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RÉGION DE DIORBEL : SYNTHESIS

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Preface

Drylands Research Working Papers present, in preliminary form, research results of studies carried out in association with collaborating researchers and institutions.

This working paper is part of a study which aims to relate long-term environmental change, population growth and technological change, and to identify the policies and institutions which are conducive to sustainable development. The study builds upon an earlier project carried out by the Overseas Development Institute (ODI) in Machakos District, Kenya, whose preliminary results were published in a series of *ODI Working Papers* in 1990-91. This led to a book (Mary Tiffen, Michael Mortimore and Francis Gichuki, *More people, less erosion: environmental recovery in Kenya*, John Wiley, 1994), which was a synthesis and interpretation of the physical and social development path in Machakos. The book generated a set of hypotheses and policy recommendations which required testing in other African dryland environments. Using compatible methodologies, four linked studies are now being carried out in:

Kenya	Makueni District	
Senegal	Diourbel Region	
Niger	Maradi Department	<i>(in association with ODI)</i>
Nigeria	Kano Region	<i>(in association with ODI)</i>

For each of these study areas, there is a series of working papers and a synthesis, which were reviewed at country workshops. The overall synthesis was discussed at the international workshop in London in 2001. In the Senegal series, the authors consider the long-term evolution of agriculture and the rural world, in order to establish the links between these, government policy, and the investments undertaken by small farmers in the Diourbel Region in the period 1960-99.

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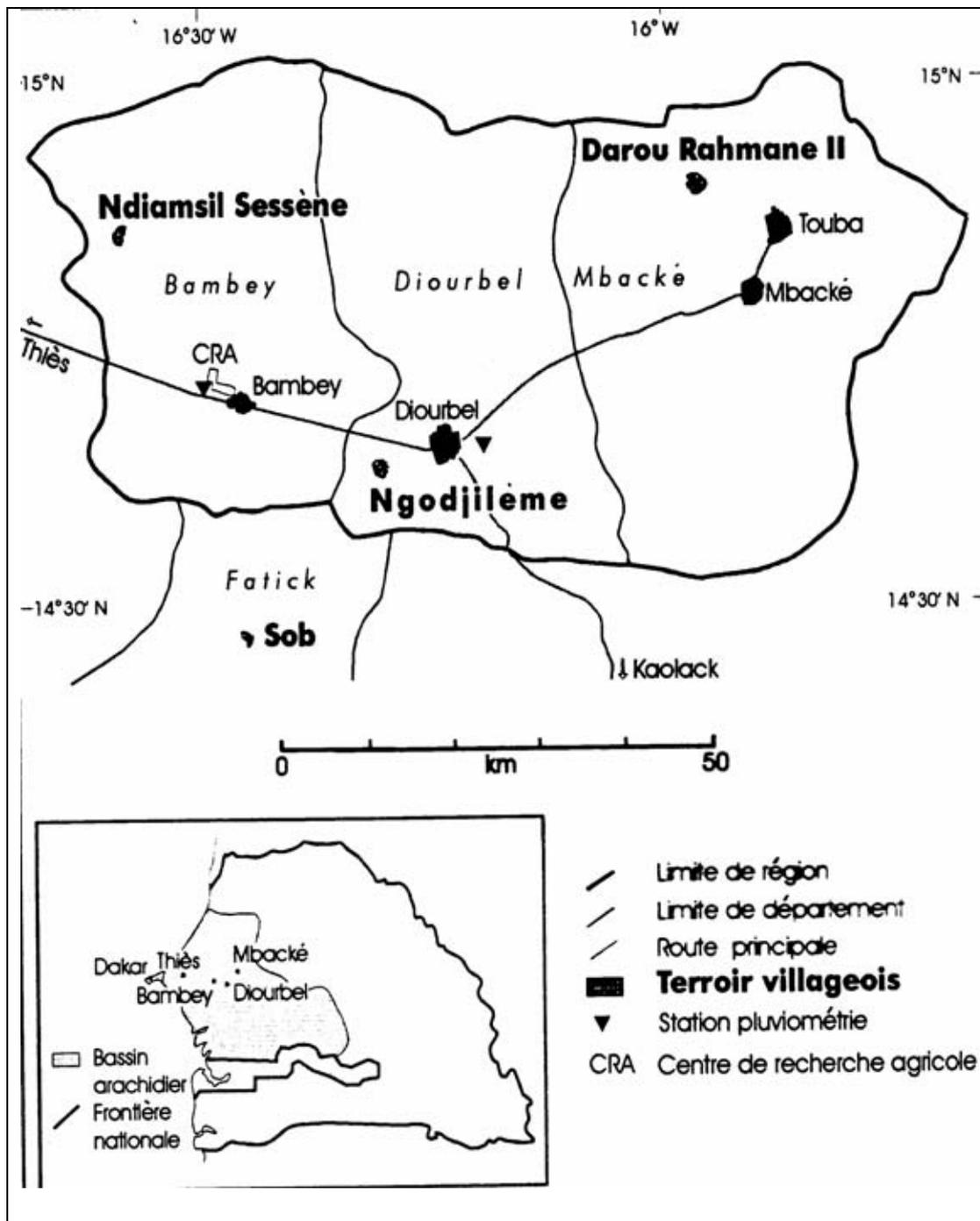
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Preface map



Abstract

The so-called crisis in Senegalese agriculture is the steep fall in groundnut production. In the 1960s this crop was the major source of export earnings and farm income. Conventional explanations have blamed population growth, leading to a scarcity of land and the reduction of fallows. The latter was blamed for falling yields, and together with a fall in woodland, was taken as a sign of environmental degradation. Only gradually was it realised that economic factors were also at work, particularly a price and marketing system that forced farmers in a risky environment to rely on credit for access to inputs, and which deprived them of much of the benefit of world prices.

In Diourbel Region, a new dynamic is observable, particularly since the change in agricultural and pricing policy which began in the 1980s, but which has some earlier roots. People in the area have always responded to the different markets for their produce and their labour. While part of the decline in productivity is due to rainfall factors, farmers have maintained or raised yields per unit of rainfall, selectively using technologies introduced by the extension service. Rising meat prices, never controlled, have led to a massive swing to livestock production, using new fattening methods. Farm trees have been conserved. There has been some diversification of crops in favour of cowpeas and hibiscus. However, despite Senegal's heavy imports of rice, millet production has been limited to rural consumption needs, since there is no urban market for this crop.

Low agricultural incomes due to falling output prices and rising input prices have encouraged such substantial diversification into non-farm activities and urban out-migration that the proportion of land farmed may have declined despite population growth. The headquarters town of the Mouride brotherhood, Touba, which is the largest town in the Region, is officially still regarded as rural. Touba, Dakar and overseas destinations have all attracted migrants, and many rural families have an urban branch. However, urban incomes, and hence, remittances, are limited by illiteracy. Rural families see the state primary school curriculum as irrelevant to their needs. Remittances are not used for farm investments, but for consumption needs, and the little farm investment that takes place is livestock-orientated.

Recommendations are made for a new policy based on recognition of the abilities and adaptiveness of rural families, and state provision of an enabling environment for their enterprise, to counter the former encouragement of dependence on state services. This still requires important state action, for example, research in support of diversified crops and livestock, the management of tariffs etc. in relation to imported foodstuffs, and the reform of education so as to support both rural economic needs, and the needs of the new, decentralised, low-level governance institutions.

A French translation of this paper is available as WP 23f. See the inside cover for more details.

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Acronyms and abbreviations

CR:	<i>Communauté rurale</i>
FCFA:	Franc de la Communauté Financière Africaine
LDN :	Loi de la Domaine Nationale
NPA:	Nouvelle Politique Agricole
ODA:	Official development aid
ONCAD:	Office National de Commercialisation et d' Assistance
PA:	Politique Agricole
SODEVA:	Société de Développement et de Vulgarisation Agricole
UBT:	Unité de Bétail Tropical (or TLU – Tropical livestock unit)
USAID:	United States Agency for International Development
WP:	Drylands Research Working Paper

1 INTRODUCTION

1.1 Thomas Malthus and African development

Malthus' well-known vision of exponential growth in population and arithmetic growth in food production, leading to an inevitable increase in poverty, together with the law of diminishing returns to additional inputs of capital and work, have led to pessimistic analyses of natural resource management in Africa. A preoccupation with population growth as a root cause of poverty focuses attention on decreasing land per capita. Malthus did not incorporate technological change into his model other than as an external variable. Later authors incorporated technological change as a response to population pressure. Boserup (1965) argued that population growth leads to the intensification of agricultural systems through increasing the frequency of cultivation and labour-intensive technical change, making them capable of producing higher output per hectare, and Ruthenberg (1981) described successive phases of intensification in different environments. The study of Machakos District in Kenya (Tiffen *et al.*, 1994) showed how in a relatively favourable policy environment, a sixfold growth in population was accompanied by a trebling of agricultural productivity per head, and a six to tenfold increase in value of agricultural output per hectare (depending on whether it was measured in constant or relative prices). Nevertheless, authors such as Sanders *et al.* (1996) think that in Sahelian conditions, population growth has not led to positive outcomes, because agriculture cannot be profitable enough to attract the investments needed to reverse or stabilise degradation.

Certainly, the evolution of systems of production depends on physical, social, cultural, economic, political and technological factors which may be external. The agricultural production system itself should be understood as one part, though often a large part, of a household livelihood system that includes crop and livestock production, arboriculture, wood cutting and harvesting from natural vegetation, fishing, services, manufacturing and non-farm employment. Changes over time must be understood in this broader context, in which macro-economic and global influences may be discerned.

This study has been designed to test the hypothesis that population growth may have positive linkages with natural resource management through the growth of markets, technological change, and other adaptive changes in livelihood management, under enabling policy conditions, as proposed in the Machakos study. Our aim is to identify the policies and institutions that favour sustainable development. At the heart of the analysis is the investment by households in the conservation and improvement of their land resource, and in the development of alternative income sources. This is achieved by a comparative methodology, using studies in Senegal, Kenya, Niger and Nigeria.

The area selected for detailed study in Senegal is the Diourbel Region, at the centre of the old Groundnut Basin. Within Diourbel, the three villages of Darou Rahmane II, Ndiamsil Sèssene and Ngodjilème were selected for field analysis, together with one village, Sob, just outside it to the south. The criterion for selection was the availability of detailed studies from the 1960s which could be used as base lines. In practice, it was not always possible to make good use of previous studies, owing to differences in interests and methodologies. The administrative Region of Diourbel is divided into the three Departments of Bambey, Diourbel and Mbacké, each with an administrative

headquarters in a town of the same name. The majority of the population are Wolof, but there is a minority of Sereer with some distinctive farming and social traditions.

1.2 A short history of an agricultural crisis¹

At the beginning of the 20th century Dakar was the capital of l’Afrique Occidentale Française. The principle underlying the economic development of colonial Senegal was to leave groundnut production to the peasants, and to concentrate state investment in developing a rail and road network and harbour facilities for the evacuation of the crop. The capital required for the transport of nuts and for processing the oil were provided by French companies who operated in association with local agents, often Lebanese, and who at the same time imported consumer goods and rice for the farmers to buy. The Government promoted the importation of broken rice from French Indo-China, both as urban food and as compensation for a rural food deficit created by the farmers’ concentration on groundnuts. Credit was important, both for purchasing food in the rainy season, when it was scarce, and for seed. Groundnut cultivation demands a high input of seed in relation to output. The low price and ease of preparation of rice rapidly made it the preferred urban staple and a complement to millet in the countryside. The headquarter towns of the *cercles* (later *régions*) became the local commercial centres for this two-way trade. The French also developed a co-operative system, which was only moderately successful, to channel credit to the peasants, and an agricultural research service was initiated in 1921. By 1955-59, just before independence in 1960, annual groundnut production averaged 691,000 tons (Diop, 1992). Groundnut exports to France benefited from a preferential tariff. At independence, therefore, groundnuts were the major engine of the economy, accounting for 80 percent of Senegalese exports, and providing the main source of cash for its farmers.

At independence, Senegal was politically separated from the other territories. It had a small, well-educated urban elite, but its French education system had, in many ways, separated them from the rural population (Wilson Fall, 2000, WP 20). The political leadership was imbued with the ideas of state planning then current in development thought, and combined this with a view of African socialism which was not well-tuned with village social organisation. The agricultural policies which were in force from the early 1960s to 1980 are known as the Programme Agricole (PA). Despite the poor record of the co-operatives, these were selected as the means to control and organise the farmers. In the first decade, they were given by stages the monopoly of trade in groundnuts, farm inputs, rice, and other cereals, making co-operative membership a necessity for all producers. The intermediary traders were driven out, and the French firms were mainly confined to processing and exporting oil. The supervisory organisation, Office National de Commercialisation et d’Assistance (ONCAD), employed a large staff which channelled credit and inputs downwards, and the groundnuts upwards. This was complemented by another large organisation (SATEC, later SODEVA²), which was responsible for extension and training in the use of the new animal-drawn equipment provided on credit. All prices were fixed by the state. The large margin between the price paid to the groundnut producer and that received for the export of oil financed the growing number of state employees, and swelled the taxable

¹ Developed from Gaye, WP 12.

² Société de Développement et de Vulgarisation Agricole.

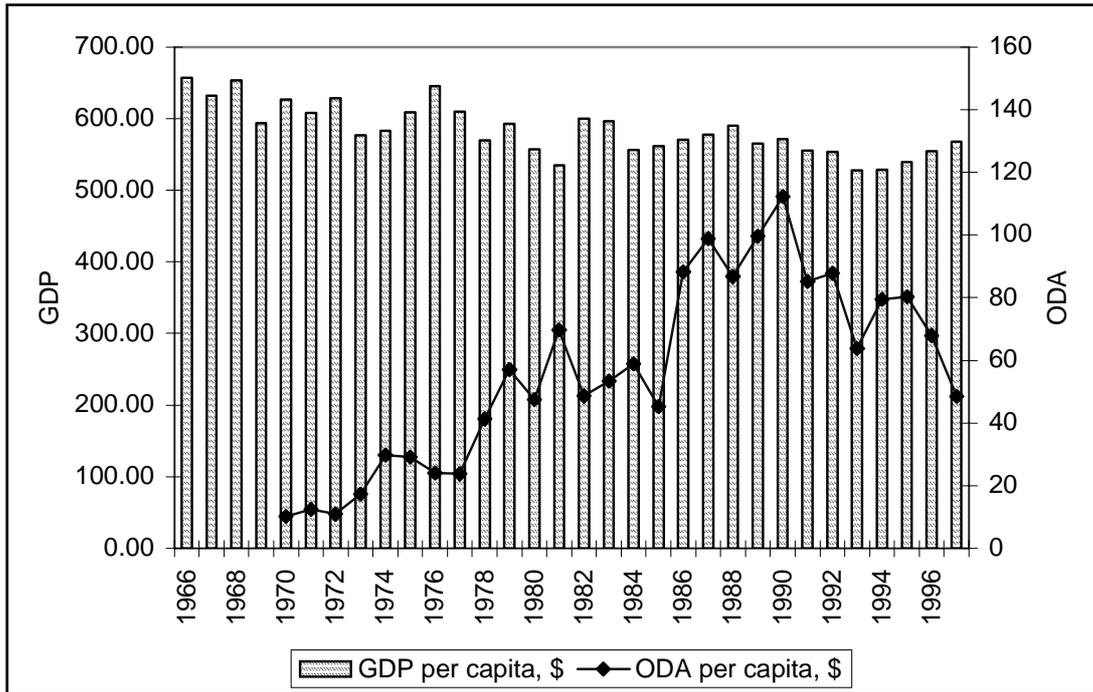
profits of downstream activities. Industrialisation was seen as the way to development, and groundnuts were to provide the necessary capital. The basic principle of pricing was to pay the peasants the lowest price that would keep them sufficiently interested in production. They were not expected to make savings for their own investments or inputs, since these were to be provided on credit.

During the 1970s the petroleum oil crisis provoked a review of import policy, but at the same time, world groundnut prices rose, encouraging the state to nationalise and expand the groundnut oil mills. The change in the rainfall regime, which began in 1968 and led to severe droughts in the early 1970s, was at the same time undermining groundnut production, and rendering the farmers unable to repay their credits. There was much unrest, and the Government was forced to annul peasant debt three times. The inefficiencies and corruption within ONCAD led to huge debts by that organisation.

