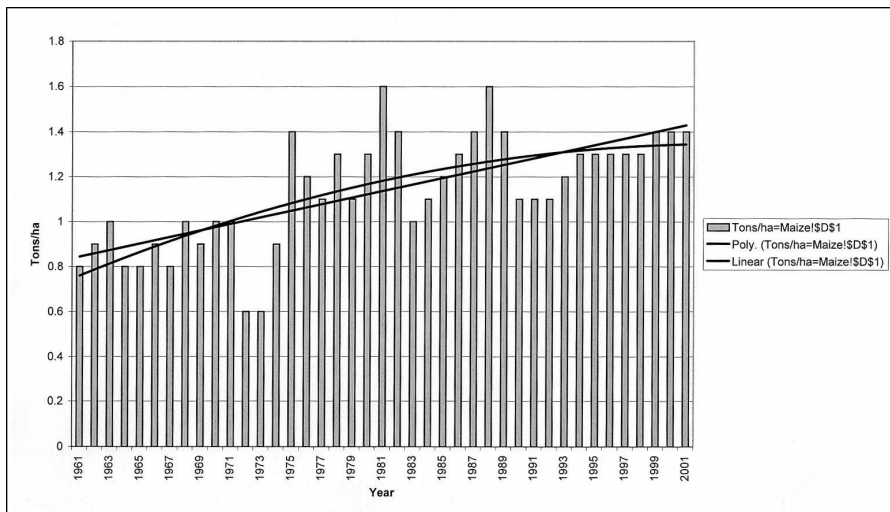
**Figure 24a. Maize yields, Niger**



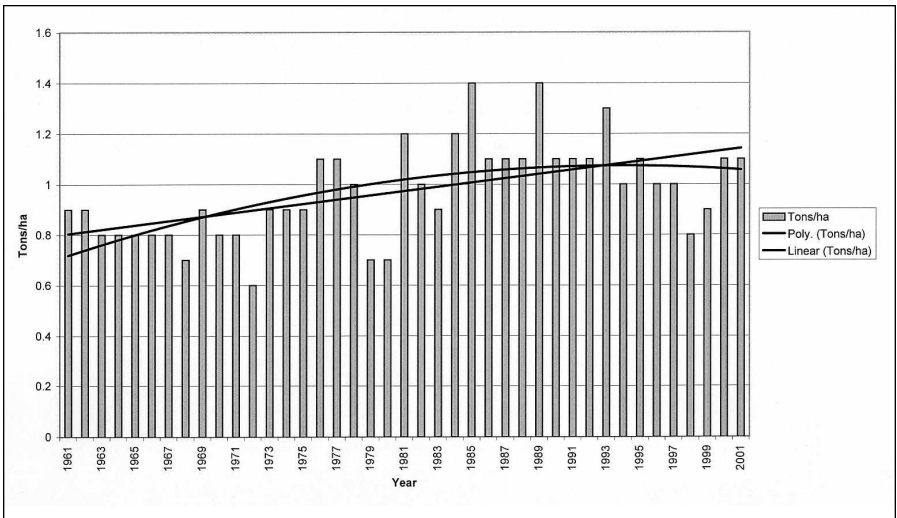
**Figure 24b. Maize yields, Mali**



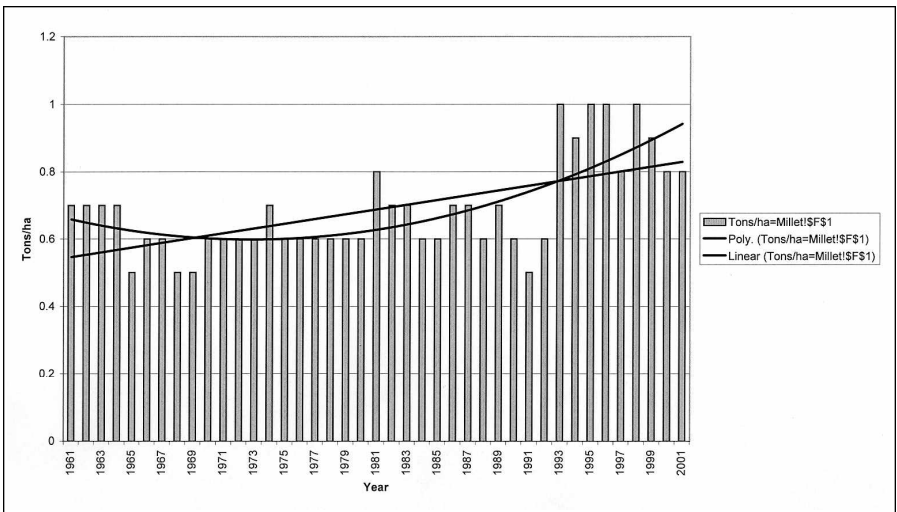
**Figure 24c. Maize yields, Nigeria**



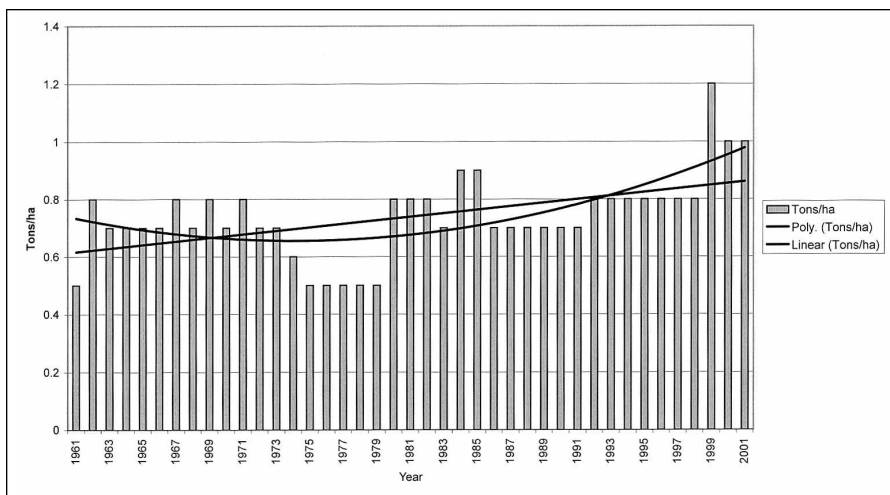
**Figure 24d. Maize yields, Senegal**



**Figure 24e. Maize yields, Ghana**

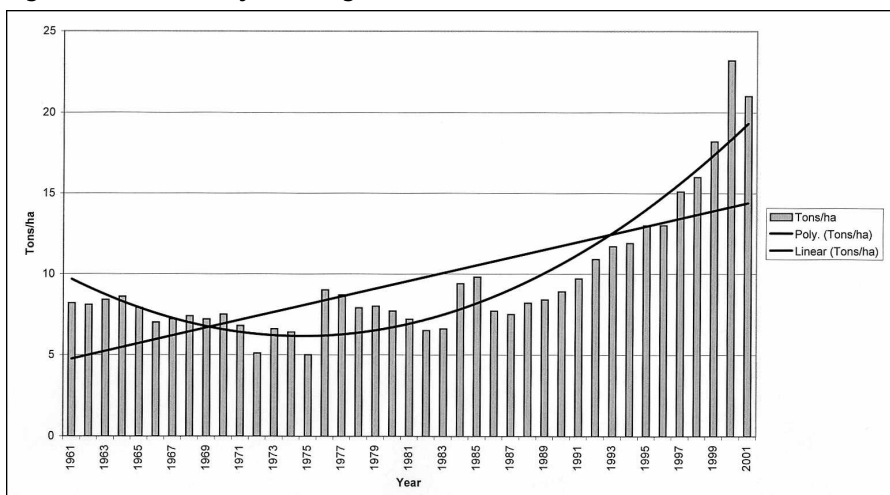


**Figure 24f. Maize yields, Cote d'Ivoire**



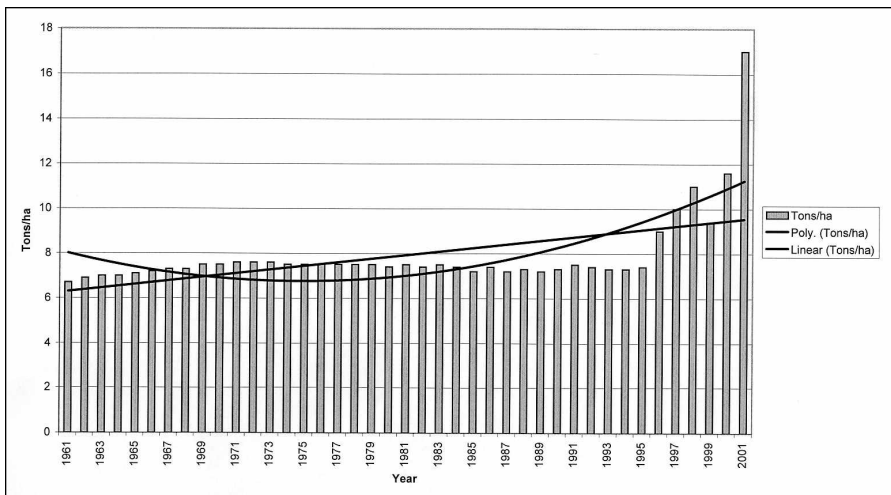
*Cassava* (Fig 25). As a food crop that has expanded significantly during the past half-century, whether considered in spatial or in production terms, and which (when processed) enjoys increasing popularity as a ‘fast food’, cassava has also benefited from research targeted on plant disease constraints. The graphs show more variable trends than for the other crops. Niger, rather surprisingly, appears to have smartly improved its

