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STRUCTURAL ADJUSTMENT AND SUSTAINABLE DEVELOPMENT IN MALI

A World Wide Fund for Nature Study

Alpha S. Maiga
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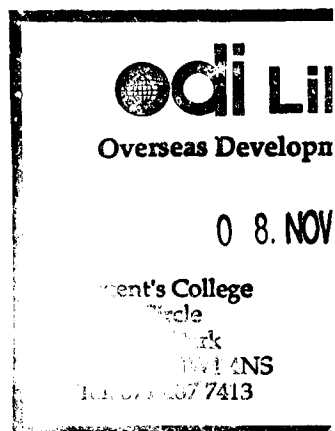
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Preface and Acknowledgements

This study on structural adjustment and sustainable development has been carried out by the Institute of Rural Economy (IER) in Bamako in collaboration with the Overseas Development Institute (ODI) in London, and is jointly funded by IER and the World Wide Fund For Nature (WWF). The study has the objective of deepening understanding of the relationship between economic reform policies and the state of the environment, with the ultimate aim of identifying the elements of a policy for sustainable development.

The work was carried out by a study team at IER, led by Mr Alpha Maiga, and including Bino Teme, Bakary Coulibaly, Lassiné Diarra, Alpha Kergna and Kalilou Tigana. James Winpenny of ODI provided general guidance to the team, offered detailed comments on drafts of the report, and contributed text to chapters 1, 3 and 4. The team wish to acknowledge the assistance of many agencies and individuals in Bamako and elsewhere, comments from the WWF Advisory Committee, and the support of the Director and other colleagues in the IER.

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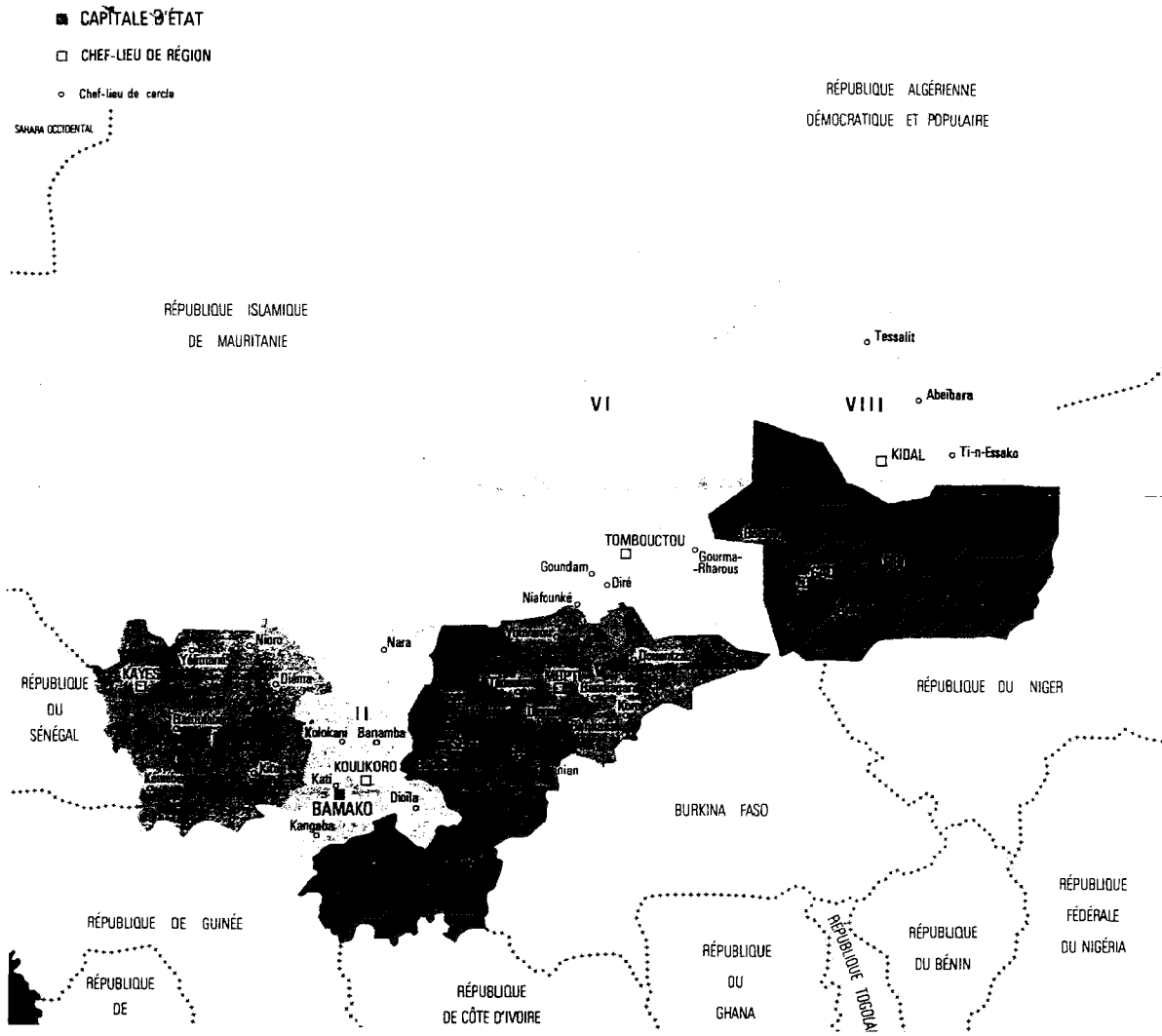
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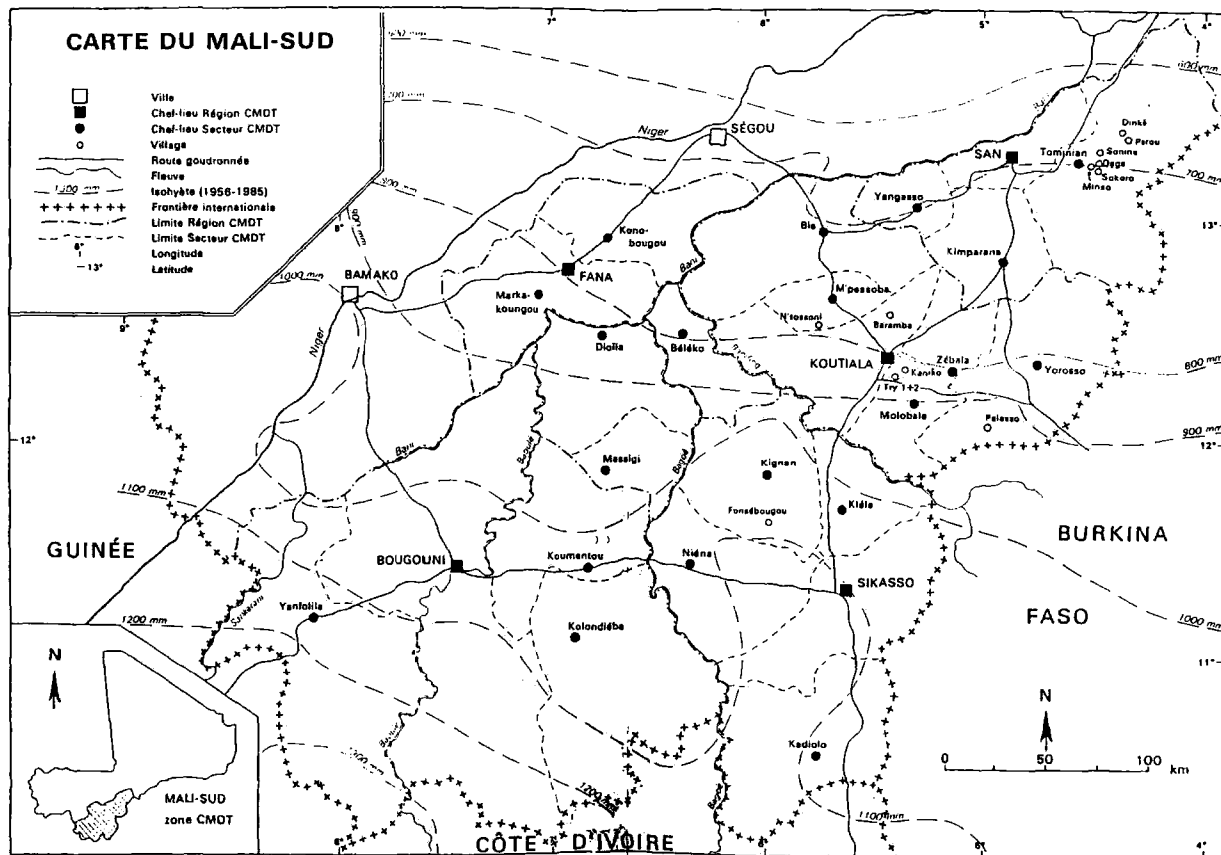
Acronyms