By 1980 the state had to embark, reluctantly, on some reconstruction measures. ONCAD was abolished in 1980, but the Nouvelle Politique Agricole (NPA) did not really commence till 1985. It was supposed to put in hand a gradual reduction of state intervention and a return of commercialisation to the private sector. In fact there was an abrupt halt to the supply of credit in 1985. The seed supplied fell by half in 1984-6, compared with 1983-4, and was at a tenth of the 1983-4 level by 1988-90. Taken by surprise by their new need to reserve seed, and weakened by the drought of 1983-4, the farmers reacted with an equally abrupt drop in groundnut area cultivated. Structural adjustment was completed only in 1994, with the devaluation of the Franc de la Communauté Financière Africaine (FCFA), which was halved in value in relation to the French franc. The state's effort to raise groundnut prices to the farmer, at the same time as reducing input and rice subsidies, was undermined by the fall in the world price from its peak in the 1970s. The nationalised oil mills were a further drain on prices, since the lower production meant that they operated far below the requirement for economic efficiency. The high prices they charged for local sales led to consumer resistance in favour of imported oils or artisan processed groundnut oil.

Senegal entered independence with the advantage of a well developed infrastructure and some industries which had been developed to supply French West Africa. In Dakar it had an excellent port, giving easy access to world markets. At that time, Senegal's per capita GDP, in terms of purchasing power, was comparable to those of Taiwan and Tunisia (Berthelemy *et al.*, 1996) and appreciably above those of Kenya and Niger. But as Figure 1 shows, the GDP per capita stagnated from 1966 to 1996, while dependence on official development aid (ODA) increased to a peak in 1990. Senegal has benefited from very substantial infusions of official development aid, from France and multilateral donors. In 1990, per capita ODA was nearly 20 percent of per capita GDP. The subsequent decline in ODA has underlined the crisis in the economy. Furthermore, rural incomes were always below urban incomes. In 1991, 78 percent and in 1995, 66 percent of the rural population had less than two thirds of the average national per capita income, compared with 21 percent and 14 percent respectively amongst the urban population (World Bank, *Africa Database 2000*).

Figure 1: GDP and ODA (from all donors), in constant 1995 US \$ per capita, 1966-1997



Source: World Bank, *Africa Database 2000*, tables on GDP per capita, official development aid from all donors, and population.

2 PERCEPTIONS OF A CRISIS

The French word, *crise*, has often been employed to portray natural resource-based economies in the Sahel (Raynaud, 1997). In Senegal, it may be understood to refer primarily to the combination of falling groundnut production, stagnating cereal production and indicators of environmental degradation linked to population growth. The crisis has been portrayed at both the national level and that of the system, where its dimensions can be specified more exactly (for example, Lericollais, 1999: 579 *et seq.*). In this chapter the perceived crisis is explored in relation to its main components with reference to Diourbel Department. An alternative to this view will be offered in Chapter 4.

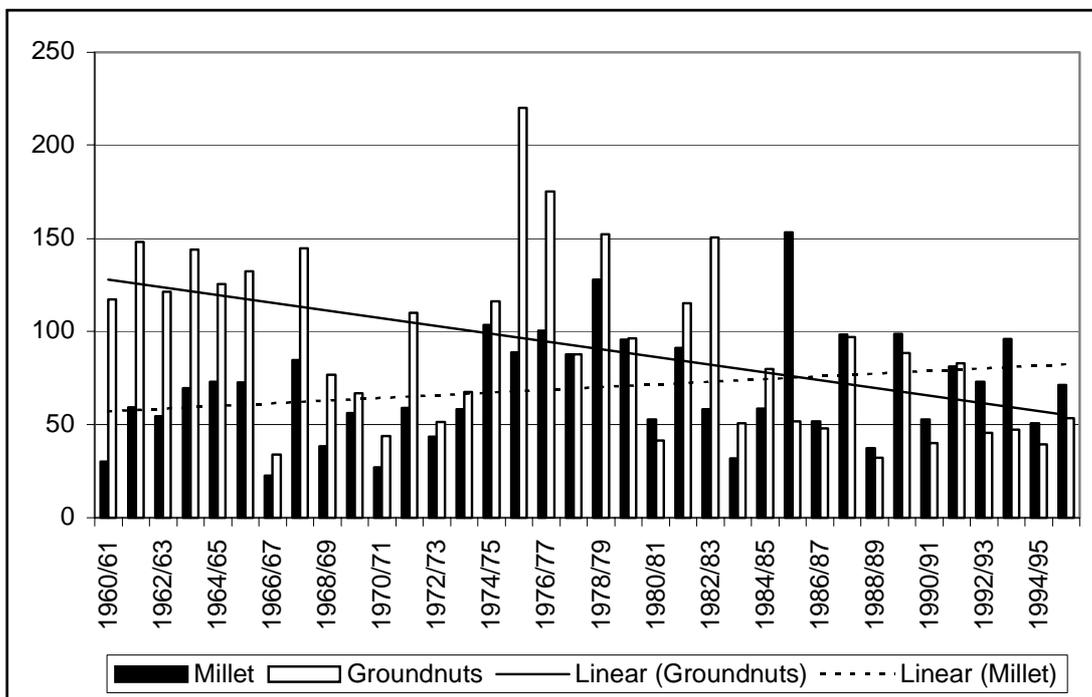
2.1 A fall in production

Official statistics show a reduction at the national level of 19 percent in the area under groundnuts between the two periods, 1960-70 and 1990-96, a fall in production of 28 percent and a yield reduction of 11 percent (calculated from Table A1, Gaye, 2000, WP 12). The national trend was reflected in Diourbel Region, where the downward trend in groundnut production is shown in Figure 2. Also shown is the trend in cereal production (millet), which was rising. However, Figure 3 shows that the rise in millet production did not match the increase in the regional population in the same period, and that on a per capita basis, production of both crops tended downwards: steeply until the Sahel

Drought in the early 1970s, followed by a short reversal, and renewed decline to the drought of 1983-84, from which production failed to recover.

The fall in production, of groundnuts in particular, was associated with a generally downward trend in the area cultivated, according to official statistics (Figure 4). This trend is in contrast to a small but increasing area planted to cowpea and a more stable trend for millet. These data suggest that farmers have tended to allocate their resources out of groundnuts and into alternatives, though the full range of diversification is hidden because data are not available for other crops.

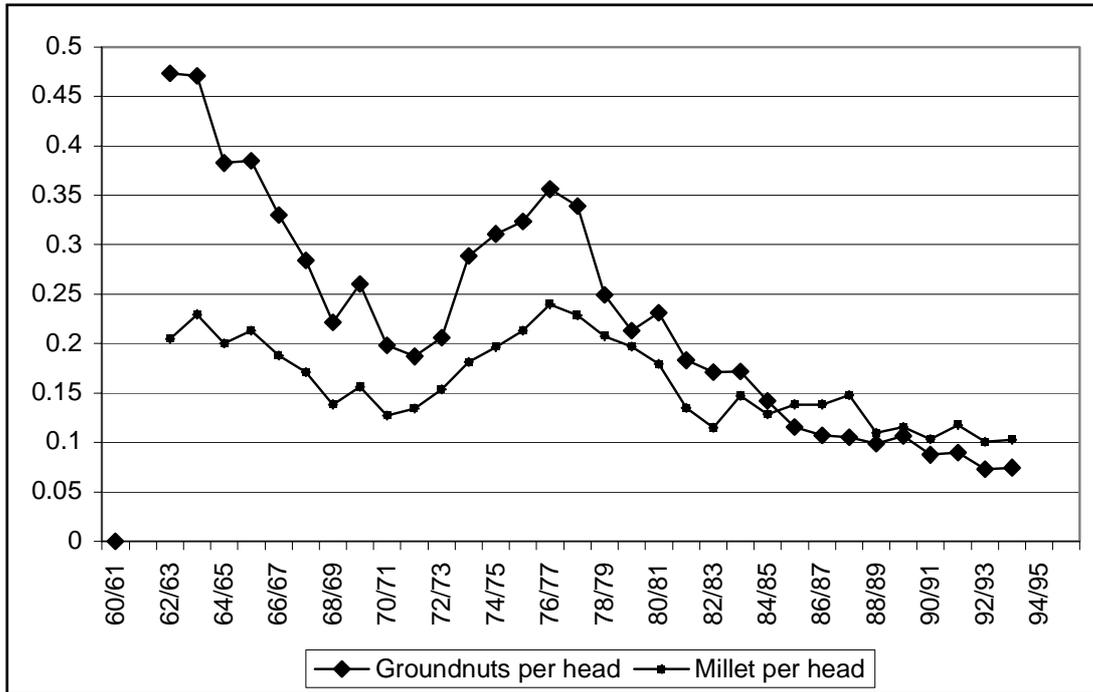
Figure 2: Annual production of millet and groundnuts, Diourbel Region, and linear trends



Source: Adapted from Faye *et al.*, 2000(WP16): Figure 3.

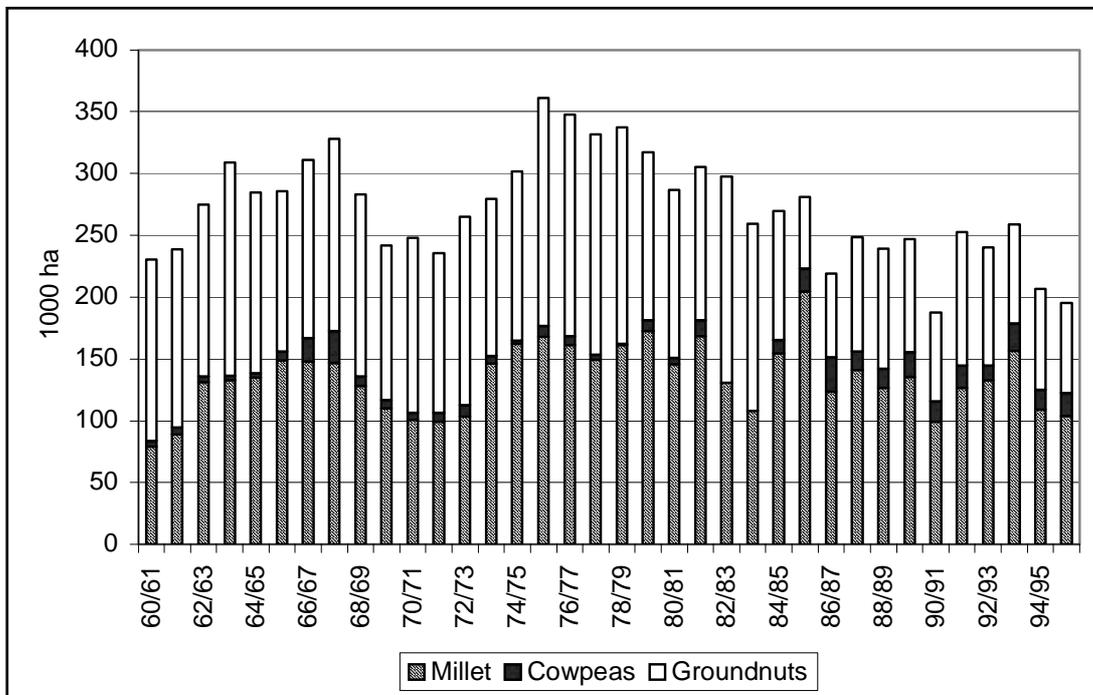
Falling production, particularly of the all-important groundnuts, has been ascribed to changes in rainfall and poor resource management and environmental degradation leading to lower output, this being propelled by population growth and pressure on the resource base. Only later were economic factors taken into account in the analysis, such as the fall in global groundnut prices.

Figure 3: Production of groundnuts and millet per capita (inhabitant of Diourbel Region), in tons



Source: Faye *et al.*, 2000, Figures 14 and 15.

Figure 4: Land planted to main crops, Diourbel Region 1960-95

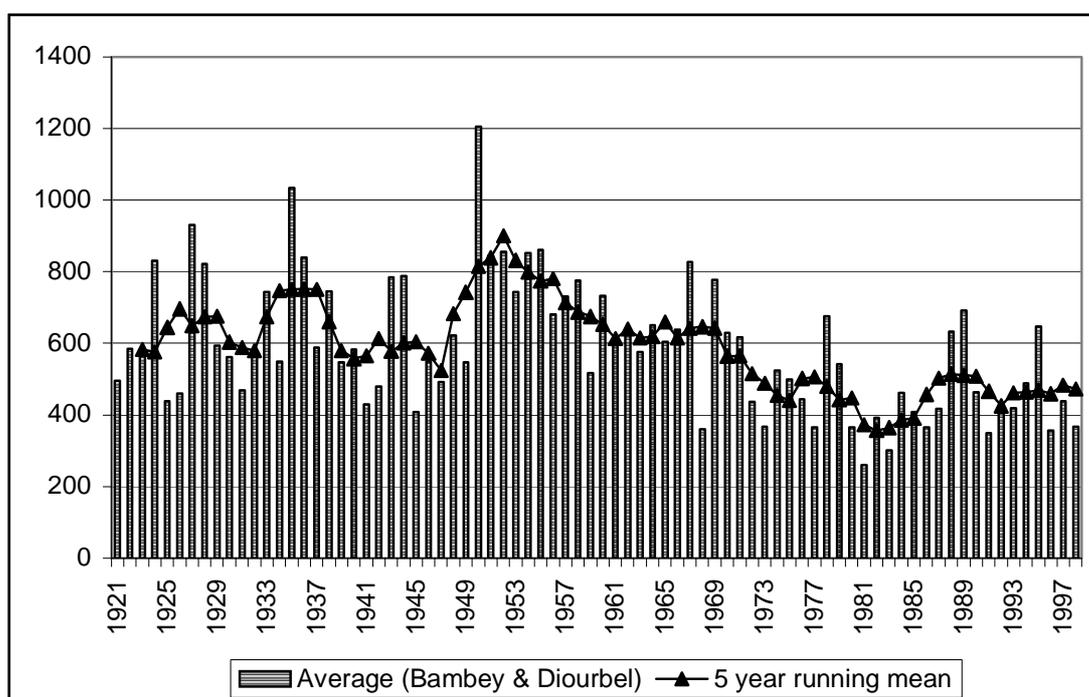


Source: Faye *et al.*, 2000 (WP 16): Figure 1 (sample data from Department of Agriculture, Diourbel Region).

2.2 A fall in rainfall

Water is a limiting factor for rainfed agriculture. In the Sahel, the late 1960s marked the beginning of a downward trend and an increase in the frequency of acute droughts. The rainfall for Bambeý and Diourbel (averaged) from 1921 to 1999 is shown in Fig 5. It is apparent that in this Region, rainfall has tended downwards from even earlier (the 1950s) until the 1980s. This trend is equivalent to a southward displacement of rainfall isohyets of 80-100 km (Badiane *et al.*, 2000, WP 14). However, after the drought of the early 1980s, the trend stabilised and even improved slightly. Also clear from the graph is the high inter-annual variability of the rainfall, which accounts for a large part of the annual variation in production.

Figure 5: Annual rainfall averaged for Bambeý and Diourbel stations, 1921-99, with 5-yr running mean



Source: Derived from Badiane *et al.*, 2000 (WP 14): Figure 1.

2.3 A rise in population and in population:land ratios

The population of Diourbel Region grew from an estimated 261,000 in 1960 to 423,000 in 1976 and to 620,000 in 1988 (Barry *et al.*, 2000, WP 13: Table 1). The annual average rate of growth was 3.24 percent in 1976-88.³ However, the urban areas have grown much faster than the rural areas. The largest town in the Region is Touba ville, (now with more than 300,000 inhabitants). It is officially part of the *communauté rurale* (CR) of Touba Mosquée, shown as a densely settled rural area in Figure 6. This CR is exceptionally large, and in fact consists of an urban nucleus with a lightly populated rural hinterland. If Touba ville were re-classified as a town, the urban population of the

³ There have only been two censuses in Senegal, in 1976 and 1988.