**Figure 25a. Cassava yields, Niger**

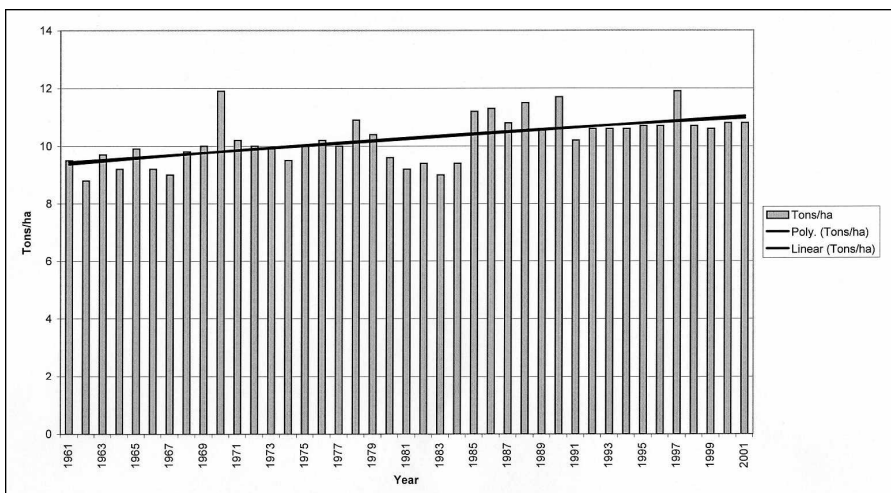


average yields since the 1980s, while Senegal – enjoying better agro-ecological conditions – appears to have presided over a decline (though a recent reversal may be evident), and Mali was flat. Of the high yielders, Nigeria has stagnated while Ghana has shot ahead, but Côte d'Ivoire made the most rapid progress of all from a very low base.

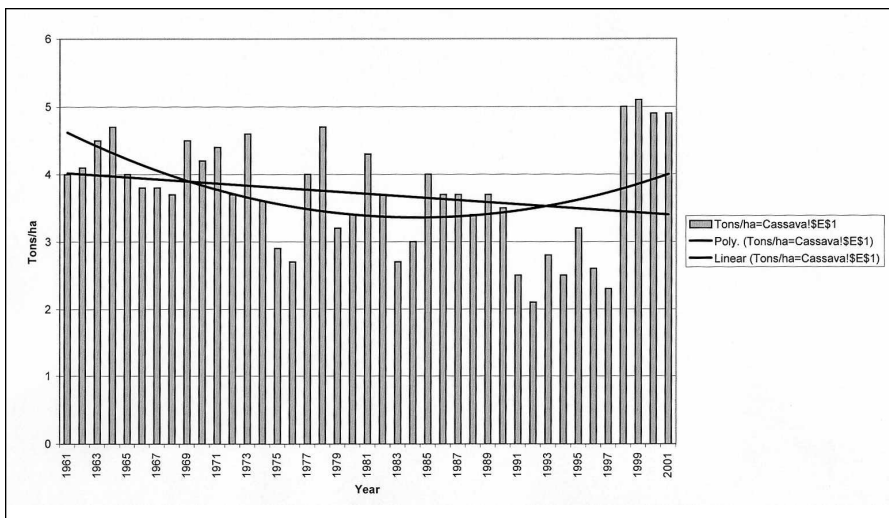
**Figure 25b. Cassava yields, Mali**



**Figure 25c. Cassava yields, Nigeria**



**Figure 25d. Cassava yields, Senegal**



**Figure 25e. Cassava yields, Ghana**

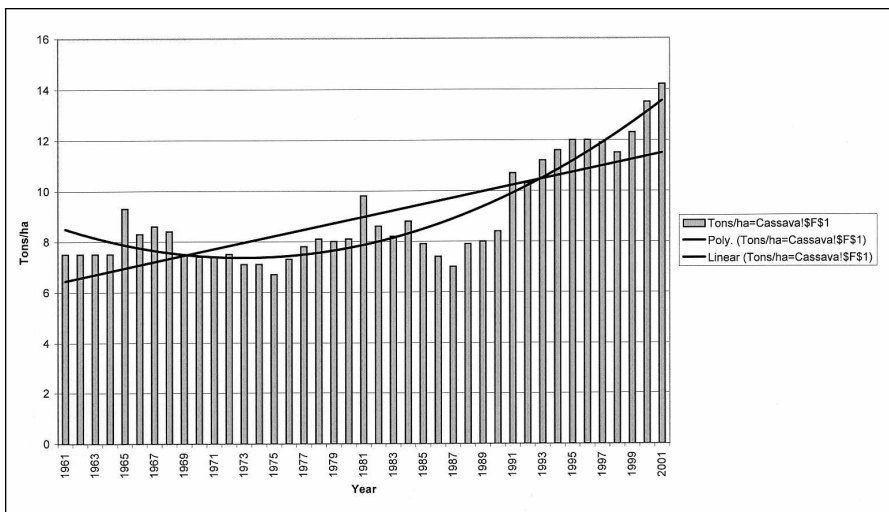
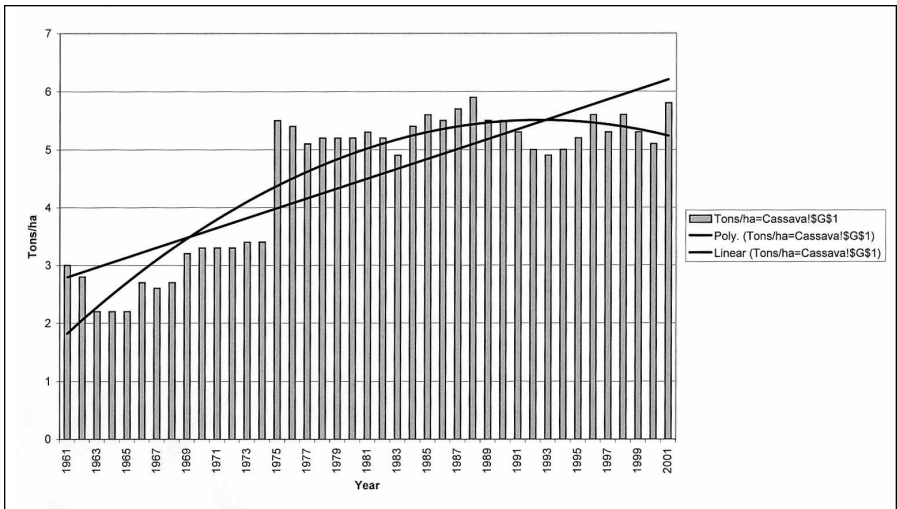