Region would have been recognised as 42 percent of the whole in 1988 (Barry *et al.*, 2000, Table 2) rather than the official 21 percent.⁴

The population of Touba ville grew at a rate of 12.9 percent/year in 1976-88, while the other three urban *communes* grew at three to five percent. Rural population growth rates were variable and much lower. In five rural *arrondissements* (excluding that containing Touba), annual growth in 1976-88 varied from 2.48 to 0.5 percent (Table 1). The rural population may have declined since 1988. In ten villages for which data from the national agricultural census of 1998 have been seen, the population is slightly below that of 1988 figures, though with considerable variation between villages (Ndione, in Barry *et al.*, 2000, WP 13).

Population densities vary considerably. In the Region as a whole (including the urban population) the average density was 142/km² in 1988. Excluding the *arrondissement* containing Touba, the densities of the five rural *arrondissements* are shown in Table 1. There was a range from 46-151/km². Densities are even more variable at the *communauté rurale* level. Figure 6 shows their densities in 1988. The highest rural population densities (apart from Touba Mosquée) are found in the CRs of Ndangalma and Rafane, (231/km²), both adjacent to Touba Toul, which has a big market, particularly for livestock. Ndoulo, another CR with high density (186/km²), is also on the livestock marketing network (Ly, 2000, WP 18). They have populations of 17-18,000. This indicates there could be other rural centres besides Touba ville which deserve classification as urban because of their size and commercial functions, although without the administrative status of *commune*. The very low densities in most of Mbacké are notable.

Rural population growth and increases in density are not known before 1976, so there is no basis for separating rural and urban populations. Péliissier (1966) reported that in 1960, rural densities were already 80-100/km² in Siin and parts of Baol. There were efforts by the colonial administration, as early as the 1930s, to reduce rural overcrowding by encouraging farmers to settle new areas to the east (Lericollais, 1999). What in French is called *saturation* (when new farms cannot be created by clearing vacant bush land) occurred early in the Sereer territory of Siin and the Wolof country of Baol.

⁴ In the census figures, 'urban' is defined by status as a *commune*. Only the administrative headquarters of each *département* is a *commune*. The density figures at CR level, provided by the Centre de Suivie Ecologique, only became available after Barry *et al.*, 2000 (WP 13) had been completed.

Figure 6: Population density by *communauté rurale* and *département* , 1988

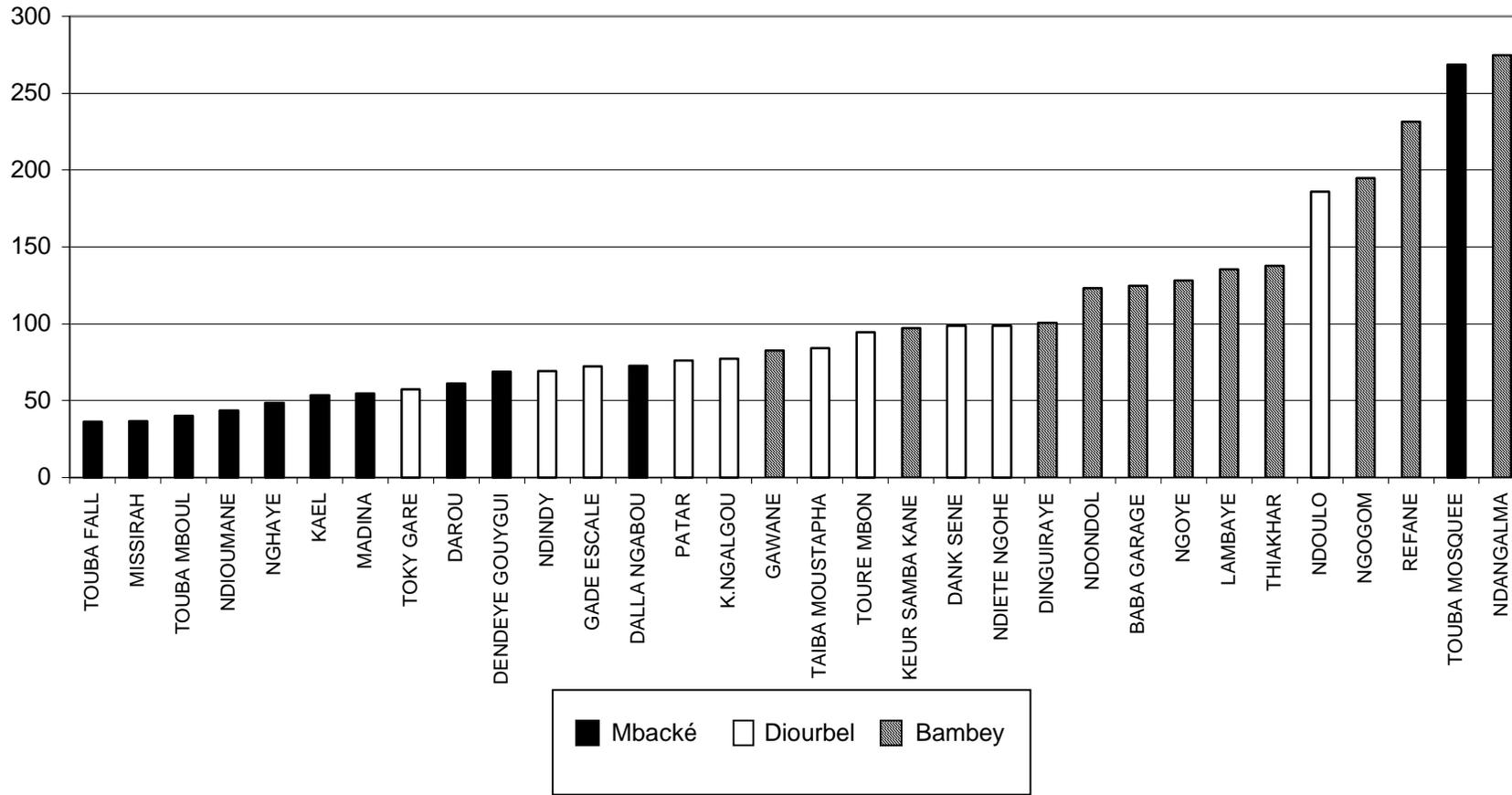


Table 1 : Total population, density per km² and annual growth rate in five rural arrondissements, 1976-1988

	1976		1988		Annual growth, 1976-88
	Population	Density per km ²	Population	Density per km ²	
Baba Garage	38 213	93	43 447	105	1.08
Lambaye	52 594	113	70 571	151	2.48
Ngoye	54 754	116	70 734	150	2.16
Ndindy	47 116	81	50 175	87	0.53
Ndoulo	43 852	74	57 122	96	2.23
Kael	31 160	40	35 664	46	1.13

Sources: Barry *et al.*, 2000 (WP 13): Tables 1 and 3.

If the population:land ratio is estimated using total population, there was an obvious decline in land available per capita over time. If the rural population only is used, the decline is less dramatic, and if estimated rural workers only, even less so (see Figure 16 below). Not all rural persons farm, and as permanent migration to urban centres within and without the district has affected mainly the 20-40 age group, the active labour force per farm has grown less than the total rural population.

2.4 A fall in the supply of new land available for cultivation

Land-use data from air photographs and satellite data was only analysed for Bambey and Diourbel and not for more lightly populated Mbacké. It shows (Table 2) that in the two Departments of Bambey and Diourbel, ‘saturation’ was reached before the beginning of our period of study (1960). Land under cultivation occupied over 82 percent of the surface in 1954. It continued to grow slowly to a remarkable 93 percent in 1999. Fallows have virtually disappeared. In Ngodjilème and Sob over 90% of village land was cultivated in 1954, according to analysis of aerial photo data (Ba *et al.*, 2000, WP21).

Lericollais (1972) argued that in Sob, saturation (a consequence of population growth 1900-1970) was the root cause of the crisis in agriculture: a system that had been integrated, intensive, and self-sufficient became threatened by a shortage of land made worse by the penetration of groundnut cultivation and the adoption of the plough. This undermined the household’s ability to feed itself, making the fallowing system unviable, fodder scarce, and initiating land degradation through the loss of soil fertility, trees and biodiversity.

2.5 A fall in soil fertility

Given a system which depended on fallowing for the restoration of soil fertility after cultivation, saturation (as described in the statistics given in Table 2) appeared to be the precursor of soil degradation. Unfortunately, the effects of drought and of over-cultivation on the yields of crops are not easy to distinguish from one another. The Sahel drought, with its dramatic social and economic consequences, stimulated analysts

to look beyond rainfall for the causes of decline in Senegalese agriculture, which, it was now considered, began before 1968 (Copans, 1975, Franke and Chasin, 1980). The export of soil nutrients in the groundnut crop was neither replaced by fertilisers on a sufficient scale nor compensated by fallowing as land became scarce and farmers' dependency on the crop increased. The reduction and, in some places, near-elimination of fallows made a strong *a priori* case for the decline of fertility. Support for this hypothesis was available from farmers' reported complaints of declining yields.

Table 2: Land use change in Bambey and Diourbel Departments, 1954-1999 (percent)

Land use	1954	1978	1999
Cultivated land	82.2	86.5	93.3
Woodland or shrubland	14.1	7.7	2.8
Fallows	2.0	1.2	0.5
Settlements	1.5	4.4	3.2
Government land	0.2v	0.2	0.2
Total	100	100	100

Source: Air photograph interpretation (1954, 1978); SPOT image interpretation (1999), Ba *et al.*, 2000 (WP 21): Table 3.

Time-series data for soil fertility indicators are extremely rare. In such a comparison, management must be taken into account. A comparison of four soils which were sampled and analysed in 1966, and resampled in 1999, showed that the topsoils (0-10 mm) had deteriorated during the intervening period. They had become more acidic, more sandy, and had less carbon (Badiane *et al.*, 2000, WP 14: Table 14.). These soils had been cultivated without significant fertilisation, being *champs de brousse*. It may be assumed that many other similar cases exist, though corroborative data are not available.

2.6 A fall in areas of woodland and biodiversity

The diminution of woodland and shrubland communities, many of them already degraded, from 1954 to 1999 is shown in Table 2. They declined from 14.1 percent of total surface area in 1954 to 7.7 in 1978 and 2.8 in 1999. These statistics suggest a terminal phase in the destruction of the natural woodland, usually called deforestation. Except in scheduled government forest reserves, or on private land, woodland seems unlikely to remain. Studies at a larger scale in four *terroirs* validates this general picture, though showing that the situation is variable from place to place (Table 3).

Many of the functions of trees in the rural economy (wood fuel, construction timber, fodder, food, medicine, fibre and other marketable products) are now supplied by the trees which are protected on farmland. However, these trees came under threat under the Programme Agricole, which encouraged farmers to uproot trees as they impeded mechanical ploughing operations. The ending of that programme has lifted this source of pressure, but bio-diversity is still considered to be under threat. Eighteen important multipurpose species have been identified which have all but disappeared in the four *terroirs* studied by Sadio *et al.* (2000, WP 17). In an integrated system such as that of

Sob, where trees are components of a nutrient cycle which includes both crops and animals (Lericollais, 1999), their loss may threaten the sustainability of the system.

Table 3: Evolution of woody areas, study sites (percent)

Village	1954	1978	1989
Darou Rahmane II	28.2	6.1	1.0
Ngodjilème	6.1	7.8	5.1
Ndiansil Séssène	5.6	2.9	2.3
Sob	4.7	5.7	2.0

Source: Air photo interpretation in Ba *et al.*, 2000 (WP 21): Table 4.

3 CAUSES OF THE CRISIS

3.1 Economic factors and policies

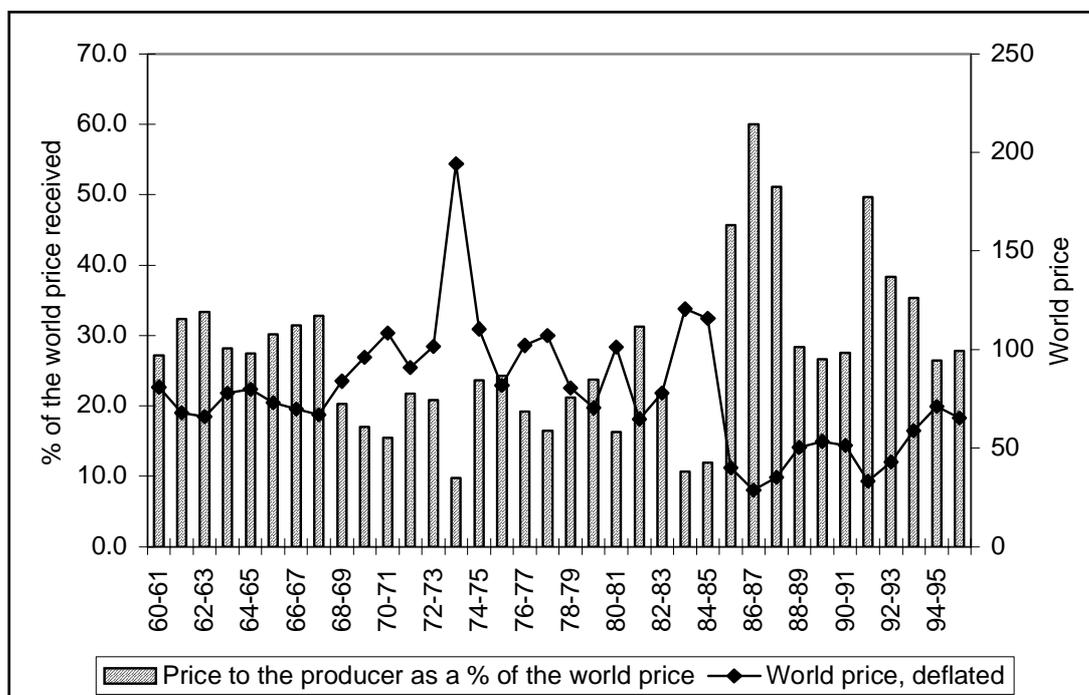
For much of the period under review most prices relating to crop output and inputs were fixed by government. In the case of groundnuts, only the final price received for exported oil was determined by the market. There is some difficulty in determining the proportion of the global price that the farmer was allowed to receive, since the producer price relates to groundnuts in shell, and the world price to groundnut oil (the residue, groundnut cake, was also sold). There are justifiable costs for processing and transport, although the indications are that in the responsible state organisations these were often excessive. Gastellu (1981) noted that while the costs of equipment and inputs were going up, the indexed official producer price fell from 100 in 1963 to 77 in 1968. In the latter year, for a harvest of 800,000 tons, the state organisation in charge of marketing retained a profit of FCFA 8000 million before delivering to the oil mills. Figure 7 shows that during the 1960s the producer received roughly 30 percent of the oil price, but that this share dropped to 10-20 percent in 1969-84, so that he obtained little benefit from the high world price. Under structural adjustment policies the state raised the producer price but was unable to maintain this in the face of falling world prices.

The real price paid to groundnut producers in Diourbel Region has been obtained by deflating current prices by the African Consumer Index in Dakar (Figure 8). Production tended to follow the real price, with a lag, until the mid-1980s, when there was a sharp divergence. Real prices rose, but groundnut production fell.

There has been very little analysis in Senegal of farm incomes. However, groundnuts are heavy consumers of inputs. They require 90-150 kg seed/ha, for a yield of 300-1000 kg/ha, according to rainfall and fertilisers used. While seed was available on credit (which the farmer learnt need not always be repaid) this was not too much of a problem. The amount of seed used in production can be seen from Figure 9. The varieties adopted after the rainfall deteriorated from 1968 demanded a larger amount of seed. While seed was available on credit, it was sometimes sold to raise money for more urgent purchases. There was a fall in seed distributed in the 1980s, with the ending of credit. Fertiliser, the second major input, was heavily subsidised from 1966 to 1984. During

this period, 0.6 kg of groundnuts bought 1 kg of fertiliser at the official prices. With the removal of subsidies, nearer to 1 kg or even 1.2 kg were necessary (Faye *et al.*, 2000, WP 16: Figure 7). Thus income from groundnuts fell, due to rising costs of inputs.