Figure 25f. Cassava yields, Cote d'Ivoire Tons/ha

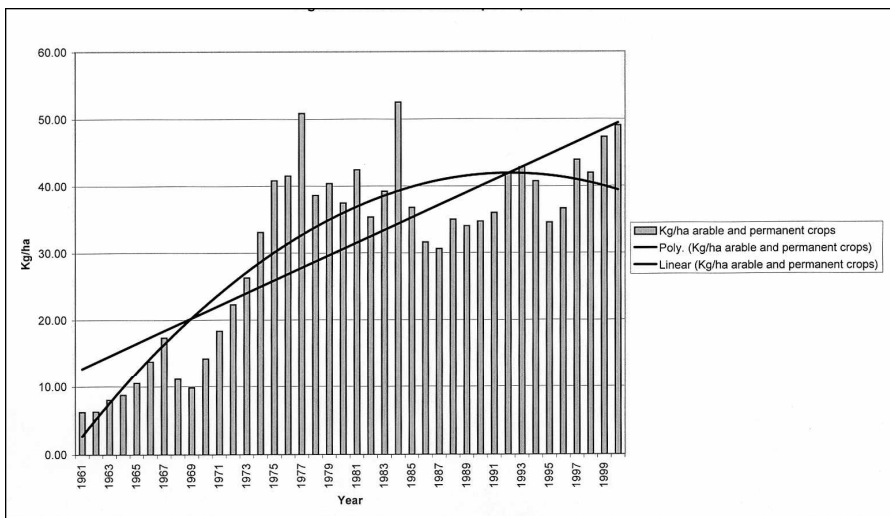


## Fertiliser consumption

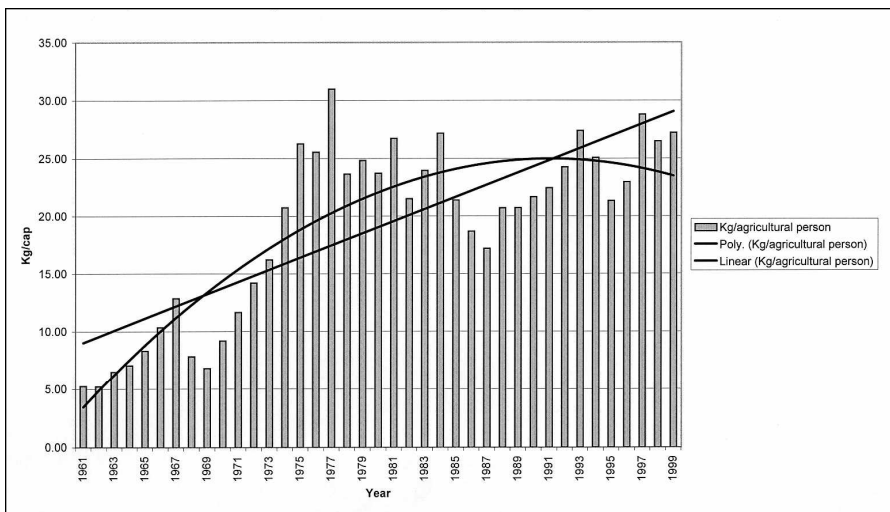
The yield data, if it is reliable, points to a gradual intensification of agricultural production. Has this been achieved with the use of inorganic fertilisers? Links with maize production have been mentioned, and it is well known that farmers can often only afford to use purchased inputs on market crops. (However, yield trends among the 'traditional' export crops – cotton, groundnuts, cocoa – have been less positive than those discussed above.) There is much debate within as well as outside West Africa about the reduction or withdrawal of fertiliser subsidies under programmes of structural adjustment. Fertilizer statistics are relatively reliable because all inorganics are either imported or manufactured under control and such is the demand for them that it may safely be assumed that stocks do not last for more than 18 months. What trends are apparent?

Figs 26 and 27 demonstrate almost identical upward trajectories for consumption on a per hectare basis and per capita of the agricultural population. Fertilizer use per ha of cropland should be set against the increases in cropland noted earlier. Also apparent is the levelling off which has occurred since the 1970s. The contradiction between these two forces is reflected in the differences between the linear trends (reflecting the entire period) and the polynomial (reflecting the vicissitudes of structural adjustment), neatly encapsulating the policy dilemma.

**Figure 26. Fertiliser consumption per hectare**

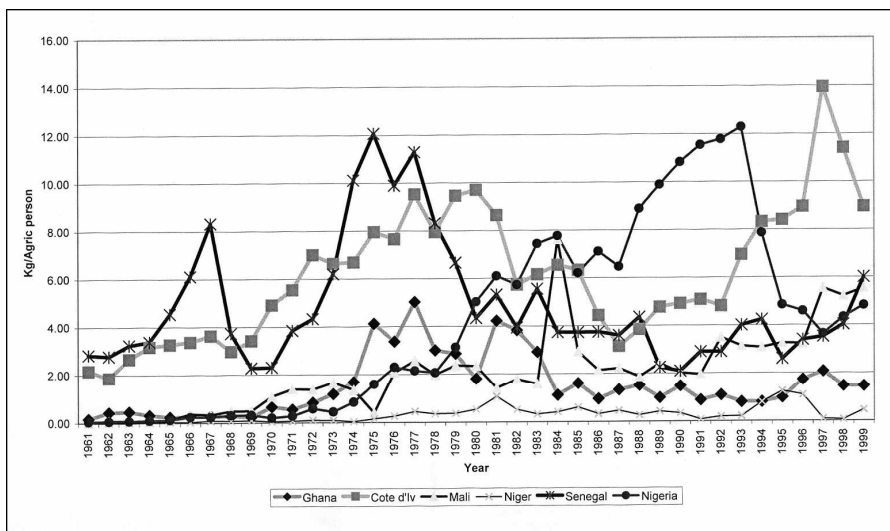


**Figure 27. Fertilizer consumption per agricultural person**



At the level of individual countries, there is extraordinary diversity of trajectories (Fig 28), which underlines the fact that fertilizer consumption is determined less by demand than by supply constraints at the point of entry or manufacture. Local studies in Kano and Maradi confirm that farmers' primary constraint is the supply rather than the price of fertilizer (J.A. Ariyo, 2002; Y. Boubacar, 2002; internal reports). It appears that in each country a separate struggle has been waged with its own chronicle of policy swings and reversals. The peaks and troughs are highly differentiated in timing, underlining that the principal determinant of fertilizer use is not demand but macroeconomic budget management in each country. For example, consumption peaked in Senegal in 1975-78, in Cote d'Ivoire in 1978-82 and again in 1997-98, in Ghana in 1978 and 1982-83, in Mali in 1985, in Nigeria in 1985, in Nigeria in 1991-93.

**Figure 28. Fertiliser consumption by country**

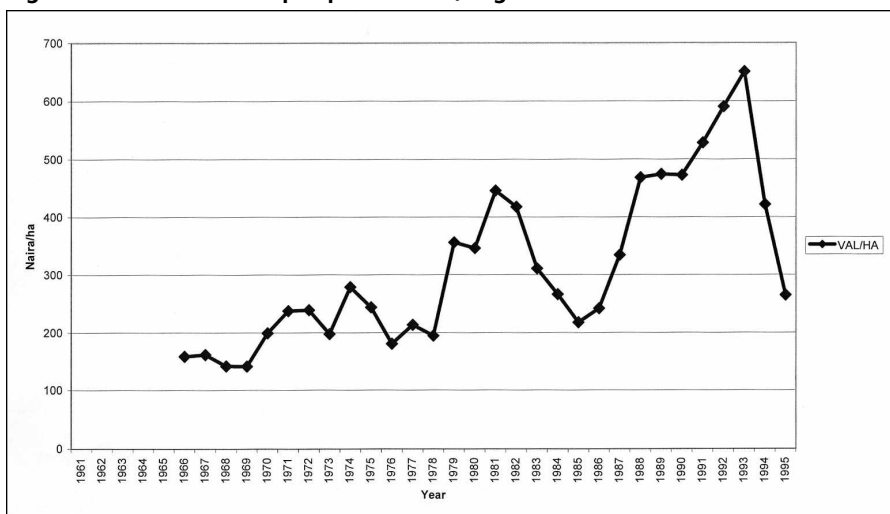


From the point of view of this essay, the fertiliser consumption data provides graphic evidence of the capability of family farming systems in West Africa as a whole to access intensification inputs productively, when they are available. The relatively high accuracy of fertilizer statistics, and ease of analysis, has taken attention away from the need to quantify the use of organic fertilization or nutrient recycling in such forms as manuring, composting, or green manuring.