Figure 7: World price for groundnut oil (in FCFA/kg) and producer price as a percentage of this, 1960-1995



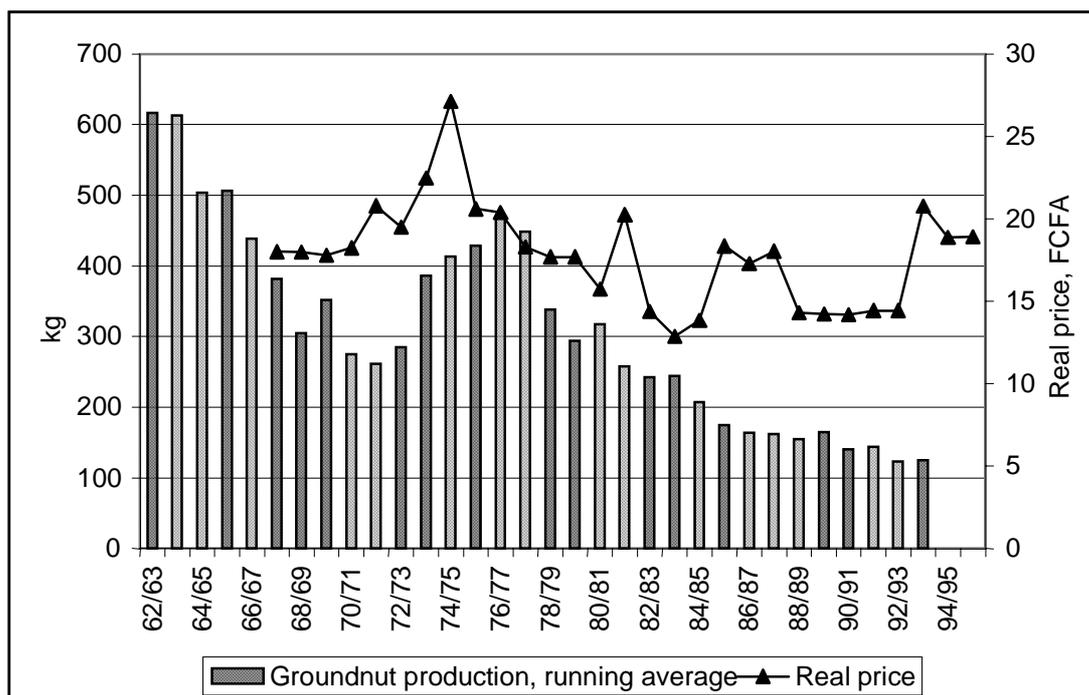
Source : Gaye, 2000 (WP 12): Figure 3.

While it might be thought that the 1960s were good for groundnut producers, several authors point out that even then, incomes were precarious, and they were vulnerable to rainfall failure. Roch (1972) noted of Wolof villages:

...la mythologie de l'arachide traite de progrès technique, d'épargne paysanne et d'augmentation du revenu par tête à la campagne; mais l'observateur affronte constamment les termes symétriques, dans certaines régions du moins: ainsi dans le Baol, il s'agit parfois de progrès technique, mais encore d'endettement paysan, de conditions d'existence précaires, de niveau de vie instable, de revenu problématique.

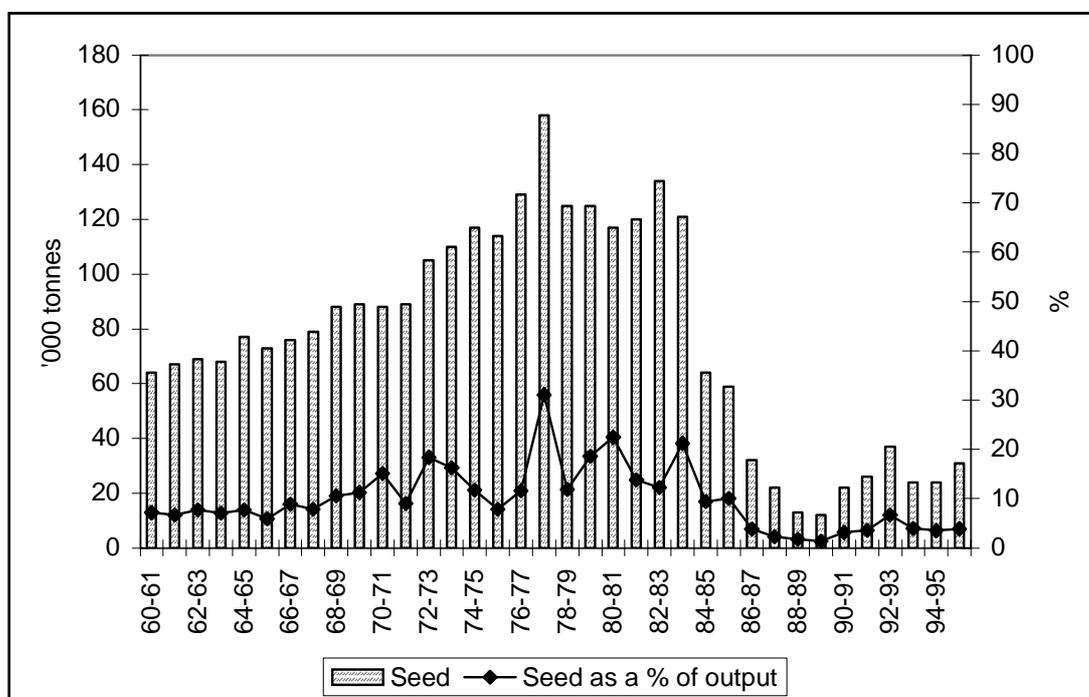
However, the purchasing power of producers has since deteriorated, subject to year-to-year variations in rainfall. This can be illustrated in relation to the village of Sob, a Sereer village where baseline data are available (Lericollais, 1972) and which was revisited for the present study. Table 4 gives gross income from groundnut sales (without deducting costs), and the value of millet or sorghum produced, both on a per capita basis for the village population, together with the purchasing power of this income in terms of rice.

Figure 8: Groundnut production, kg per inhabitant, in Diourbel Region and real producer prices



Source : Faye *et al.*, 2000 (WP 16): Figure 13.

Figure 9: Seed distributed and groundnut production in Senegal



Source : Gaye, 2000 (WP12): Figure 1.

The farmer has not had the alternative of deriving income from the sale of millet. The millet market is limited due to the preference for the more easily prepared rice, and its lower price. Even under the freer market conditions prevailing since the mid 1980s, the price of millet is normally between 50-55 percent that of rice (Faye *et al.*, 2000, WP 16: Figure 12). Various policies promoting rice growing have the effect of levelling off grain imports 1986-93, but did not greatly reduce them (Gaye, 2000, WP12: Figure 6).

Table 4: Groundnut sales income (PMBH), millet/sorghum availability (DMIH) and the purchasing power for rice (EQRH) per head, at Sob, 1965-1999

	PMBH (FCFA/head)	DMIH (kg/head)	EQRH (kg/head)
1965	5,136	121	147
1966	1,975	83	49
1967	4,577	221	81
1968	3,702	89	82
1969	3,854	357	86
1987	18,625	265	168
1999	13,950	136	62

Sources: 1965-1969 , Lericollais, 1972 (for 1965-69), Lericollais, 1999 (for 1987), Faye *et al.*, 2000 (WP 16) (for 1999).

3.2 The credit-based co-operative system

Statistical analysis links the decline in groundnut production to the introduction of the NPA, and particularly to the abandonment of credit for seed (Gaye, 2000, WP 12). The collapse of the credit-based co-operative system meant that the farmer no longer has easy access to selected seed from the research stations, but uses what he stores or buys on the open market.

The top-down direction of investment, which was imposed by the all but compulsory participation in co-operatives, did secure a rapid uptake of animal drawn equipment, though the farmers quite rapidly abandoned the 'heavy' system of ox-drawn implements and deep ploughing for the 'light' system of horse or donkey drawn seeders, harrows and carts. During 1969-76, 10-15,000 of each of these were distributed, along with 8,000 groundnut lifters (Faye *et al.*, 2000, WP 16: Table A4). These reduced male labour requirements per hectare and made possible the expansion of cultivated area shown in Figure 1. The evidence suggests that farmers did not make further investments, except in carts, after credit was withdrawn, (Fall and Faye, 2001, WP 22) but they have maintained their dilapidated equipment with the help of local artisans.

The co-operative system did not, as intended, liberate the groundnut farmer from debts previously owed to private traders. It substituted indebtedness to, and dependence on, bureaucratically controlled co-operatives, for fertiliser, seed and equipment. The prices set made it impossible for the groundnut farmer to generate his own savings to finance the development of his farming.

4 A NEW LOOK AT CHANGE: ELEMENTS OF A NEW DYNAMIC

4.1 Responding to markets

An alternative to the 'crisis interpretation' analysed in Chapters 2 and 3 would put the farmer at the centre of the stage, responding actively to the changing environment in which he is living. The Wolof, and to a somewhat lesser extent, the Sereer, have always responded to commercial agricultural opportunities. In the early part of the 20th century, many Wolof migrated out of their original heartland to colonise new lands in the east of the present Diourbel Region, under the leadership of their Mouride sheikhs (Wilson Fall, 2000, WP 20). While growing millet for sustenance, they concentrated on groundnuts, using the extensive methods of farming appropriate to newly settled areas where new land could be opened up as fields became exhausted. The Sereer, who remained in their original area, and who did not accept Islam till the 1950s, were already farming under conditions of greater land scarcity. By the 1960s, they had incorporated groundnuts into a three year rotation (groundnuts-millet-fallow) in place of their millet-fallow system. The fallow element was steadily reduced, and they maintained fertility by manuring with their livestock, and through the use of the *kadd* tree (*Faidherbia albida*: Pelissier, 1966). Lericollais (1972) found that fallows comprised only 18 percent of the farmed area in Sob in 1965-9. By 1985-6, fallows were less than three percent in Sob, though higher (8-15 percent) in some other Sereer villages (Faye *et al.*, 1999).

Table 5: Percentage source of income in Sereer and Wolof villages, 1960 and 1999, and purchasing power in rice

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

Sources: de Garine, 1960 (cited in Waterbury, 1987), for two Khombol villages; survey by Faye and Fall, 2000 (WP 22) for four villages, 1999.⁵

⁵ Note: In 1999 Wolof and Sereer household income was very similar in total, but the Sereer had larger households and thus lower incomes on a per capita basis. Income per capita is difficult to calculate accurately because household heads include in their households persons who have independent incomes, but who contribute regular remittances or occasional gifts. The major part of the absent member's income is therefore not calculated. The calculation of income

Table 5 shows (for two small samples) the constituents of household real incomes in 1960 and 1999. By 1999 livestock had replaced groundnuts as the main source of agricultural income, but groundnuts and subsistence grains were still important. Production and sale of cowpeas was a small, new and significant element. Non-agricultural income had increased conspicuously in Sereer villages, and remained at over 40 percent of income in Wolof villages. These two small samples show a substantial change in farming and income systems. They are substantiated by regional statistics and surveys of migration. The attempt to measure change in purchasing power for rice per person is subject to the important caveat in the footnote to Table 5. Wolof rural purchasing power may not have fallen by as much as is shown, but it is probably correct that there was a fall.

4.2 The increasing density of the marketing infrastructure

The two-way flows of groundnuts and consumer goods which characterised the colonial period were disrupted when the PA displaced many French firms and their local agents. The departmental centres where they were based went into decline, including the regional capital of Diourbel. With the NPA, the state's intervention in marketing was greatly reduced. The official collection points (or *escales*), which had increased steadily during the colonial and PA periods, were reduced by nearly two thirds between 1980 and 1988. Private traders were again allowed to buy groundnuts, though the state continued to fix the price for nuts destined for export, which remained in its hands. Mouride notables, big groundnut producers, looked for alternative outlets for their groundnuts. Large-scale smuggling to the Gambia and local processing of groundnuts for the domestic market competed with the state mills for the crop (Ly, 2000, WP 18; Gaye, 2000, WP 12: Figure 2).

However, the state monopoly was not extended to livestock, and ancient rural markets for these survived. With the ending of the PA, and the relaxation of the grip of the co-operatives, they and other rural weekly markets began to expand rapidly. By 1999 there were 18 major rural periodic markets in the Region. Livestock markets benefited from a growing demand for transport and traction animals as well as for meat. Touba has increased its importance steadily as the biggest trading centre outside Dakar. Traders from Dakar visit the rural markets as the road network has improved (Ly, 2000, WP 18).

State control of the trade in millet was never so tight as of groundnuts. The major, but limited, market demand was from pastoralists, but millet began to enter rural markets to supply deficit households. By the 1990s a survey (Gaye, 1994), quoted by Ly, 2000, (WP 18), showed that family heads no longer considered selling cereals as socially disapproved except as a last resort, and about 12 percent of the crop was passing through the markets. These markets also provided for the trade in vegetables, *bisap* (*Hibiscus sabdariffa*), and cowpeas. Similarly, attitudes to the sale of animals have changed. Authors describing the Sereer system in the 1960s wrote of reluctance to sell animals, which were regarded as essential elements of family capital. However, both Sereer and Wolof households now buy animals for fattening and resale. The growth of Touba, with two huge annual pilgrimages and associated festivities, has boosted local

per capita was attempted mainly because the income data of the early surveys was given in this form.

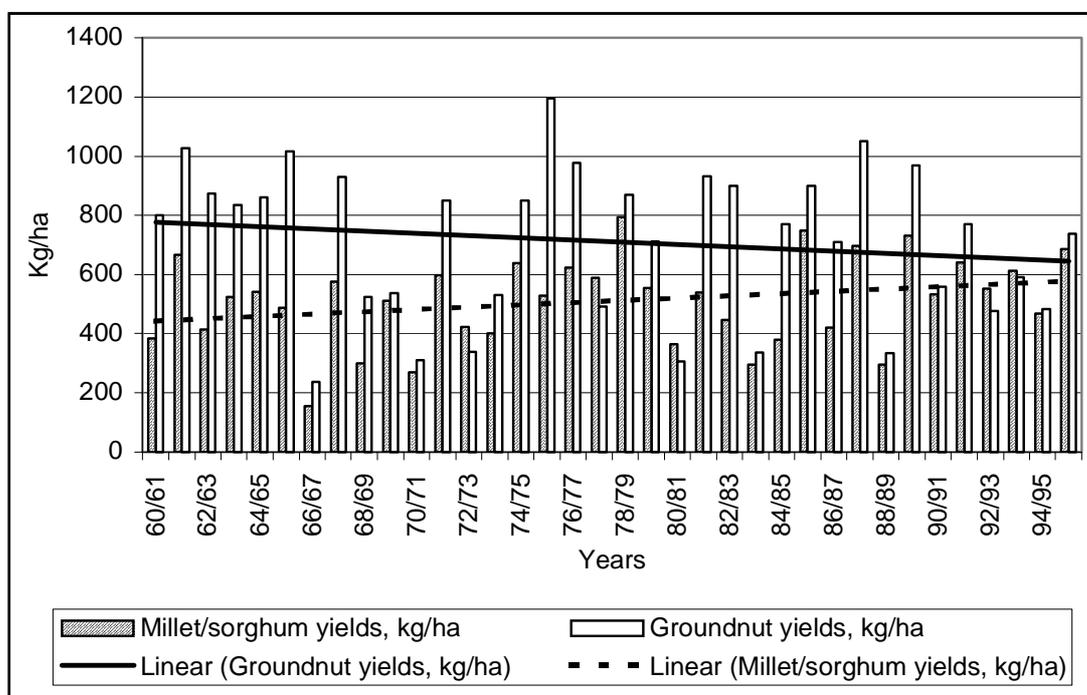
demand for animals for slaughter, which can be readily assembled through the weekly markets (Faye and Fall, 2001, WP 22; Wilson Fall, 2000, WP 20).

4.3 Maintaining or improving farm productivity

Yields

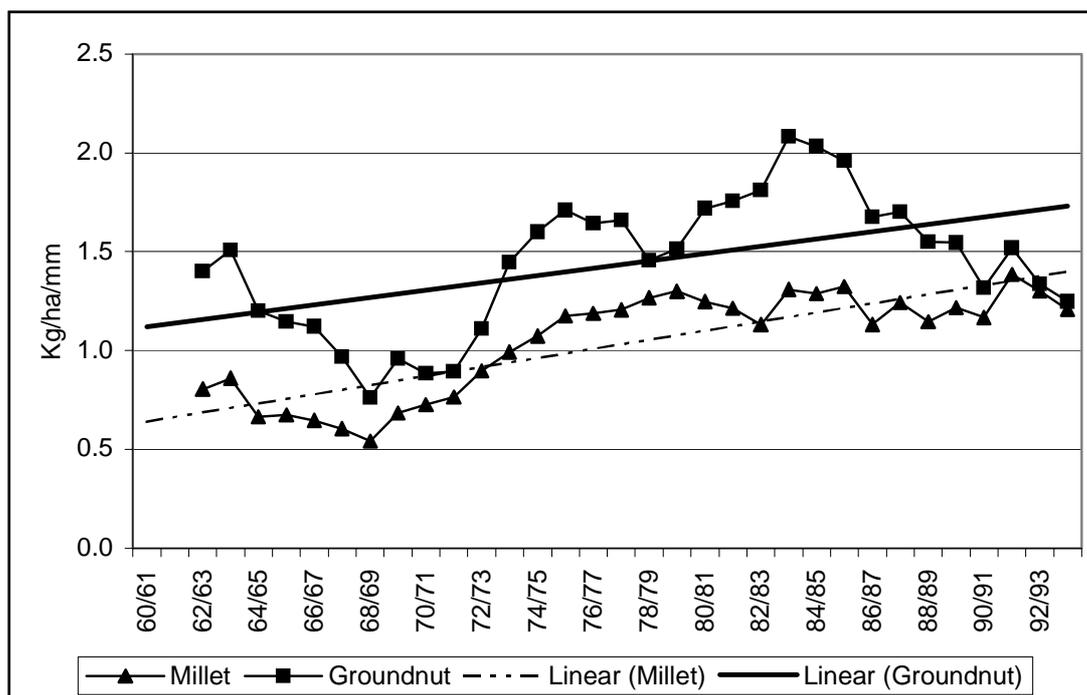
In Figure 2 we showed that the production of millet has been maintained at the level of the 1960s, despite the fall in rainfall. However, there has been variation over time. Faye *et al.*, 2000 (WP 16) note an increase in the early 1960s, a drought-induced fall in 1967-1974, then recovery to 1980, followed by an erratic period. The very high production of 1985-6 reflected increased planting in reaction to the shortage of groundnut seed, but was not maintained. While production did not keep pace with the increase in the regional population (Figure 3), this was not due to a fall in yields per hectare or to deteriorating rainfall. Yields for cereals and groundnuts are shown in Figure 10. Notwithstanding further droughts in 1980/81, 1984/85 and later, the linear trend in cereal yields was upward. This is believed to reflect adaptation to the new circumstances. The longer season millets were dropped in favour of shorter season varieties, and sorghum in favour of millet. Groundnut yields were assisted by the distribution of new upright varieties but the trend for them was slightly down. The droughts of the 1990s did not have the same impact on yields (compare Figures 5 and 10). Farmers had learnt how to make better use of rainfall (Figure 11).

Figure 10: Millet and groundnut yields per hectare, 1960-95



Source: Faye *et al.*, 2000 (WP 16): Figure 2.

Figure 11: Millet and groundnut yields per mm of rainfall, 1960-95 (5-yr running average)

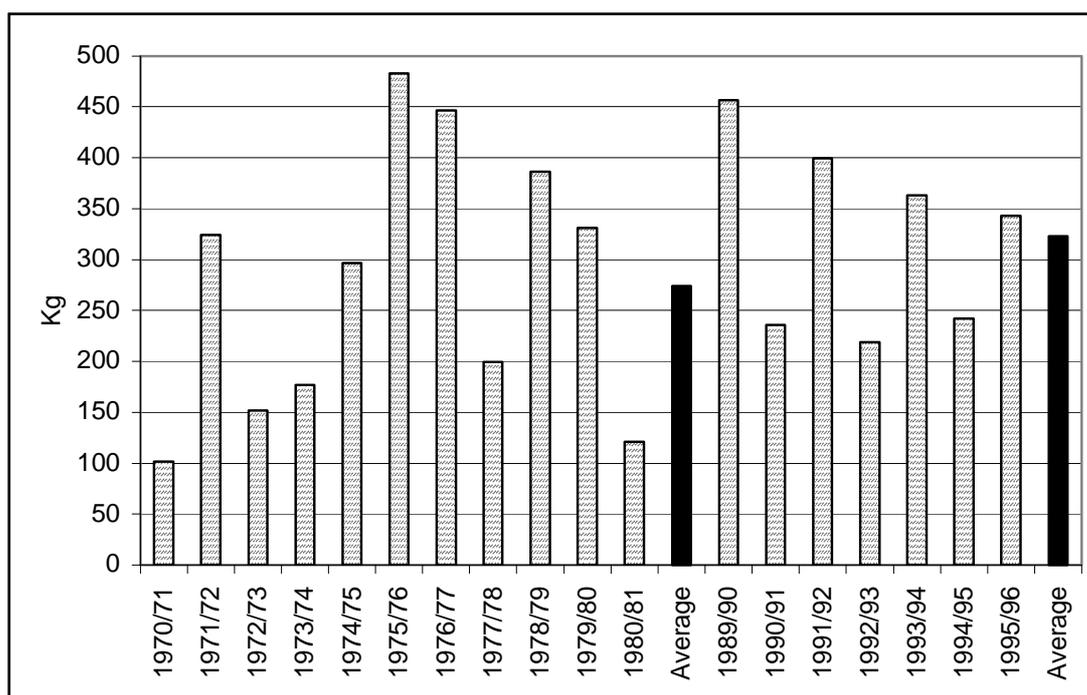


Source: Faye *et al.*, 2000 (WP 16): Figure 5.

Crop income per hectare

Farmers also maintained the value to them of production per hectare taking into account the cost of their fertiliser and seed inputs. Figure 12 shows the estimated value to them (in terms of the rice they could purchase) of their groundnut output after the cost of seed and fertiliser has been deducted, for two periods, 1970/71-1980/81, (when use is calculated by the known amounts of fertiliser distributed to co-operatives for a known planted area in Diourbel) and 1989/90-1995/96, when little fertiliser was being used and farmers were saving their own seed. Fertiliser use on groundnuts is known to have more or less ceased when the subsidy was removed. According to Kelly *et al.* (1995), farmers increased their use of seed to maintain yields when they were not using fertiliser, and this was economically rational. The model assumes that no fertiliser was used in the second period, but that seed used increased from 80kg seed/ha in the first period, to 120 kg seed/ha in the second period. Despite the increased use of seed, average income per hectare was higher without fertiliser in the second period. This model (Figure 12) also demonstrates the very low income gained from groundnuts in years of poor rain, expenditures on seed and fertiliser having already been made. It shows the real difficulties in repaying credit under these circumstances. The credit-based fertiliser system was not viable unless farmers were allowed to default in bad years, but the annulment of debts made the credit system impossibly costly for the state. It was not financially sustainable (Gaye, 2000, WP 12: 39). The question remains as to whether the high seed, low chemical input regime adopted by the farmers in response to the NPA is environmentally sustainable, or whether it has detrimental effects on the soils.

Figure 12: Estimated income from groundnuts (per ha) in terms of rice purchasable (kg), after deducting seed and fertiliser costs



Source: Calculated from data in Faye *et al.*, 2000 (WP 16) and Gaye, 2000 (WP 12).

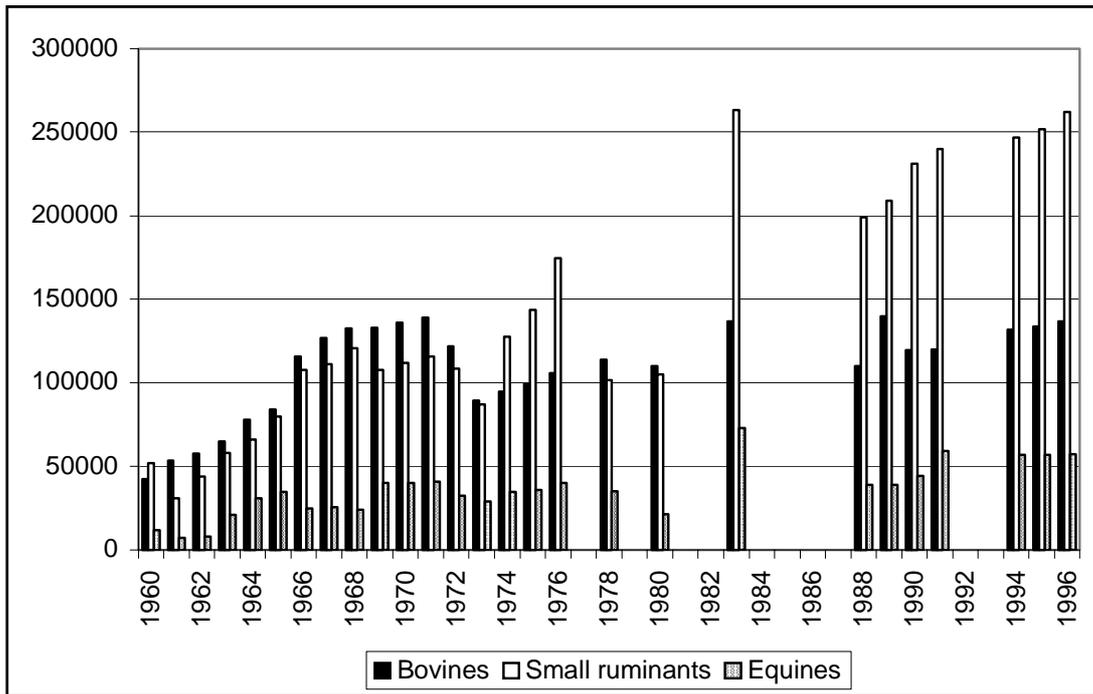
4.4 Increasing livestock production⁶

Since 1960, the populations of cattle, small ruminants and equines have maintained an upward trend (Figure 13). Meat production has risen. The trend in marketed milk production is uncertain (as more cattle are now on transhumance), but if the age-sex structure of the herds has remained constant, more milk must have been produced. The most rapid increase has been in the numbers of small ruminants. The real price of their meat increased after 1980, unlike the prices of grain, groundnuts and beef (Figure 14). In one Sereer *communauté rurale*, adjacent to the south of Diourbel Region, small stock increased from 3,042 in 1954 to 8,836 in 1990 (Faye *et al.*, 1998: 309).

The performance of the livestock system can be analysed through the productivity per unit of livestock, labour or land. However, no data on inputs are available. On the basis of rather sparse information it is possible to develop some hypotheses on the nature of change.

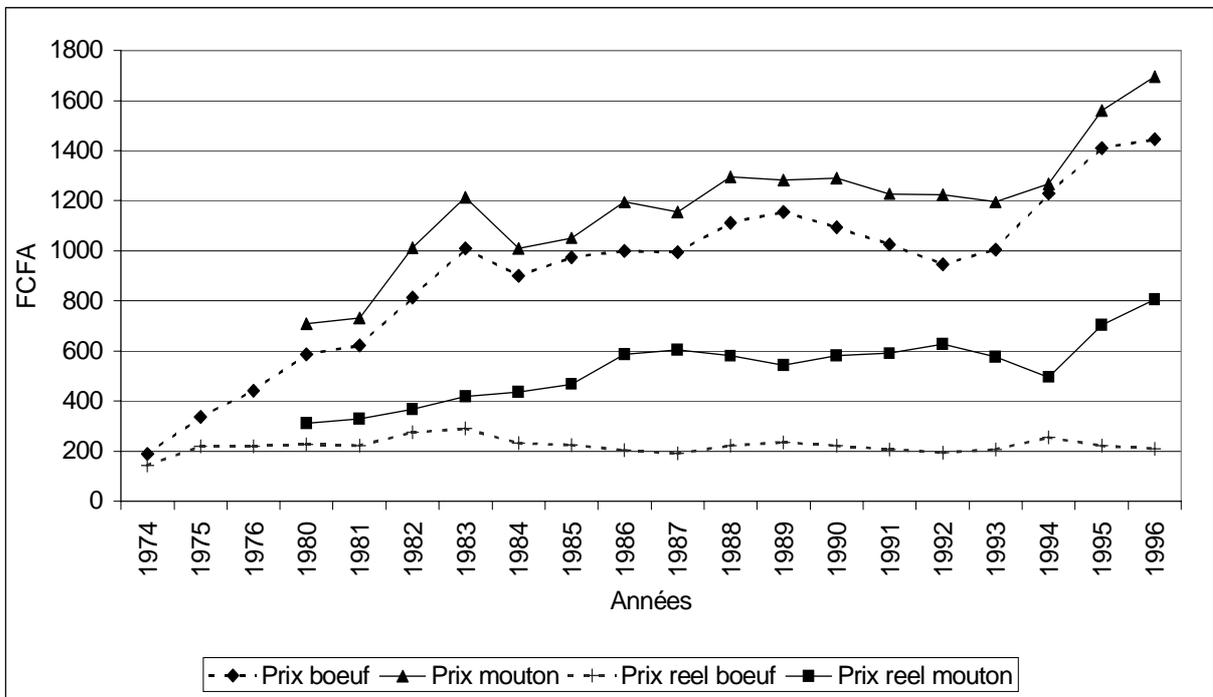
⁶ Data for livestock are not available for every year, since figures are based on vaccination campaigns. The veterinary authorities think these were most accurate in the earlier part of the period; more recently, figures may be understated since there have been no epidemics in the last decade, and farmers are not so careful to bring in their animals for vaccination.

Figure 13: Changes in livestock owned, 1960-96, Diourbel Region



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

Figure 14: Price of meat, 1974-96



Source : Faye *et al.*, 2000 (WP 16): Figure 20 .

Key translation: *Prix boeuf* = Beef price; *Prix mouton* = Mutton price; *Prix réel* = Real price.

Table 6 : Animal fattening in the Diourbel Region, 1975-1981

Year	Cattle	Sheep
1975	350	1 409
1976	1 071	3 697
1977	1 257	3 882
1978	3 615	15 184
1979	6 976	14 592
1980	8 647	17 000
1981	10 437	31 430

Source : Faye *et al.*, 2000 (WP 16): Table 4, quoting SODEVA reports.

Improvement in the productivity per livestock unit is the result of genetic improvements or in their health and nutrition status, which increases growth rates and milk output per unit of time. We have no data on this. However, we do know that fattening has become widespread for both cattle and small livestock, which probably increases their productivity in terms of weight gain, even though in years of drought, a fall in the average weight of carcasses at abattoirs is observed. Table 6 gives statistics of animals kept in pens for fattening collected by the extension service, 1975-82.

The productivity per unit of labour is also difficult to measure, since past studies in the Groundnut Basin were not much interested in the livestock sector, except in respect of the traction capacity and manure made available to cropping.

However, we can estimate changes in productivity per hectare if transhumance outside the Region is discounted. The number of Tropical Livestock Units (TLU or UBT) per hectare rose from 0.12 in 1960 to 0.46 in 1995. This suggests that output of meat, milk and manure per hectare has substantially increased since 1960. In addition, their relatively new functions of transport and traction energy for cropping have substantially increased the value of their output of services. The value of manure has always been recognised, especially by the Sereer, but also by the Wolof, who paid Fulani herdsmen to manure their fields.

While real beef prices have remained steady over time, mutton prices have escalated since 1980. The livestock sector has been buoyant, reflecting good market conditions leading to readiness to invest in fattening by buying in animals and fodder. Women are also able to generate personal livestock incomes from small stock, so this sector has not suffered from the absence of male labour on migration.

4.5 Introducing new technologies

Technology promotion was at the root of the Programme Agricole, and the key technologies were understood to be improved groundnut seed, inorganic fertilisers, and labour saving seeders, ploughs, weeders, and carts. The Programme followed the classic path of capital-based intensification aiming to produce export crops, in which the small farmer's capital constraint is resolved by credit, and output quality is controlled through state-owned marketing structures and processing.