## Value of output per hectare

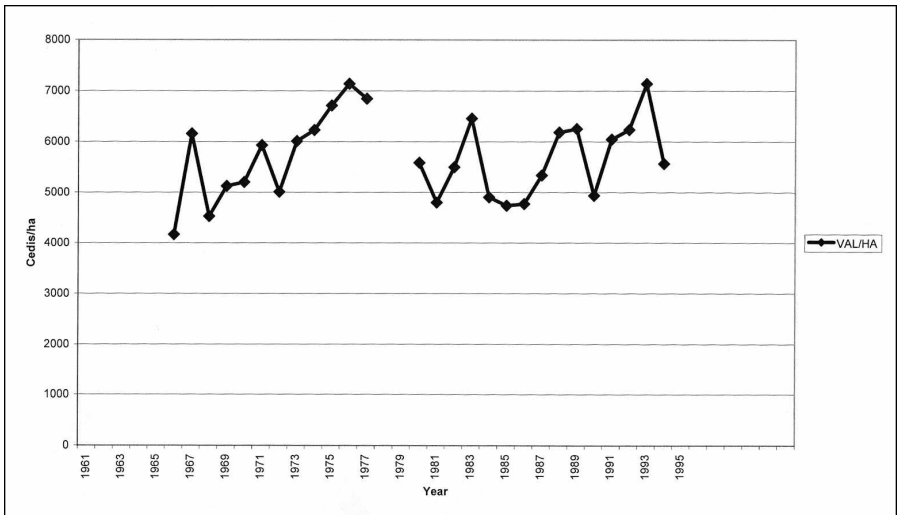
Intensification can be defined as increasing the value of output per hectare by increasing inputs of labour, capital or new knowledge: see (Tiffen *et al.*, 1994). By accessing the FAO crop price series (which are denominated in local currencies) and using as a deflator the Consumer Price Indices published by the World Bank (*World Bank Database*, 2001), it is possible to generate an estimate of the value of output per hectare in constant terms and taking account of all crops for which data series exist. This is possible for a 30-year period, 1965-95. The results are shown in Fig 29a-f. Since the currencies differ, comparisons between the levels achieved are impossible except for CFA franc zone countries.<sup>5</sup>

Figure 29a. Value of output per hectare, Nigeria

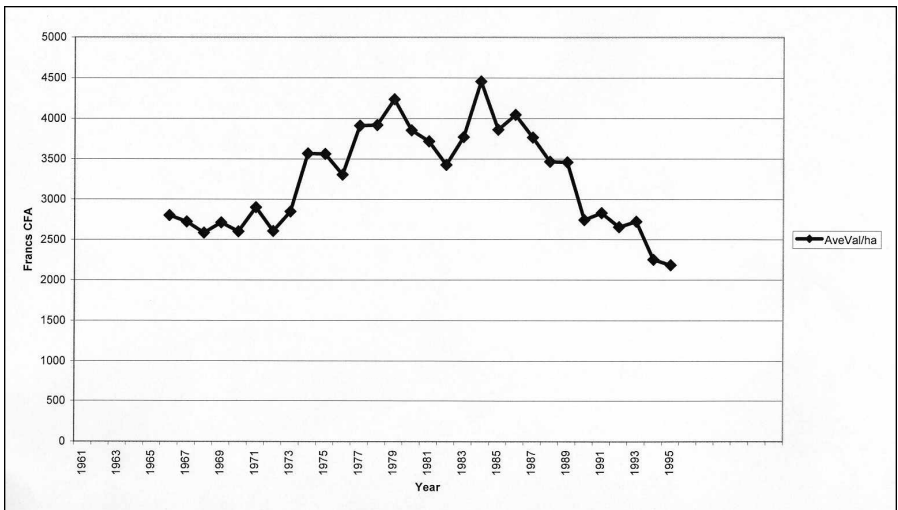


5 As value per hectare is subject to the influence of price trends as well as internal factor allocations, these trends should be interpreted with caution.

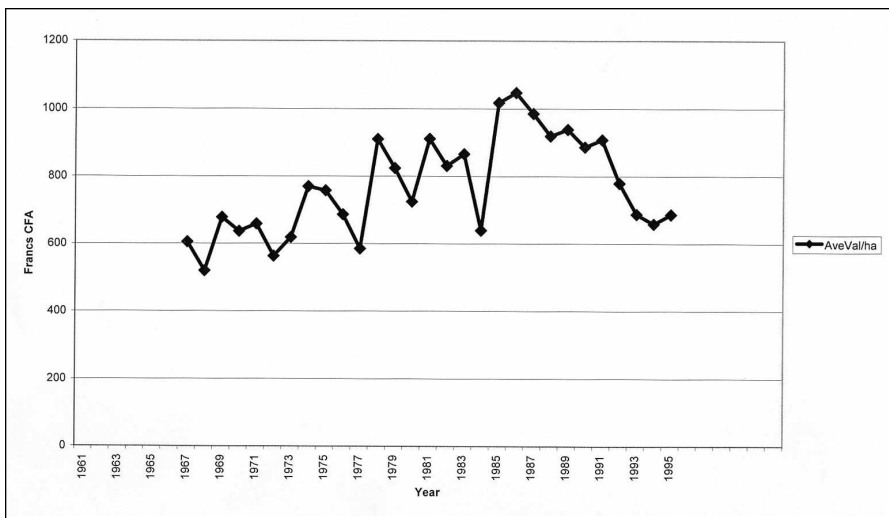
**Figure 29b. Value of output per hectare, Ghana**



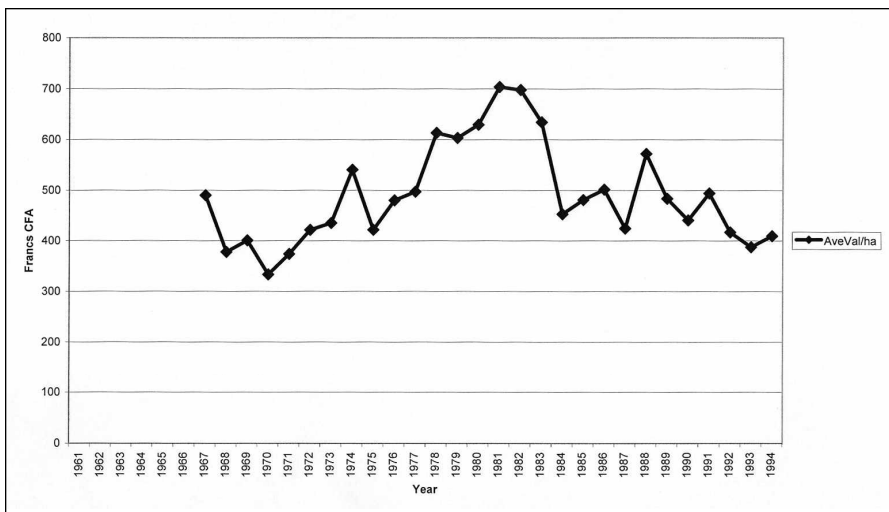
**Figure 29c. Value of output per hectare, Cote d'Ivoire**



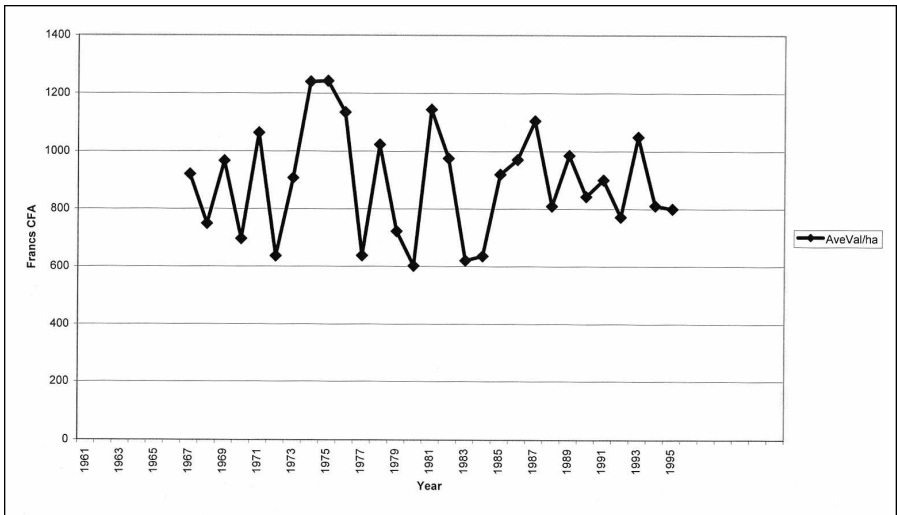
**Figure 29d. Value of output per hectare, Mali**



**Figure 29e. Value of output per hectare, Niger**



**Figure 29f. Value of output per hectare, Senegal**



First there are two countries where upward trends dominate, though with major interruptions: Nigeria and Ghana (Fig 29a,b). A second group shows a tendency to ‘hump’, with upward trends before the early 1980s and downward ones after. This group consists of Côte d’Ivoire, Mali and Niger (Fig 29c,d,e). Finally, Senegal fluctuated violently and remained flat (Fig 29f). The most important observation is the proven occurrence of prolonged periods during which values per hectare improved. The second obvious point is that given this capability to intensify in value terms, interruptions can be understood as the result of external factors rather than of any structural incapability. Improved macro-economic management of these factors is in the best interest of family farms. A third observation is that the negative trends apparent in the CFA franc-zone countries during the latter part of the period give cause for concern, as they do not reflect intensification, but rather its opposite. In Senegal, agriculturalists speak of ‘décapitalisation’ and in Côte d’Ivoire (see above) there are hints that extensification rather than intensification is occurring. The impact of the devaluation of the CFA franc by 50% in January, 1994, cannot be monitored in this study as the price series ended in 1995. Considerable uncertainty hung over the 1990s, and its resolution became an urgent policy priority. The trajectory of Côte d’Ivoire shows that we are not merely looking at a ‘Sahelian syndrome’.<sup>6</sup>

<sup>6</sup> This issue is capable of resolution but not within the limits set to this review.

## 8. Price incentives and competitiveness

An attempt was made to investigate links between the price behaviour of individual crops and market responses, but was abandoned owing to three factors: (a) as mentioned before, the price series have not been updated after 1995, but the 1990s are crucial for an assessment of competitiveness; (b) direct responses are unlikely because family farmers do not work with an open cheque book – they continue to work under constraints of various kinds, which have a bearing on market decisions; and (c) prices alone are known to us, but we are not in a position to assess profitability owing to an absence of information concerning costs (except for fertiliser).

Expanded production and improving yields per hectare of major crops such as maize or cassava provide indirect evidence of market responses on a large scale. By comparison with food crops, the 'traditional' export crops are not necessarily considered profitable, unless when diverted to domestic markets (e.g., groundnuts). A widely reported phenomenon is an expanded interest in 'niche' crops, such as Hibiscus (Senegal, Niger, Nigeria), sesame (Mali, Nigeria), tiger nuts (Maradi Department of Niger), and many others. What is significant is not their individual quantitative importance but the emerging diversity of marketable crops. However it should not be denied that some of these niche crops are but poor substitutes for once profitable export agriculture.

Table 2 shows a country-by-country ranking of crops in terms of their real price improvement over the period of 30 years (comparing prices in the years 1965-67 with those of 1993-95). The differences between countries, even neighbours, are striking, and it can be seen that price incentive behaviour is too complex to be summed up in a simple statement such as 'export agriculture – down, urban food commodities – up'. There are some surprises in this table, which suggests that the leaders are (predictably) rice, maize, cassava and groundnuts, but that in some countries plantain, tomato, chillies, sesame and melon seed deserve to join them. But we cannot be sure if these crude indicators are not themselves products of some unknown artefact, and as pointed out already, prices are not the only consideration where farmers make marketing decisions.

**Table 2. A ranking of major commodities on the basis of price trends, 1965-1995**

	Ghana	Cote d'Ivoire	Mali	Niger	Nigeria	Senegal
Rice	1	7	1	8	11	4
Maize	9	8	4	3	12	3
Cassava	10	2	2	6	7	5
Gnut	2	3	3	4	6	2
Cotton	5	6	7	9	10	6
Tomato	7	5	6	2	3	8
Onions	9	11	6	7	5	6
Bananas	8	9				6
Plantains	3	1			1	
Oranges	11	10				7
Cocoa	4	4			9	
Chillies	6	4			2	
Melon-seed			5		4	1
Cowpeas				5	8	3
Sesame				1	9	
<b>Top three:</b>	Rice	Plantains	Rice	Sesame	Plantains	Melon-seed
	Gnuts	Cassava	Cassava	Tomatoes	Chillies	Gnuts
	Plantains	Gnuts	Gnuts	Maize	Tomatoes	Cowpeas
						Maize

## 9. Smallholder livestock production

The interactions between crop and livestock production demand, in an ideal world, an integrated assessment under the headings already considered. But the systemic differences between crops and livestock force a more pragmatic approach which focuses on them separately. The questions we shall address in this section are: (1) What long-term trends are discernible in livestock production and were they able to keep up with population growth, a proxy for domestic demand for livestock products? (2) How far were these trends driven by rainfall, which can be used as a proxy for feed supply? (3) How far were they responsive to trends in meat prices, the only indicator presently available of market demand? (Milk price series are also available, but the informality, fragmentation, and localisation of a great proportion of marketing is likely to make a superficial data analysis such as this misleading.)

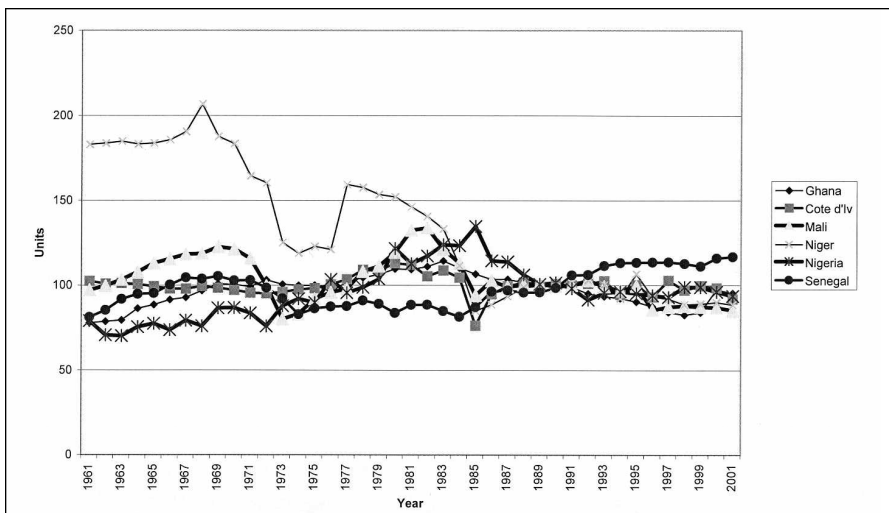
It is a necessary assumption in the following discussion that all livestock production is in the hands of smallholders, because in the crude indices used, no separate account is taken of (a) large-scale, commercial livestock enterprises (whose number is so small in West Africa that they have little impact on the general situation), (b) animals belonging to wealthy urban owners which are managed under contract by pastoral specialists, sometimes in fragmented herds, and (c) larger-than-average herds belonging to some nomadic specialists, which however support large extended families so that on a per capita basis they can still be considered as smallholdings. A second preliminary point that must be made is that national indices are less sufficient guides to livestock productivity than they are for crops, because of the frequency of trans-border movements both of grazing herds and of meat on its way to market (whether slaughtered or alive – usually the latter). Throughout the period, a consistent pattern of livestock marketing – of movements from interior drylands to urbanised coastal markets – has been sustained, notwithstanding vicissitudes induced by exchange rate changes or EU dumping practices. Producers' responses to prices, therefore, may not always be confined to the country leading the demand.

In partial answer to Question (1), we have plotted long-term trends in livestock per capita, using standard units,<sup>7</sup> for each country (Fig 30). It

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<sup>7</sup> The units have yet to be confirmed by FAO

**Figure 30. Indices of livestock per caput**



should be noted that livestock have multiple purposes in rural livelihoods (investment, meat, hides/skins, milk and other dairy products, transport, farm energy and manure). Over the 40 years, only Niger and perhaps Mali failed to maintain or improve on their per capita livestock holdings. Given average rates of increase in the human population often in the range 2.5-3.5%, this overall stability represents a massive real increase in the livestock sectors. It results from a direct link with household livelihood strategies, in which animals are seen as investments, breeders, or income earners, rather than merely for consumption (Faye *et al.*, 2000). Statistically significant correlations have been found between livestock and human populations in Nigeria and Niger (Bourn and Wint, 1994).