This development pathway faltered under the impact of debts by both farmers and state organisations and official credit is virtually non-existent under the NPA. The critical questions now concern the sustainability of technical modernisation without credit, the extent of the investment that farmers can mobilise from their own resources, and the necessary conditions for attracting such investment. As the farmers of the Groundnut Basin were very dependent on the co-operative system, are they now capable of autonomous initiatives to maintain or adapt new technologies to enhance productivity and incomes?

New crop varieties

The Centre National de Recherche Agricole at Bambey bred groundnut varieties for the different agro-ecological regions. From 10 to 20,000 tons of these were distributed, through the co-operatives, between 1960 and 1985. This was always a priority programme to support the groundnut industry. Upright varieties that are more resistant to drought are now favoured. Limited quantities of new varieties of millet (10–80 tons annually) were also distributed, but as a hectare requires only 4 kg of seed, this was still significant (Faye *et al.*, 2000 WP 16: Tables 1, 2). The variety *Souna III* was spread in the 1970s with the support of USAID. The new cereal varieties were estimated to give a gain of 30 percent (Gaye, 2000, WP 12: 19). No work was done on *Hibiscus sabdariffa*.

Farmers adapted to the shorter rainy season by abandoning the long cycle (>90 day) millet (*sanio*) and sorghum (>120 days) in favour of short cycle varieties, and the genetic resources of the system are to that extent impoverished. The abandonment of some rice varieties adapted to cultivation in *bas-fonds* has also been reported. On the other hand, improved drought-escaping or drought-resisting properties in the varieties presently favoured must have contributed to maintaining grain production in the face of declining rainfall (as reported in 4.3). Cowpea varieties suitable for the short season have been successfully exploited, increasing their cropped area steadily (Figure 4). *Hibiscus sabdariffa* (*bissap*) has been taken up in response to a new market niche.

Fertiliser

Under the PA, different formulae and recommended doses of fertiliser were tested and promoted through the co-operatives, for both groundnuts and millet. Fertiliser manufacture (Senegal has its own phosphate mines) is an important state industry. Data from SODEVA show that an average of 4800 tons of the groundnut formula, and 4000 tons of the millet formula, were distributed annually in 1970-80, but the quantities varied considerably from year to year. This gives little indication of the levels of application, as delays in delivery, unequal distribution, irregular use, the priority given to market crops, and the impact of poverty on purchasing ability (even under subsidy) are known to affect inorganic fertiliser use. Fertiliser was promoted as an essential component of animal traction systems of cultivation; it was used, but at less than recommended rates (Garin, 1992; Yung, 1992).

With the removal of most subsidies and credit, a scarcity of fertilisers affects all crop production. Unlike new seeds, which farmers may select and improve themselves, fertiliser is non-renewable and quickly lost with bad management or wasted in years of poor rainfall. Given the present price structure of agriculture and the absence of high

value rainfed crops, its contribution to farm incomes may continue to be restricted to irrigated farming, which is extremely rare in Diourbel Region. Farmers in the Region know that fertiliser can help resolve the shortfall of plant nutrients in rainfed cropping, but are relatively powerless to do anything about it at present input and output prices.

Animal traction equipment

Senegalese farmers used to hire labourers from neighbouring countries (among whom the 'stranger farmers' from the Gambia have been documented), giving them land for their own crop production and rice for sustenance, in return for their work on the groundnut crop. Another option for a groundnut farmer was to buy rice and provide a meal for a labouring group. However, animal traction became widely acceptable as an alternative. The Centre National de Recherche Agricole (CNRA) at Bambey worked on animal traction from its first establishment in 1920. The first stage was to develop ox- or horse-drawn tools for ploughing and sowing in lines, and then weeding was tackled to eliminate the ensuing labour bottleneck (Yung, 1992). Between 1960 and 1970 the spread of animal-drawn tools became a main priority of the extension services.

Animals for traction were supplied on credit from 1965. The extension services initially favoured a system they believed would improve soil structure, with a heavy ox-drawn plough (*charrue*), stumping (including the removal of the valuable tree, *kadd*), heavy manuring, and addition of phosphates. After 15 years, the 'heavy' system was estimated only to have benefited five percent of farmers, although stumping was promoted through the provision of food aid and calcium phosphate fertiliser (Gaye, 2000, WP 12: 19). Farmers overwhelmingly preferred the alternative, lighter plough (*houe*), seeders, and crop lifters which can be drawn by single horses or donkeys. In 1969-76, 11,718 seeders, nearly 17,000 *houes* and 8,000 lifters were distributed in the Diourbel Region, compared with about 300 ox-drawn implements. Garin (1992) attributes the adoption of light ploughs and seeders to the fact that they made earlier planting possible, which gave a productivity gain of 30-100 percent over late planting. The ox-drawn cart was slightly more popular than the other ox-drawn implements, with 1,171 distributed, compared with 9,951 horse-drawn (Faye *et al.*, 2000, WP 16: Table A.4; see also Yung, 1992).

The sustainability of light animal traction systems seems assured. They are more compatible with tree protection on small farms and are no longer discouraged by the extension service. The light cart is very widespread and, as elsewhere in the Sahel, is popular because it can be used to earn income outside the agricultural season.

Animal types

SODEVA, the principal organisation involved with interventions which had an impact on livestock husbandry, started training traction animals in 1965 and regularly augmenting their numbers in Diourbel Region. Later, it promoted the acquisition of animals and management skills for fattening.

New requirements for traction and fattening reconfigured the needs for animals and subsequently the composition of herds. The growth in numbers of equines, reported earlier, has taken place in the context of a preference on the part of farmers for the light traction alternative. Fattening promotes interest in prime individuals, cattle and sheep or

rams in particular. The need for investment opportunities consistent with small savings (including those of women) lies behind the shift from cattle to small ruminants which characterises farming households, together with the costs of transhumance – increasingly necessary for cattle – and the greater grazing efficiency of goats. In exercising these preferences, farming households show an economic rationality which takes account, not only of the strategic value of animals, but also of the relative returns to investment in animals versus crop production.

Animal feeding regimes

SODEVA promoted the systematic collection of cereal residues and their storage in stacks, a practice which is consistent with the increasing value and tendency to privatise residue fodders. However, this requires more labour than free grazing. It is commonly reported that grazing contracts with nomadic herdsmen are becoming less frequent in Senegal. Another important innovation is the cutting of grass fodder on fallows for stall-fed animals. More and more animals are kept in enclosures for a part of the year. This is linked with the growth of fattening as an explicit market objective in livestock keeping. SODEVA also promoted mineral supplements. There is an important trade in groundnut hay between Dakar and the rural areas, and between rural regions. Groundnut cake produced as a by-product of artisanal oil manufacture is also utilised (Faye *et al.*, 1998).

New or improved livestock feeding methods have found ready acceptance among both Wolof and Sereer farmers wishing to exploit the economic potential of livestock keeping. They do not represent radical departures for the Sereer at least, who, according to Lericollais (1972), have long kept animals in kraals at night, moving these every two to three days to spread manure. In the dry season, browse was (and still is) important fodder, leaves and pods of the *kadd* being especially appreciated.

Animal health

A campaign to eradicate rinderpest, assisted by USAID and the European Community (EC), was completed by 1968. Systematic and compulsory vaccination against contagious bovine pleuropneumonia and work to combat tick-borne diseases led to an improvement in animal health.

Factors conducive to uptake

The existence of a good research system and a well-staffed extension system undoubtedly contributed to the rapid uptake of viable new techniques. SODEVA is the best example. Its extension staff for the Groundnut Basin rose from 571 to 1,882 agents in the 1970s. It lost three quarters of its staff under structural adjustment in the early 1980s (Gaye, 2000, WP 12: 18-20). The credit system helped, but credit did not stop farmers from being very selective in the innovations they took up. They used those where they saw an economic benefit, particularly in relation to shorter season crops, light manuring, and faster ploughing and sowing. It is possible to combine keeping animals for energy or savings with profitable fattening for market, by judicious buying and selling of livestock and the purchase of feed and supplements when needed. There is evidence that such commercial orientations to livestock ownership are gaining importance relative to more traditional cultural values.

The few examples given here show that the farmers of the Diourbel Region have innovated and adapted new practices to well-tested experience. The lesson is that farmers prefer to select technologies that are appropriate to their circumstances and within their means. A major consideration has been their perception of the relative benefits of investing scarce resources between export and local market crops, between crop and livestock production, and between agriculture and off-farm incomes (to be discussed below).

4.6 Investing in land use change and soil fertility

The data given earlier (Table 2) show that before the beginning of our period (1960), over 80 percent of the surface of Bambey and Diourbel Departments was under cultivation. ‘Saturation’ is a problematic development for an agrarian system which depends on fallowing for maintaining soil fertility between cycles of cultivation. It is not necessarily problematic if an alternative exists. In such a situation, the statistics tell a different story: that of conversion from one land use (managed or unmanaged natural vegetation) to a more productive use (annual cultivation of crops). Such conversion is a form of investment – in the costs of clearing the natural vegetation, suppressing regrowth, protecting or planting useful trees, and perhaps enclosure. These investments are most often created by family labour or, as in the *daara* system, that of groups (in this case of disciples of a sheikh founding a new village). The fact that such efforts are made necessary by an increasing scarcity of cultivable land, as theorised by Boserup (1965), and may represent a diminishing return to labour when compared with fallowing systems, does not invalidate classifying them as investments.

The alternative to fallowing, which existed in Sereer systems if not in those of the Wolof, is organic fertilisation using the manure of the livestock owned by farming families. (It was more common for Wolof farmers to obtain manuring from Peul herds on contract.) However, the supply of organic manure or composted materials has never been sufficient to fertilise the entire cultivated area. Therefore, a distinction emerged early on between fields which farmers chose to fertilise (*champs de case*) and those for which they had formerly relied on fallowing (*champs de brousse*)⁷. Later some of these came to be used for groundnuts, on which they could afford to use inorganic fertilisers. This distinction in terms of management has come to be as important, if not more so, than that between the two major soil types occurring naturally in the Region: the *dior* and the *deck* soils⁸. Its importance can be shown in the status of fertility indicators on the two types of field (Table 7).

The indicators show that management of *champs de case* may be sustainable (though at low levels of fertility) on *dior* soils, whereas that of *champs de brousse* is not. Under the PA, and given the profitability of groundnut production and subsidised fertilisers

⁷ *Champs de case* are normally close to the house, used for cereal production, and benefit from fertilisation by manure and household waste, as well as *parcage* (‘night parking’) of livestock. *Champs de brousse* are further from the house, cultivated in grain-legume rotations, and used to be fallowed. Later, inorganic fertilisers were used in conjunction with groundnut production.

⁸ *Dior* soils are derived from former dunes, have a high sand fraction and few nutrients. *Deck* soils are hydromorphic in origin, occasionally flooded, have a lower sand fraction and contain more nutrients. They are sometimes more difficult to cultivate.

available on credit, the situation was different. Neither of these conditions now applies, and so the ‘fertility crisis’, if there is one, is geographically bounded on the *champs de brousse*. Unfortunately, there are few data on the relative areas under these two management regimes. But for the *terroir* of Sob, Garin *et al.* (1999) showed that between 1965-69 and 1985-87, the proportion of the area fertilised with organic manure remained the same, while fallows, and the use of inorganic fertilisers, almost disappeared (Table 8).

Table 7: Indicators of soil fertility on *champs de case* and *champs de brousse* (top 10 cm), at Ndiamsil Sessène, 1967 and 1999

	<i>Champs de case</i>			<i>Champs de brousse</i>		
	1967	1999	% change	1967	1999	% change
<i>Dior soils</i>						
Carbon (%)	0.16	0.73	356	0.16	0.12	-25
Total nitrogen	0.014	0.06	378	0.014	0.010	-28
Assimilable phosphorus (ppm)	30	349	1063	30	14	-54
<i>Deck soils</i>						
Carbon (%)				0.16	0.20	25
Total nitrogen				0.014	0.025	79
Assimilable phosphorus (ppm)				na	24	na

Sources: Pochtier, 1968; Badiane *et al.*, 2000 (WP 15): Tables 8-10.

na: not available.

Table 8: Area manured annually, by method used, in Sob, for two reference periods (percent of *terroir*)

Method	1965-69	1985-87
Wet season <i>parcage</i>	8,1	1,1
Dry season <i>parcage</i>	6,3	6,8
Manure carried to fields	2,1	8,9
Total organic manure	16,5	16,8
Total fallow	17,1	3
Inorganic fertiliser	13	<1

Source: Garin *et al.*, 1999.

Pochtier (1993) reported rather higher percentages of *parcage* for Sereer villages, though an equally dramatic fall from 40 percent in 1965 to 20 percent in 1987.

As the critical element in organic fertilisation is animal manure (which can be combined with ash, household waste, bedding material from stalls, composted vegetation, and even urine, under optimal management), a major constraint affecting the extension of the *champs de case* to include more cultivated areas is the resident livestock population.

Therefore the evidence of increasing livestock populations (Figure 13) and the near-quadrupling of the livestock densities from an average of 0.12 tropical livestock units (UBT)/ha in 1960 (or 8 ha/UBT) to 0.46 in 1995 (just over 2 ha/UBT), are important in this regard. On the assumption that additional manure resources are not wasted (though efficiency is another matter), these facts imply an increase in the area under organic fertilisation, *or* an increase in the levels of application, in the long term. But changes in livestock ownership and management complicate such a simple equation. It is reported that a scarcity of fodder (with perhaps a risk of crop damage from grazing animals) during the rainy season has led to an increase in cattle transhumance. Such an increase lies behind the reduction in rainy season *parcage* shown in Table 8. This in turn means a loss of manure from some of the village animals for a part of the year. This must have a negative effect on fertilisation (Pochtier, 1993). On the other hand, the shift from cattle to small ruminants (reported above) and also the popularity of fattening, increase the occurrence of stall-feeding, the portage of manure to the fields, the need for transport animals and carts, the possibility of improved composting methods, and (incidentally) the labour requirements of such intensification in livestock keeping.

Any system of concentrating nutrients from a larger ecosystem on the fields of a small area faces a question, not only of its capability of expansion, but also of its long-term sustainability (Garin *et al.*, 1999). Under fallowing, nutrients are redistributed by grazing and manuring from uncultivated to cultivated fields, and the use of inorganic fertilisers imports nutrients from outside the system. The *champs de brousse* cannot go indefinitely without fertilisation, and it is possible that in some areas, fields are returning to fallow. In one *terroir* (Njamsil Sessène) fallow land has recently increased, in association with reported out-migration. Nevertheless, under somewhat higher rainfall (650 mm), efficient recycling of nutrients sustains a high-intensity system on over 85 percent of the surface in the Kano Close-Settled Zone of Nigeria (Harris, 2000, WP 36).

Nutrient cycling is central to crop-livestock integration, which as a route to agricultural intensification, is linked with demographic pressure according to McIntire *et al.* (1989), who propose that a separation of livestock keeping from crop production is only possible at low densities of the human population (specialised pastoralism) and very high ones (commercial specialisation). Livestock were more important to Sereer than to Wolof in the past. But as economic motives for livestock ownership (farm energy, transport, fattening, savings, milk, manure) tend to replace social ones, the resources necessary to maintain animals (crop residues, concentrates, browse, enclosures, and perhaps soon, access to pastures for transhumance and even water) are acquiring or increasing their market value. Ownership of a donkey, for example, is an enterprise carrying clear implications for investment and recurrent costs and potential profit on and off the farm. The trend is towards an internalisation of integrated crop-livestock systems in place of the open and specialised systems of the past, though perhaps along different lines from those observed in Kenya, since tenure law and custom differ (Fall, 2000, WP 8).

4.7 Conserving trees

Shortly before the beginning of our period, areas of natural woodland were already few and scattered, and occupied only 14 percent of the area in the two departments examined (1954). In 1999, they occupied less than three percent (Table 2). The

reduction in wooded areas corresponds historically to the increase in cultivated areas. While the Sereer settlement system was relatively stable, Wolof expansion and migration during the earlier colonial period was associated with extensive clearance of woodland. It is clear from Table 2 that the process of 'agricultural extensification' which has been blamed for deforestation had almost run its course by 1960.

The decline in wooded areas has, however, been variable, dependent on local conditions. For example, in Ngodjilème the wooded area was stable (at five to six percent of the area) from 1954 to 1989, and there are local institutional arrangements for managing woodlands (some are held jointly by different villages) and areas of pasture land between villages. In Darou Rahmane II, where there is a large demand for firewood 8 km away in Touba, land rights are at the discretion of the sheikh and are relatively insecure, and there was a dramatic decline in woodland from 28 to two percent of the area. The few government forest reserves in the Region are degraded.

Deforestation is traditionally debated in terms of clearance for farming. On the other hand, farmlands (more especially those long settled) in Diourbel Region are populated by mature trees of economically valued species, mostly volunteer individuals which have been protected. Although these communities are not visibly threatened, degradation is reported, and has taken two forms: (a) increased mortality – since the 1970s – as a result of drought, which has affected certain vulnerable species more than others; and (b) uprooting on the recommendation of agricultural extension services, in order to promote ploughing technologies under the PA (Lericollais, 1999; Sadio, 2000, WP 17). The first of these threatens biodiversity, and 18 species are listed as under threat in the four *terroirs* of this study (Sadio, 2000, WP 17). A southward biodiversity 'drift' of trees – some of them introduced earlier from more humid ecozones – has been observed elsewhere in the Sahel (e.g., Northern Nigeria) since drought became frequent in the 1970s.

However, a capacity to regenerate is not in question at the level of the community as a whole. There are usually abundant seedlings in the fields (from 13 to 70/ha were observed in the four *terroirs*) and while there is normally a noticeable gap in the age-structure between seedlings and mature individuals, it is probable that this is due to the farmers' suppression of seedling growth in order to control the competition with crops.

Trees on farmland are not felled, except when dead, though their canopies may be substantially modified in the course of harvesting branchwood, browse, or other useful commodities. It is of some interest to note that there is little evidence that markets for wood and other tree products threaten the continued existence of farm tree communities, which are long-established features of Senegalese farming systems (Pélissier, 1966). Multiple use-value extends to most species, and is not limited to the celebrated *kadd* (*Faidherbia albida*). It seems appropriate, therefore, to consider farm trees as investments which provide recurrent income or add value to that of field crops. In addition to their market value, however, many trees contribute to nutrient cycling, and impede soil erosion by wind or water, or provide amenity value in villages.

There is an inventory of local knowledge on the management of trees. This was ignored by the forest service in the past, which relied on coercion to 'protect' trees from those who saw themselves as their owners. A surviving negative view of farmers'

management of trees owes much to this tradition, as well as to the absence of effective institutions for managing common forests.

4.8 Maintaining security of tenure

In typical Sereer villages like Ngodjilème and Sob, land was passed on through the matrilineal line, under a system controlled by the *lamans*, or ‘masters of the lands’. The *lamans* were not the proprietors of the land, but rather the managers of the village landholding system who made land available to the family or other community members according to their needs. In a Wolof village like Ndiamasil, the influence of Islam has led to patrilineal inheritance rules, but the allocation of lands is carried out through the same *lamanat* system. The patrilineal system has also been adopted in some but not all Sereer villages, leading apparently to remarkably few disputes between nephews and sons (Lericollais, 1999: 192)

Darou Rahmane II, by contrast, is a *daara*, that is to say, a group of Mouride faithful led by a sheikh, and for whom they provide free labour one day a week on his large groundnut fields in exchange for blessings and heavenly promises. He may give them land, which is usually heritable, but if the family does not use it, its control returns to the sheikh. Usage rights may be somewhat precarious, contingent upon loyalty.

In 1964, the Loi de la Domaine Nationale (LDN) was passed with the objective of vesting sole proprietary rights to land in the state, with the users having rights of usufruct only. Formerly, the ultimate administrator of village land was the *laman*, heir to the original founding family, or in Wolof villages founded by a religious leader, the sheikh. The LDN was meant to remove the customary land tenure system, that was viewed by many to favour the status quo, in order to help government efforts to promote economic development through the modernisation and extension of agriculture. Thirty-five years after its establishment, many detractors suggest that this law has actually impeded agricultural investment because of its impact upon tenure security.

Many authors have acknowledged that under customary land tenure systems rights to land are secure and heritable, and that customary systems allow for many different types of land transaction (loans, rentals, pledges, etc) which adjusted land supply to need and are now banned by the LDN. In removing the powers of the *lamans*, it made many farmers nervous about their security of tenure, in particular to land not currently cultivated. It has prompted some to appropriate remaining uncultivated reserves (Lake and Touré, 1984), accentuating existing inequalities. Collective management of fallow land and uncultivated land, as it was done formerly in Sereer villages, became more difficult without the authority of the *laman*. The creation of *communautés rurales* with some legal powers has contributed to local solution of disputes but although this was instituted by law in 1974, it only gradually came into effect (Lo and Dione, 2000, WP 19; Wilson Fall, 2000, WP 20).

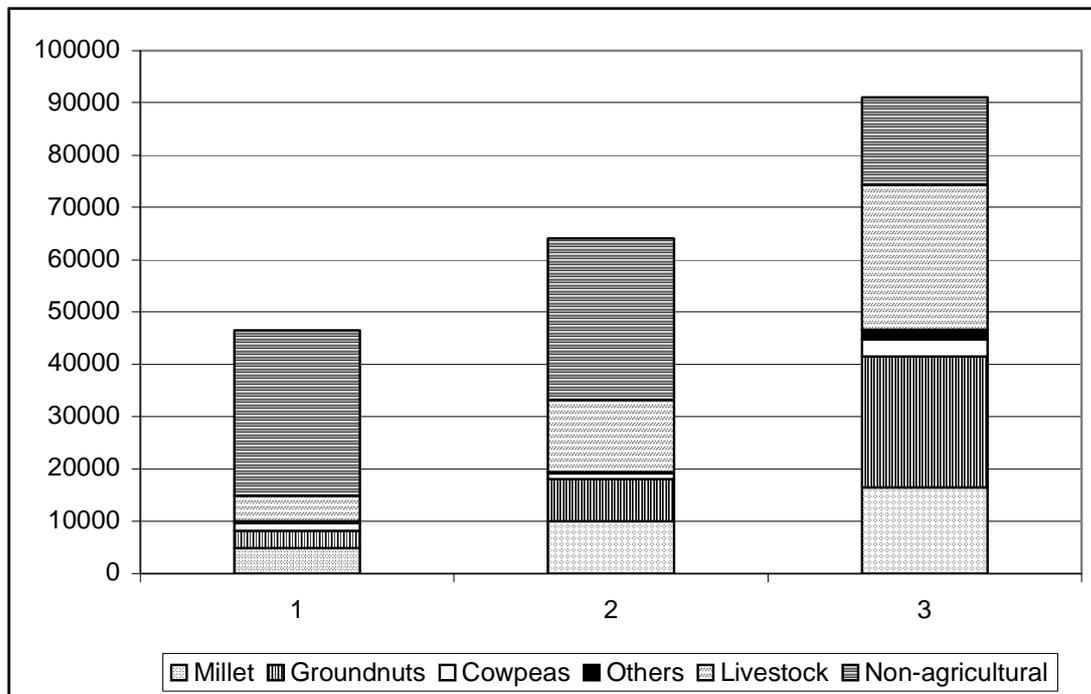
Potential negative effects of the LDN have been circumvented by non-observance, as well as a poor understanding of it amongst farmers. However, while most land is still predominantly influenced by custom, there is no question of going back to the *lamans*. In spite of the continuing application and importance of custom, the existence of the LDN has led to increased uncertainty about land tenure security amongst cultivators. This uncertainty has had consequences for the management of natural resources. For example, in some of the villages, there has been a reduction in the length of time for

which land is loaned, thereby removing the incentives for borrowers to invest in the land. However, as it is incompletely observed, the impact of the LDN on investment in natural resource management cannot be stated with confidence. Decisions to invest are the result of a mix of macro-economic, technical and institutional factors.

4.9 Income diversification, out-migration and investment

Table 5 showed that non-agricultural incomes were as important for Wolof households in 1999 as in 1960, and more important for Sereer households. Figure 15 divides households into three groups, based on food sufficiency, defined in terms of the proportion of annual cereal needs produced by the household. It shows that non-agricultural income was proportionately most important to those who had to buy in cereals, and who were also weakest in terms of incomes from groundnuts and livestock.

Figure 15: Structure of incomes by type of household*, 1999-2000



Source: Faye and Fall, 2001 (WP 22): Figure 2.

*Household types: 1. Farm providing less than six months cereal need. 2. Farm providing 6-11 months cereal need. 3. Farm providing 12 months or more of food need.

Non-agricultural income has two elements: that generated locally (or by temporary dry-season migration); and remittances from family members permanently resident elsewhere.

Most permanent migrants, including many young people, moved to Greater Dakar or to Touba, where they join the urban economy, mainly in informal, low-paid employment. Migration has been a central strategy among families coping with poor market conditions and drought. Their movements are consistent with low opportunity costs of farm labour, especially since the end of the PA, and evidence of the withdrawal of land

from groundnuts (Faye *et al.*, 2000, WP 16: Figure 1). It also accords with data on migration collected in Diourbel Region in the early 1990s (David and Niang, 1995).

The migrants send money back to their families, but the amounts are limited by their low earnings. The few in salaried employment sent an average of US\$36 per month, the majority in informal occupations managed only \$22 in 1992 (David and Niang, 1995, quoted in Wilson Fall, 2000, WP 20: 12-13). Some who have migrated overseas (again mainly in petty commerce), through the Mouride networks, can help their families substantially, to the extent that farmers say that the best investment from any windfall would be to send a son overseas.

Although non-agricultural income plays a role in financing it, farm investment is not the first priority for the money sent home by young migrants. David and Niang (1995 :45) found it went first to consumption or other necessities, then to house improvements, and after that to carts and horses (not necessarily for the farm).

Table 9: Use of money income according to type of household (percent, by year)

Type of household*	Type 1(%)	Type 2(%)	Type 3(%)
Buying millet	16.9	7.5	5.4
Buying rice	15.2	13.1	10.3
Buying other food	22.0	11.7	26.6
Buying other products	5.6	2.7	3.2
Clothing	14.3	19.2	9.0
Equipment	0.5	0.6	2.1
Buying animals	0.8	12.0	18.9
Buying animal food or medication	1.1	4.4	2.9
Buying crop inputs	1.9	1.9	2.4
Payment for services	1.6	1.8	2.0
Health and education	3.6	4.1	2.7
Ceremonial expenses	16.6	21.0	14.5
Total	100.0	100.0	100.0

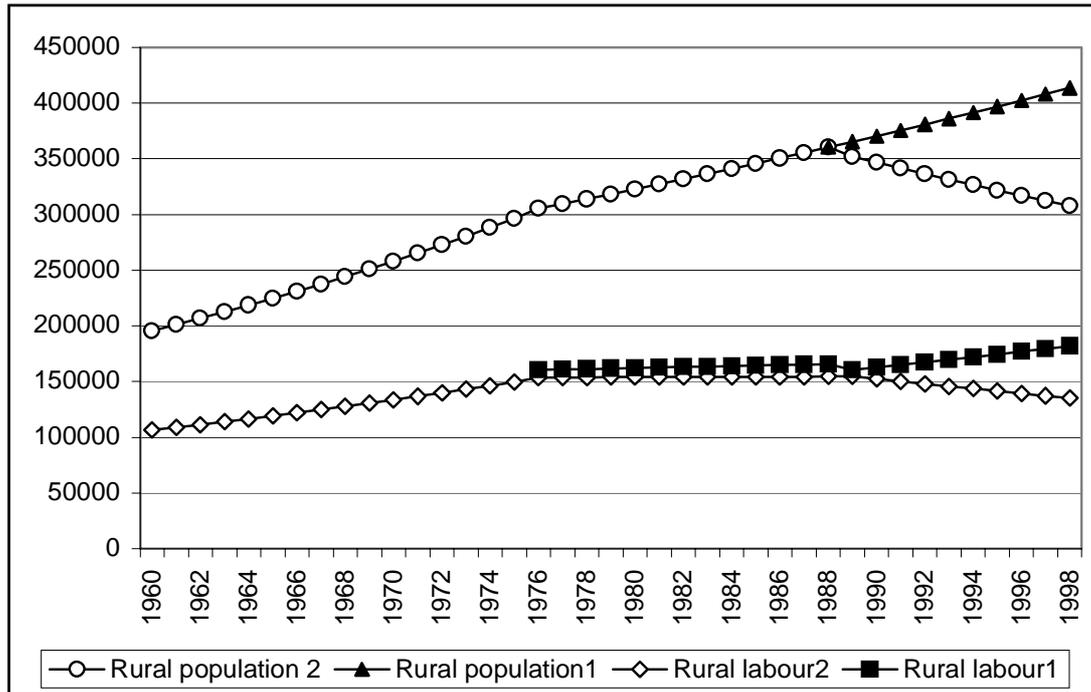
*Types as in Figure 15. Source: Faye and Fall, 2001 (WP 22): Table 13.

Table 9 shows current expenditure according to food sufficiency type. Those who produce less than six months' millet (Type 1) have to spend most on food, and buy more of the cheaper millet compared with those households who produce their own millet and spend more on buying rice. In Type 1 households, expenditure on the farm enterprise is markedly low. In the other two groups, expenditure on buying animals or animal food and medication is substantial, rising to over 20 percent of cash expenditure amongst Type 3 households. Expenditure on equipment and crop inputs is markedly small in all groups.

Social investment in ceremonies is high. However, it is noticeable that the rural families do not invest in education. In the 1988 census, while 35 percent of commune (urban) residents aged 5-19 had been to primary school, only nine percent of rural residents

(defined to include Touba) had been to school (Barry *et al.* 2000, WP 13: Table 5). Primary schooling starts immediately in French, and the curriculum is modelled on the French one. Rural parents do not see it as relevant, in which Gastellu (1981) concurred. Hence, their children do not have access to any of the qualifications that could lead to work as a skilled artisan or in modern services. Parents can dictate an email to a son in Italy, but they cannot write privately to him.

Figure 16: Possible trends in total population, rural population and rural labour since 1960



Source: Barry *et al.*, 2000 (WP 13): Figure B1.

The withdrawal of labour from agriculture may have caused the rural labour force to stagnate or even fall. Two scenarios are presented in Figure 16, the first based on projecting forward the rate of urbanisation in the Region between 1976 and 1988. This necessarily implies a fall in rural population growth. The second is based on projecting forward the rural growth rate of just over one percent, 1976-88. This necessarily implies a reduction in the urban growth rate from its high rates 1976-88, which is possible in that towns like Touba tend to grow more slowly as they become larger. From these projections of rural population, the rural labour force (defined as the age group 15-60) was estimated, assuming that the proportion of the total rural population in this age group remained unchanged. The scenario with a decline in the rural labour force seems the most likely if the opportunity cost of rural labour has fallen since the end of the Programme Agricole in 1985.

4.10 Adapting social institutions

Some major social changes occurred in colonial times. The old aristocratic hierarchies disappeared or lost influence. The Wolof turned more and more to their religious leaders

as intermediaries who would speak for them to an alien administration, and furthermore, give them an organisation and an ethic that enabled them to open up new lands in a hostile environment. Their sheikhs attracted two types of follower: peasant farmers with their families seeking new land and youths seeking learning, blessing, and eventually, through work as disciples (*talibé*) on the sheikh's personal estate, an entitlement to land. This institution of discipleship was known as the *daara*. The sheikhs became large farmer-traders as well as religious leaders. The rural *daara* was adapted to form urban *daara* amongst the young men doing temporary or permanent urban work. From the 1950s more and more Sereer adopted Islam in its Mouride form, which gradually undermined many of their former cultural traditions. O'Brien (1979) saw the Mouride leadership, itself strongly interested in groundnuts, as wringing concessions on price and debt from the state in the 1973-9, by threat of withdrawing from groundnuts when low prices and droughts were causing real hardship, comparing it to "a bizarre and theatrical form of trade unionism".