Superimposed on this simplified representation of trends in the long term are responses to feed constraints, most easily shown in rainfall variability and trends, as the livestock populations of West Africa are concentrated in the drylands. Long-term decline in average annual rainfall was a fact of life in the Sahel from a peak in the early 1950s until the early 1980s (Fig 10), amounting to a fall of 25-30% between the long-term averages for 1931-60 and 1961-90. This meant a greater frequency of droughts during the 1970s and 1980s than had been experienced before in the period of recorded rainfall. Plant biomass productivity in the Sahel depends directly on rainfall. Consequently, the trajectory of livestock per

capita in Niger was strongly downward, via a collapse in the Sahel Drought of 1973-74, and subsequent recovery, until the even worse collapse of 1986 which followed three years of drought, high mortality, and the movement of surviving herds to Nigeria. Thereafter, numbers stabilised, though at a low level; however, recent data from Maradi Department suggest a strongly upward trend which contradicts this national picture (Mortimore *et al.*, 2001). Mali's trajectory reflected that of Niger in its fluctuations but not in its downward path, while that of Senegal, the third Sahelian country in our set, in spite of a slump between the two afore-mentioned droughts, moved strongly upward - more strongly than in any of the other five countries.

A rather different pattern is discernible, as might be expected, in Nigeria, Ghana and Cote d'Ivoire. Nigeria's very large livestock population grew rapidly, quickly recovering from the major droughts, until it peaked in 1986, the year in which a major part of Niger's surviving herds entered the country; but thereafter it fell until stabilising at a lower level during the 1990s. Ghana's trajectory was parallel, no doubt reflecting very similar ecological and trans-border relations. That of Cote d'Ivoire shows a stronger impact of drought in 1986 (though not in 1973-74), but is otherwise similar.

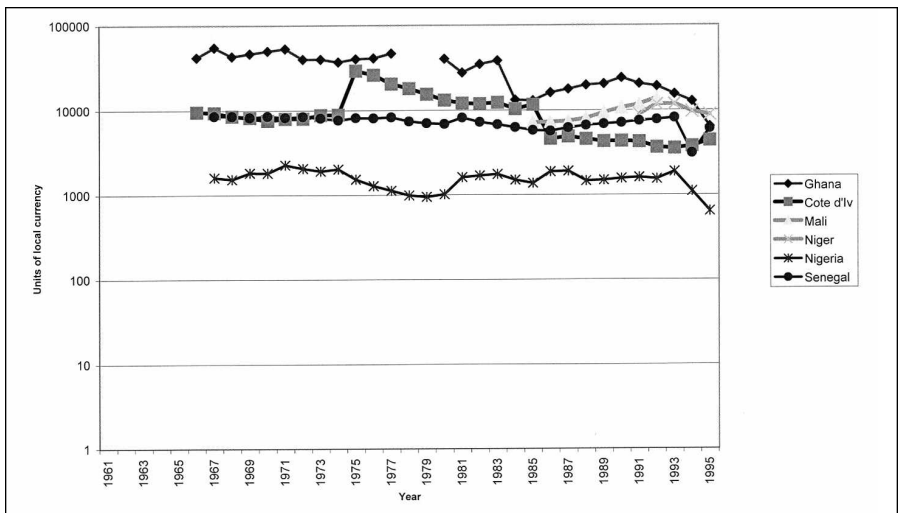
So the answer to the second part of Question (1) is that with the apparent exception of Niger, per capita livestock holdings were maintained or improved against a rapidly rising human population, but that in answer to Question (2), the discernible impact of rainfall was a major drag on this achievement and a determinant of inter-year variations.

In answer to Question (3), the trends in selected meat prices (those of cattle, goat and chicken meat slaughtered in the country, or 'indigenous' meat are plotted for a 30-year period (1965-1994) (Figs 31a,b,c). The general trend is stable or slowly declining over the period as a whole. For individual countries, the similarities indicate that the products are substitutable. Sudden adjustments either up or down (for example, in Cote d'Ivoire in 1974 and 1987) reflect factors other than the normal interaction of supply and demand, as shown by the continuity in direction before and after the event. Greater stability or even upward movements were achieved in some countries between 1987 and 1993, but sudden falls in the last year or two of this shortened series probably reflect (in some) the impact of the devaluation of the CFA franc in 1994 (though in

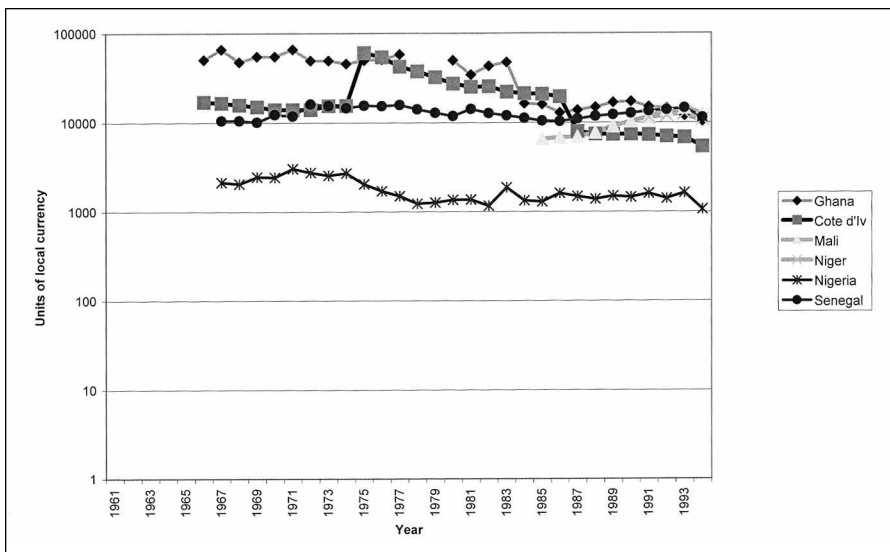
a direction opposite to what might have been expected, as it should have reduced competition from imported European meat). The persistence of per capita livestock holdings in the face of stagnating or declining meat prices, of course, reflects not irrational behaviour, but the wider role of livestock in household livelihoods, mentioned earlier. However if the multiple purposes of livestock interrupt such a causal link, in the other direction it can be said that smallholders' success in maintaining their livestock holdings likely contributed to downward trends in prices, given the fact that few West Africans eat meat often, demand for what is regarded as a food for special occasions being constrained by widespread poverty.

In other words, in addressing Question (3), the evidence suggests that a simple market response model does less than justice to the complexity of livestock keeping in West Africa. Rather than merely responding to profitable meat prices (consumer demand) by increasing their production of indigenous meat, livestock owners have tended to accord priority to the multiple benefits of animals in their own (producers') diverse livelihood strategies. This may even have driven meat prices down – a trend noted in the major urban meat markets of Kano in Nigeria during the 1990s (Ariyo *et al.*, 2001)– as it is far from clear to what extent the influence of global price trends can be traced to West African meat markets, or has percolated to livestock decisions in rural households in West Africa.

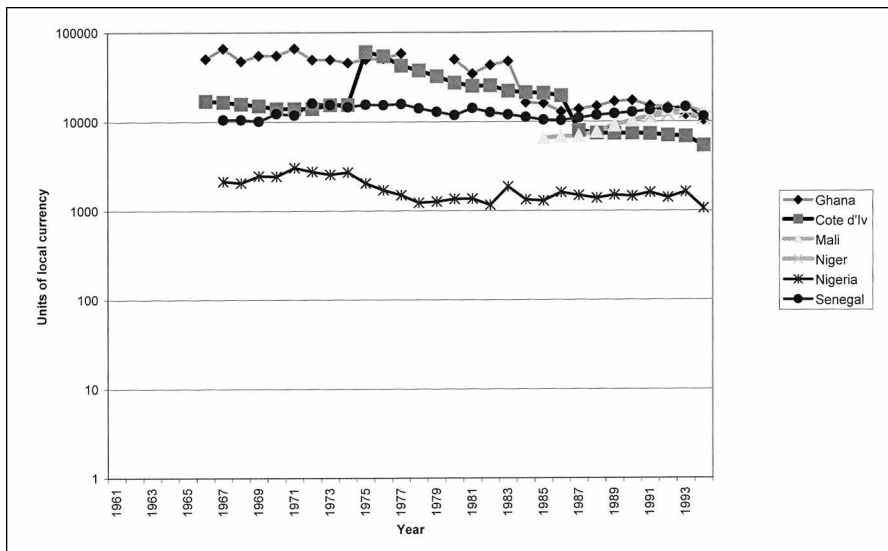
**Figure 31a. Indigenous cattle meat prices (deflated)**



**Figure 31b. Indigenous goat meat prices (deflated)**



**Figure 31c. Indigenous chicken meat prices (deflated)**



## 10. Findings

This review of long-term data series for six West African countries (three Sahelian, three with diversified agro-ecologies) has shown country-specific trajectories of change. Can it point to robust findings of general applicability for West Africa as a whole? These are briefly summarised under three heads: 1, the historical achievements of family farms; 2, some indicators of capability in the family farming sub-sector; and 3, the top three constraints that have affected the performance of the sub-sector. These findings arise from an analysis of the past. Questions concerning the future are identified in the following section.