During the next decades the increased importance of the young, and the increase in urban – rural linkages continued. The migration east to new lands already undermined the authority of the head of the family, since a son could leave his father's household with a religious excuse. By the 1990s, many elderly households relied on remittances from their urban-based younger members. In 1988 the census recorded nearly 8,000 Diourbel migrants who had come to Dakar within the previous five years, and 55,000 lifetime migrants (Barry *et al.*, 2000, WP 13: Table 7). Although the Mouride commercial network has its headquarters at Touba, whole quarters of Dakar are the result of their investments. In the 1988 census, 85 percent of the population of Diourbel classified itself as Mouride. By the 1990s their commercial network had extended to Europe, the United States and South Africa. Social investments in marriage and other religious ceremonies remain important to ensure that the old still receive support from the young, to strengthen urban-rural ties, and to give a young migrant support in getting urban work and commercial opportunity. During the last decade these relationships have been further strengthened by the spread of telecentres which enable relatives to keep in touch despite distance (Wilson Fall, 2000, WP 20). Many families now have two geographical locations, one rural and one urban, with frequent interchange and visits. The young men no longer return for the wet season, though they may make sporadic visits. The rural family has become the guardian of the family's land patrimony.

The new legal institutions of the *communauté rurale* seem already to have become well-known and important. In some villages, NGO or other aid programmes have supported new initiatives, particularly amongst women. However, in other places, they are totally absent, and this is given as a reason for a lack of associative activities. We observed at the Bambey workshop that there was still an inclination to rely on the state for services which might in other countries be expected to come from private initiatives – for example, the farmers thought that the state ought to enlarge the market for cowpeas.

5 POLICIES FOR POSITIVE CHANGE

5.1 A new paradigm

In this study, we have analysed long-term change during 40 years in the northern Groundnut Basin in the light of environmental changes brought about by external factors (rainfall in particular) and of policy in Senegal. We have portrayed the essentials of the agricultural crisis as conventionally understood. This crisis is in part a consequence of the withdrawal of the policies of the Programme Agricole, which became an insupportable burden for the state and which failed to generate sustained growth in incomes per capita. There is a search in progress for an alternative and practicable policy framework for the development of rural livelihoods, agriculture and natural resource management in Senegal.

It is the argument of this paper that such an alternative will be difficult to define within the framework set by conventional explanations of the causes of the crisis. These perspectives include putting the blame on the wrong causes, namely:

- a fall in rainfall
- a rise in population and in the population:land ratio
- soil and vegetation degradation
- a groundnut crisis (fall in government revenues)

These perspectives see the farmer as essentially dependent on external factors (in the natural environment, government policy and research institutions) for his salvation. This was the underlying principle of both colonial and post-colonial economic planning in the agricultural sector. Dependency has never been an accurate diagnosis of Senegalese farmers. It is time to look for a better paradigm based on enabling rural households to make full use of their undoubted capabilities, while at the same time taking appropriate measures to increase their skills. Related to the dependency view is the narrow view of the rural crisis as a groundnut crisis, so that recovery is seen as dependent on the revival of groundnuts as the motor of the rural economy, disregarding the diversification on which the farmers have embarked.

We have presented evidence of the emergence of a new dynamic whose defining characteristic is the autonomy of the farmer and his capacity to allocate his resources of labour, land or capital rationally in response to the opportunity costs of the scarce factor. It is particularly to be seen in their strategies of diversifying their income sources. The new dynamic may be recognised in:

- response to markets and prices (for products, labour, inputs);
- response to changed rainfall regimes (modifying crops, varieties etc);
- selective response to information and the availability of new technology, taking the household and local circumstances into account.

We argue here that the most appropriate policy objective should be to support and facilitate farmers in these choices. The new development policy and orientation must start from a vision which integrates the strategies of the actors at the foundation level of the economy and the local dynamics. These give the perspective of an alternative economy to that which the state has tried to impose up to now. In particular, if it is

desired to improve the productivity of agriculture, economic incentives must be found for private investment in land conservation and productivity. Investments in new forms of livestock husbandry by farmers demonstrate that they can do this. In crop production certain new developments (cowpea, *bissap*) show the same response to market signals. Experience elsewhere (Kenya) shows that market profitability is an effective motivation for investment in land conservation and improvement. At the same time, taking into account that dry season activities will always be important, information and infrastructural support needs to be developed in this sphere also.

5.2 Some strengths and weaknesses

The *Basin Arachidier* of Senegal has both strengths and weaknesses. Some of those which the present study has brought to light are as follows.

Strengths

- *A strong entrepreneurial tradition:* The Wolof, and more recently the Sereer also, found means to develop groundnut cultivation in new country, to make large investments in urban development in Touba and Dakar, to develop existing cattle markets into a new rural markets after the disruption imposed by the state on the marketing system in the 1960s, to take advantage of differential prices across the borders (legally or otherwise), to develop artisanal processing of groundnuts, and to develop the market for groundnut hay. They have also developed an international network of street sellers of souvenirs and ethnic goods that extends from the USA to South Africa and Europe.
- *Farming experience:* Enterprising farmers are willing to assess new products and technologies, and to adopt those that seem profitable and suitable to their circumstances (light as opposed to heavy traction, new groundnut varieties), while maintaining a strong capability to produce (and sell) staple food grains. They have intensified livestock production and exploited its market potentials, while increasing the integration of crop with livestock production.
- *Natural resources:* The natural resource base continues to yield crops, albeit at low levels, after four or more decades of annual cultivation, and can yield at higher levels if it becomes profitable to use some fertiliser, or to increase manuring inputs, or if rainfall returns to higher levels. Notwithstanding a scarcity of natural pastures, livestock numbers have increased on a sustainable basis. Farmers have a good knowledge of fertility conservation and the importance of trees as browse and as contributors to fertility.
- *Social institutions:* There is a tradition of mutual support within the family and religious brotherhoods that transfers resources between urban and rural members, at home and overseas. This tradition also extends to systems of saving and credit (*tontines*).
- *Adaptive livelihood strategies:* Dissatisfied with state policies in relation to groundnut production, people have developed alternative income sources.
- *Transport and communications infrastructure:* which are good when compared with several other African countries.
- *New institutions (communautés rurales):* which already seem to be giving people greater control over some aspects of local development. Under a new policy they are

to be changed into *communes rurales* which like the present urban communes, will have power to enact by-laws and to raise taxes.

Weaknesses

- *Policy disincentives*: Statist policies have tended to be unfriendly to farmers and traders. Price fixing has had a negative impact on farm investment and sustainable natural resource management in the past, leaving a difficult heritage to overcome. Traders were not encouraged by state-controlled marketing and input supply.
- *A proneness to drought-triggered food scarcities* causes families to lose or sell assets, and which makes them dependent on food relief from family members elsewhere, or from others, at unpredictable times. The variability of rainfall increases the risks associated with the use of fertiliser and makes farming too risky for reliable credit repayments.
- *An attitude of dependence*, first on the state, and now (it seems) on NGOs, has been built up.
- *High levels of illiteracy* impede the development of the non-farm sector and of local institutions. There is a gulf between the few educated in the French language state system, who are separated from their parents at the secondary stage, and the masses, who speak, but do not read, a local language. The educated do not think of retiring to their village (in contrast with, for example, Kenya). This separation impedes the informal flow of information and perhaps of investment funds.

5.3 The questions under study, and policy recommendations

- (i) *Is agricultural intensification viable when rainfall is low, variable and often inadequate for crop growth?*

Can farmers deriving an erratic and poor income from cropping make the savings needed for investing in improving their land? We have found that farmers have maintained or increased cereal output per hectare despite the deterioration in rainfall. On average they have maintained food production per capita for their own households, but food production has not kept pace with urban population growth. This cannot be blamed solely on rainfall: the urban preference for rice has not encouraged the production of millet for sale. Those farmers who can meet their own cereal needs are in the best position to invest in livestock and other enterprises, but there is a large minority who need regularly to buy grain. Farmers have found markets for new crops, such as *bissap*, and, to a more limited degree, cowpeas.

Intensification has gone further for livestock than for crops. New feeding methods have meant that the number of livestock they can support from their crop residues and reduced grazing areas has increased. Farmers have made investments to upgrade their feeding systems and also buy in supplementary feed to fatten cattle and sheep for the market. More farmers can afford to do this via small ruminants than via cattle, where ownership is very unevenly spread. However, the market favours the meat of small ruminants.

However, intensification, especially for crops, has met limitations in the past. These limitations may continue in the future unless conditions change.

- Young men see better opportunities off the farm than on the farm, so labour-intensive improvements and practices may be difficult to undertake.
- Off-farm incomes are nevertheless low, and cannot provide much investment capital for improving the farm.
- Fertiliser appears not to be profitable for groundnuts and millet at current prices.
- While livestock numbers have increased, they cannot provide sufficient manure for the total cropped area, but only for the *champs de case*.
- Formal credit has failed because it cannot be repaid in bad seasons.

(ii) *If farming is to intensify, what are the necessary policy conditions?*

This analysis began with a diagnosis (which reflects an orthodox view) of a ‘blocked’ system, i.e., one that has largely failed to intensify, at least in regard to groundnuts, notwithstanding policies designed to achieve this by state control of prices, marketing, processing, input supply and credit, research and extension to modernise agriculture, and public investment in transport and communications infrastructure. On the other hand, the successes just noted have been partly due to policies on livestock health, the dissemination of new millet varieties and of information on livestock feeding. The reform of land tenure has not had a positive impact on investment. While rice was subsidised, the market for millet was depressed, discouraging output from rainfed farming areas. But market liberalisation has recently encouraged the free flow of agricultural products. Expanding market systems are supported well by earlier investments in transport and communications infrastructure.

The withdrawal of the state from direct control of agriculture raises the question of what its proper role should be. Within the framework of the new paradigm suggested earlier, and arising from this study, we can identify the following ways of facilitating agricultural intensification:

- Development of markets and the free flow of market information (while avoiding privileging imported foods, such as rice, by subsidies or otherwise), to stimulate the market for dryland crops, livestock products, and inputs.
- Encouraging private investment in agriculture and processing activities. The growth of Touba provides a demonstration of the potential of private investment, supported by strong institutions, to mobilise resources in commerce. However, Touba has tended to attract investment away from, rather than towards, agriculture. Enabling policies and infrastructure are required which strengthen the interactions between farm and non-farm sectors at the local level. There has long been investment by Mouride leaders in groundnuts, some of whom have large-scale farms, using fertiliser and tractors to an extent not possible for smaller farmers short of capital. Touba has decorticating plants, and big Mouride farmer-traders buy in groundnuts from smaller farmers, offering a higher price than the Government. Some leaders have invested in the Diourbel oil plant. They should be encouraged to think of processing other products, such as dairy products and hides and skins.
- Support for a livestock element which provides income, manure and traction, through continuing livestock health services, and attention to security (theft is becoming a problem).
- Development of options for profitable crop diversification. Research institutions should be testing and developing (with meaningful farmers’ participation)

alternatives to the groundnut, including those that provide fodder. There are already some joint programmes with ICRISAT and ICARDA⁹. Experience in other countries and market analysis may suggest suitable crops and varieties to try.

- Soil fertility management remains a strategic priority.
- In order to overcome a scarcity of capital, micro-financing credit systems may still have much to offer smallholders in rural areas, and should continue to be developed by donors and NGOs, while recognising that farmers may have good reason to prefer private commercial sector alternatives.

(iii) *If agriculture alone cannot support foreseeable population growth in semi-arid areas, what are the necessary policy conditions for developing the non-farm sector?*

This study shows that (in common with other areas in the Sahel) the *Basin Arachidier* depends on its rural inhabitants having access to employment and income opportunities in the urban and national economy and even overseas. This does not threaten the failure of agriculture, because subsistence production remains important for almost all rural households. However, we have shown that families already depend for their monetary needs and food consumption (when drought or poverty undermine food sufficiency), on a tripod of crop, livestock and non-farm incomes. All three will need development to support more private investment in better health or education, micro-enterprises, livestock and farm improvements.

- An education system is needed that prepares children, not only for salaried employment, but also for self-employment in the non-farm sector. The state educational system appears not to interest many rural families, which are unwilling to invest the working time of children, and their money, in it.
- A lack of literacy and numeracy limits not only children but also many adults from acquiring well-paid work or developing micro-enterprises.
- Public investment in small towns (water, electricity, transport, telecommunications, health) is necessary. The *communes rurales* which already have active market centres and associated densities of population need to be recognised as towns. If the example of Touba is to be followed by smaller towns, investors in such activities as informal workshops, maintaining farm equipment and rural infrastructure, and service provision need supporting infrastructure. Private investment in commerce can bring employment and commercial opportunities closer to rural people (Faye and Fall, 2001, WP 22). Public investment may make educated people more willing to work, invest and retire in rural towns.

(iv) *If government is short of revenues to finance services, how should it decide its priorities for people living in semi-arid districts?*

From the foregoing, it is apparent that the provision of basic services (governance, infrastructure, education, human and animal health) is a necessary condition for optimising private investment and growth in rural areas. Senegal has had 40 years of continuous democratic government. The challenge which is being faced today is to link

⁹ ICRISAT: The International Crops Research Institute for the Semi-Arid Tropics. ICARDA: International Centre for Agricultural Research in the Dry Areas.

the centre more effectively with the local through new or strengthened forms of dialogue to set agreed priorities.

It is assumed that decentralisation of administrative structures and service provision will continue. This will give local authorities power to make by-laws and raise local taxes. However, these new institutions need to be supported by the provision of education, and of information in languages locally understood. Transparency in the actions and interventions of agencies in the rural sector should be increased, to overcome passivity, and strengthen popular participation in decision making.

Dialogue with government should harness the talents of all Senegalese, and this should involve a dialogue on priorities with leaders who have the confidence of rural people – the Mouride leaders, community leaders and the new local institutions. While government has to be conscious that the interest of the Mouride leaders are not necessarily the same as those of the small producer (O'Brien, 1979; Copans 1981) they should nevertheless be involved in discussion of the way forward, not only in agriculture, but also in education, where they have often appeared to oppose state schooling.

Participation in the dialogue should however be extended to rural people in their own right. Our country workshops, in Senegal, Kenya, and Niger showed us that representative members of rural communities (both men and women) can participate meaningfully and usefully in such debates, provided they are held in the language they understand. Local dialogues should be in the local language, translated into French for the benefit of those who cannot understand, and not vice versa.

(v) *What priority areas require action at the national level?*

Some of the policy priorities we have identified in the foregoing discussion of the Diourbel Region also apply at the national level (a need to support the intensification of agriculture, diversify crop production, enhance livestock production, re-orientate rural education, and invest in small towns). In addition, national policy needs to take account of the following issues.

- *Diversification from groundnuts:* Groundnuts should cease to be the focus of agricultural policy, research, and development. The state has tried one alternative, the development of irrigated rice in the Senegal River valley, but some schemes have doubtful economic viability. More effort should be going into developing alternative dryland crops, to increase the options available in legumes, cereals, oil crops, forage crops or others, and into supporting the livestock sector. Currently Senegal is importing cooking oils, milk and rice. Research should pay attention to the income effects of the alternatives, to costs as well as benefits. The aim must be to assist farmers with information and examples, so that they can judge what is economic in their context.
- *Pricing of imported food:* There is a consensus in support of the view that subsidised rice imports tended in the past to undermine the capacity of the agricultural sector to produce staple food grains for the market. This policy brought about a change in food preferences in favour of rice. There is a case for importing affordable food for poor people during times of scarcity (notably after droughts). But a better balance is necessary if a market for locally produced food grains is to be encouraged. This

should be a policy objective of macro-economic policy and should be taken into account in exchange rate policy.

- *Land tenure*: A dynamic equilibrium has developed between the LDN and customary practice, which has successfully avoided a loss of confidence in the security of rights of access to natural resources. Government should make it clear that rights under custom will continue to be recognised, including inheritance, those of women, and of farmers who have land under fallow or grazing.
- *Communication*: The ability to communicate information over space is a fundamental requirement for access to new opportunities and technologies. The ability to read, write and calculate enhances peoples' abilities to weigh up the profitability of different livelihood strategies and actions. It will also support them in monitoring the new communes and negotiating with the centre. Government needs to discuss and review with community leaders and others the aims, language and content of rural primary schooling, and the language of local governance institutions. French will always be the gateway to higher education and the language of national unity, but there is need for reconsideration of the role of Senegal's other languages.

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