### Historical achievements of family farms

- Small family farms have invested in land development in an incremental process of landscape transformation which represents, in aggregate, a massive commitment of labour and capital to increasing agricultural output over time.
- Following many vicissitudes during the 40-year period, small-scale farmers (who comprise the overwhelming majority of agricultural producers) emerged at the end of the period as producers of equal or greater food output per capita of the total population than they were at the beginning, notwithstanding a doubling (or more) of the numbers of consumers, and (in some countries) a recent stagnation in the size of the agricultural (producer) population. The exceptions are Niger, which is exceptionally vulnerable to Sahelian biophysical constraints, and Senegal, where policy has privileged imported food.
- In some countries (Côte d'Ivoire, Ghana and Nigeria – cocoa; Mali – cotton; Senegal – groundnut oil) a continuing commitment to certain export commodities was accompanied by a recovery, more or less, of food sufficiency at national level. Export of other agricultural commodities declined (Nigeria – palm oil, cotton, groundnuts; Niger – groundnuts).
- A significant intensification of agriculture, achieved under favourable conditions in certain districts, has been observed before; but the long-term data series suggest that family farms in general are not ignoring the logic of intensification under increasing scarcities of additional cultivable land.

## Indicators of capability

- Family farms have demonstrated a capability to add value to agricultural enterprises through productive investment and incremental intensification, as well as through extensification (often considered to have been the only means of increasing production). This does not mean that all family farms invest nor that all practices are sustainable. But at national level, average performance is suggestive.
- Between reversals induced by policy, global market factors or environmental disasters, upward trends were maintained for significant periods of time in several variables in most countries. More needs to be known about these developmental windows in agriculture, and the factors that interrupted them. However, their existence suggests a capability in the family farming sub-sector which gives some ground for confidence, if enabling conditions can be created and sustained.
- In particular, the recovery that followed the crisis of the early 1980s testifies to the capability of family farming in a general sense to respond to enabling policies, even if imperfectly designed and incoherently implemented. In significant respects, positions lost after the 1960s were regained.
- Family farms can adapt to markets, by switching between crops, exploring niches, and adopting or adapting technologies and production systems while simultaneously coping with severe constraints. They have partially accomplished a transition from export to food crop marketing in response to changing opportunities. Although these data do not show it, they have also developed labour and other input markets.
- Capability to compete is suggested by the frequency of positive production trends under conditions of stagnating or declining producer prices, for livestock as well as for crops. Price trends mirror global commodity price trends. Without changes in global prices, West African countries as a whole are not poised to stage a major recovery in the export of traditional agricultural commodities.

## Major constraints

- Macro-economic management – even on the basis of the superficial observations offered here – emerges as the primary constraint or determinant of the performance of the agricultural sectors, country by coun-

try, and within it, of family farms. Policy must be tailored to the specific conditions of a country – its agro-ecological endowment, its people-land ratio, its level of urbanisation and economic diversification, its commitment to export agriculture. Can any generalisations be made? A research priority should be to analyse medium-term periods in the data series, in relation to the stability and specific content of policy, for as many (and diverse) countries as possible. A comparative analysis of such periods could point the way towards ‘best practice’ guidelines.

- The second major constraint – or determinant - which clearly underlies the data series is a growing scarcity of additional cultivable land (the closing of the land frontier). The data examined do not resolve conclusively the tension between neo-Malthusian and ‘neo-Boserupian’ interpretations of land use change, as no generally compatible time-series data on land degradation exist, but as already observed, there are powerful suggestions of intensification coming through at national level in some countries. Since small-scale farming is, as a general proposition, more efficient in its use of land than large-scale farming, a second research priority should be to establish the linkage between agricultural change and the increasingly finite supply of new land, and better evaluate the capability of family farms to manage transformation. The process of intensification goes far beyond the use (where possible) of inorganic fertilisers, and prominent facilitators are known to be the growth of markets and the integration of crop with animal husbandry.
- The third major constraint which explains much of the variability in the data series is rainfall and in particular the occurrence of droughts, especially (but not exclusively) in drier areas. Given the extent of such variability, and a trend throughout the Sahelo-Sudanian zone to increased aridity from the 1960s to the 1990s, it is truly remarkable that family farms, with their weak access to insurance, high dependency on home-produced food, and vulnerability to capital depletion, have nevertheless weathered so many storms during the period under consideration (most notably, the drought cycles of the early 1970s and 1980s). Since the Sahel Drought, research has contributed much to a systematic understanding of resilience at the household level, but there has been little analysis of the social sources of this resilience with a view to finding ways of supporting or extending it through policy. Such a research priority would correct an important area of policy neglect.

# 11. Questions for the future

A case has been made for the capability of family farming based on the evidence of its long-term performance in 1960-2000, as suggested by available data. A parallel case can be constructed, using the findings of local level studies of farming and livestock producing communities in a diversity of situations (Wiggins, 2002). This is not attempted here. The final question is, given the evidence of the performance of family farming under *past and present* conditions, are there grounds for believing that it can continue to adapt and perform its basic functions effectively under *changing* conditions?

Any analysis of the past shows that an adaptive capability is built into West African farming, and that the more risky the environment, the greater this adaptability is. By comparison, large-scale commercial systems are widely conceded to be specialised, and more dependent on constant access to inputs and markets as well as on non-variable growing conditions. This general argument may be reasonably used to support the case for family farming in West Africa, where alternative systems (with the exception of plantations in the humid zone) have a short history, a limited range of experience, and a chequered record of success.

- *Climate change: can family farms adapt?* Available scenarios of climate change do not permit a confident prediction of rainfall trends in West Africa, so the nature of this challenge (if any) to farming is unclear. Meanwhile, Sahelian farmers have already adapted to a greater change in average rainfall (25-30%, 1931-60 to 1961-90) than found in climate change scenarios.
- *Land scarcity: can they intensify?* Unfortunately there is insufficient recognition, in neo-Malthusian arguments linking land scarcity with degradation, of the dynamics of a transition from extensive to more intensive land use, dynamics which are handled at the level of the individual farm, in terms of day by day allocations of labour and capital. The emergence of indicators of intensification in national level data shows that this transition is not merely occurring as a local aberration to a general degradational decline.

- *Food sufficiency: can they continue to 'feed the nation' with diminishing relative or absolute numbers of producers?* Demand for staple food commodities is unlikely to decline, given current rates of population growth and food preferences determined by both culture and poverty. The strongest evidence that family farms will continue to perform this function is the strength of recovery from stagnating food production in the 1980s. It is clear that economic incentives rather than capability are the chief constraint.
- *Changes in livelihoods and in personal expectations: can family farming continue to attract labour and capital as livelihoods diversify, migration and urbanisation intensify, and social values change?* In West Africa, there are sharp differences between agricultural systems even in the same country with respect to the opportunity costs of agricultural labour; much north-south and trans-border migration is related to these differences. The only honest answer to this question is to 'wait and see' how intensifying patterns of interaction, producer price trends, wages in alternative occupations, and the social value of land (among other factors) evolve.
- *Global markets: can family farms compete?* Probably the greatest unknown in answering the previous question is the future impact of competitive (and – on experience till now – unfair) global markets on economic incentives in West African agriculture. Compared with commercial agriculture, family farming undervalues a large proportion of its labour inputs (unpaid family labour); by this or other means, food sufficiency has often been achieved in the face of stagnant or declining prices. Competition with imported food has been both overt (e.g., in Senegal – rice, Côte d'Ivoire – meat) and covert (e.g., through persistent food aid in Sahelian countries). The ending of surplus disposal in food aid by the USA, as in the EU would appear to be a precondition for optimising market incentives for family farms or large scale commercial farms alike.<sup>8</sup> The competitiveness of family farming in domestic markets is also linked with the resilience of cultural food preferences. In overseas markets, competition damaged some export agriculture irreparably – for example, Nigerian palm oil exports, which could not compete with those of Malaysia. However this was due as much to unfavourable currency exchange rates as to producer incapa-

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<sup>8</sup> The EU has ceased to use food of European origin, having adopted a policy of food aid in cash for purchases within the famine-affected region (EU Trade Commissioner, 17/1/03)

bility, and the same factor that led to an over-valued currency (oil) also stimulated a compensating increase in domestic demand. Notwithstanding recent promotion of export agriculture as the only escape route from economic stagnation in African countries, the long term data do not in general point to significant efficiency improvements or major increases in output.

- *Closer regional integration: a threat or an opportunity?* The agro-ecological similarity of many West African states limits the scope for regional exchange of agricultural commodities. However, family farming is structurally linked with income diversification at the household level, and opportunities to move labour and skills around the ECOWAS countries are beneficial to rural areas especially where the opportunity for agriculture is seasonally adjusted. In such areas, the flexibility of family farming with regard to labour and capital allocations is its greatest merit.
- *The 'livestock revolution': cause of conflict or agency of integration?* There is a global trend towards eating more meat associated with gradual increases in incomes, and if reproduced in West Africa, this may alter the relative incentives for producing crops and livestock. Already, in the eyes of some observers, animal production is under threat from the conversion of natural pastures to farmland. However, there are also signs of increasing integration on farms where animals complement crop production rather than compete with it. Fodder crop production is not yet competitive with food or export crops in most parts of West Africa, though some crops with high-value residues are experiencing rapid increases in price and/or output (cowpeas, groundnuts). The answer to this question depends on which viewpoint is embraced: in areas where crops can be grown, exclusive use for pasture or cultivation creates a conflict that will be exacerbated by increased competitive prices for livestock; but integrated use offers an opportunity for the best of both worlds, and is ideally suited to the circumstances of small farmers.

These questions do not exhaust the range of uncertainty about the future course of change. However, they suggest that family farming is likely to offer as viable a strategy as any alternative – while retaining the flexibility and autonomy necessary for autonomous rural communities in a time of opportunity and challenge.

# Annex

## Farm and non-farm investments in Maradi, Niger

Rural households in Maradi Department are used to making productive investments in livestock and new crop production technologies. Current priorities for household investment still include investments in livestock and, increasingly, land (Hamadou, 2000a). Investments are now more diversified than before. Many people invest in land. Women's focus is on livestock, while men's is on agricultural production, especially for the market. Many young men invest in migratory strategies (Diarra Doka, 2001). With income diversification, and devaluation, investment in prestige items has increased.

Much investment goes into domestic structures. The methods of house building are starting to change, from circular mud huts with thatched roofs to rectangular mud *soro* houses (where a source of clay exists). Cement and metal sheets are being used for roofs (Doka, 2001). These changes involve greatly increased costs, and as improved houses are first constructed by the well-to-do, their appearance in any number provides an indicator of increasing wealth in the community.

If farm investment is restricted in meaning to major fixed cost items obtained through markets or on credit, such as ploughs or other new technologies, it should not surprise us that the capability of poor rural households to invest has been rather limited. Le Gal found an association between holdings of more than 10 ha and the use of animal traction, modern inputs (fertiliser, improved seeds and chemical treatments), and hired labour (Grégoire and Raynaut, 1980: 144-7). However, some farms of two hectares or less used modern inputs, and some without animal traction nevertheless hired labour. This absence of a clear distinction between 'modernising' and other farms points to the presence of a perception that investment is essential, notwithstanding the constraints under which small and poor farmers work.

The statistics of land use change are the measure of this process in Maradi. Between 1972-73 and 1994-5 an additional 1,400,000 hectares were cleared (Hamadou, 2000, Table 11).

Farm investments occur on the frontier of technological change and adaptation. In changes in agronomic practices, a division may be made

between those that require significant monetary funds and those that do not (Table A: Amoukou, 2000: internal report).

From these data it may be seen that the trend to capitalisation (requiring funds) has been strongest in the southern, wetter and more market-accessible villages, but that in the most risky village (Dan Kullu) some farmers have both capitalised and intensified using additional labour (more dry sowing and weeding).

Table B shows that in acquiring major farm equipment, credit played a minor (even insignificant) role alongside private finance. Amoukou reports that the majority of major farm investments were made during the last 10 years. Hamadou found investments increased after the devaluation of the FCFA in 1994, which had resulted in a rise in farm prices (Table C). Credit was then less available, though some was provided by CARE. The sources of this private finance were agricultural incomes (Table C: Amoukou, 2000), though the possibility that off-farm incomes also contributed is not excluded by the data.

**Table A. Trends in the use of certain agronomic practices from more than 30 years ago to the present**

Practice	Jiratawa	Magami	Shariken Hausa	Dan Kullu
<i>Requiring few funds:</i>				
Bush clearing	=	=	=	=
Tillage, hand	-	=	=	=
Dry sowing	-	=	=	+
Sow after rain	=	=	=	=
No. weedings*	=	=	=	+
Hand weeding	=	=	=	=
<i>Requiring funds:</i>				
Tillage, plough	+	+	none	+ (one)
Treating seeds	+	+	+	+
Sow by seeder	+	+	none	+
Improved seeds	+	=	+	+
Weeder/ridger	+	+	none	none

Source: Amoukou, 2000.

= no change - decrease + increase

\* Normally two, increasing to 3 in villages shown +

**Table B. Mode of acquisition of major farm investments during the past 20 years, four villages**

Investment	Credit	Purchase	Lease
Plough	3	17	1
Seeder	0	7	1
Cart	3	15	0
Weeder/ridger	0	4	0
Oxen	3	16	3
Total	9 (12%)	59 (81%)	5 (7%)

Source: Amoukou, 2000.

**Table C. Year of acquisition of new capital equipment**

	Plough oxen	Ox cart	Heavy plough	Light plough	Bicycle*	Motor cycle**
To 1994	1	8	10	4	2	0
1995 onwards	18	9	2	34	6	4

Source: Hamadou, 2000.

\*1 in Dan Kullu (remainder in Jiratawa) \*\* All in Jiratawa

The profiles of private investment financing varied significantly among villages. Farmers in Jiratawa, with irrigation, ranked their sources in the same order for the past 30 years, with crop sales at the top. Farmers in Magami, mainly rainfed, though starting similarly, shifted animal sales and trade to higher rankings during the past ten years. Farmers in Sharken Hausa, less market-accessible, drier and rainfed, ranked animal sales first and scarcely changed the rankings of their other options. But those in Dan Kullu, the driest and least accessible, switched from animal sales to crops and then to trade as their first, raised animal fattening from fourth to second ranking, and depressed crop sales. Nevertheless, the proportion of farmers selling cereal grain (mostly millet) at the present time increases northwards. These rankings conform accurately to what we know of the constraints and opportunities facing these differentiated communities. In all four, mineral fertilisers were the most important purchased input, hired labour the second, and new or treated seed the third. These rankings did not change during the 30-year period.

**Table D. Rankings of investment sources for agriculture, from 30 years ago to the present**

	<b>Jiratawa</b>	<b>Magami</b>	<b>Sharken Hausa</b>	<b>Dan Kullu</b>
30 years ago	crop sales large rum. small rum. fattening trade	crop sales large rum. small rum. trade fattening	large rum. large rum. trade fattening crop sales	large rum. crop sales small rum. fattening trade
20 years ago	crop sales large rum. small rum. fattening	crop sales large rum. trade small rum.	large rum. small rum. trade fattening	crop sales large rum trade small rum.
last 10 years	crop sales large rum. small rum. fattening trade	large rum. crop sales small rum. trade fattening	large rum. small rum. trade crop sales fattening	trade fattening crop sales large rum. small rum.
Selling cereals	0/10	2/10	5/10	5/10

Source: Amoukou, 2000.

rum. = ruminants

Although these findings result from a very small sample, they dispel the myths that no farmers can finance investment and that they do not know how best to manage their investments in a dry, high-risk environment. Not every farmer, of course, has investment capability, and that of the most successful is still less than they would wish. Investing farmers are better off, but by no means wealthy, and they include women.

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