AV	Association Villageoise
BNDA	Banque Nationale de Développement Agricole
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement
CMDT	Compagnie Malienne pour le Développement des Textiles
EDF	European Development Fund
ON	Office du Niger
PIRL	Projet d'Inventaire des Ressources Ligneuses
TCI	Taxe Conjonctuelle à l' Importation

Administrative Map of Mali



Map of Southern Mali



1. Introduction

The study's aim is to document and analyse the recent evolution of Mali's natural environment, consider the explanatory causes and the responsibility of structural adjustment for the observed effects, and make recommendations on how policies should be reformed if sustainable development is to be achieved.

1.1 The setting

Mali is one of the world's poorest countries. Its population of c. 8.7 mn is growing at c. 2.5% p.a. and has a current income per head, after the recent devaluation, of only \$200. According to the 1987 Census, 80% of the population is rural.

Mali covers an area of 1,240,000 square kilometres and lies between 11 and 25 degrees North, and 3 and 12 degrees West. The northerly three-quarters of its land falls in the saharan and sahelian zone, with less than 600 mm of rainfall. 30% of land is desert, and a further 21% is sahelian. The southern part is in the soudano-sahelian, soudanian and soudano-guinean zones, with a semi-humid climate and a dry season from November to May. The extreme South, representing 6% of the territory, includes some dense forest. Altogether, around one quarter of its total area is arable.

Environmental problems impinge on the livelihoods of the majority of the population, in particular desertification, increasing aridity, overgrazing in many areas, soil erosion and depletion, unsustainable intensive farming, and devegetation. Although the population is small in relation to the land area, the quality of land is generally poor and there are many obstacles, not least climate and poverty, to developing a more productive and sustainable agriculture.

Agriculture is the mainstay of the economy, providing half of GDP, a livelihood for over 80% of the population, and three-quarters of export revenues through cotton and livestock. Millet, rice, and other coarse cereals are widely grown, and many farmers and householders keep livestock. Compared to agriculture, other sectors are minor. There is some agro-processing and light industry catering to the modest domestic market, and some gold is produced. Some adventurous tourists visit the historic Saharan trading cities, but the country is not geared up for major tourist traffic.

Mali's social indicators leave much to be desired. Apart from its extreme poverty, the society is largely illiterate (83%), with a primary education enrolment rate of only 23% (17% for girls). The crude death rate (18.7/1000) and infant mortality rate (166/1000) are very high, and basic health services are limited in their coverage.

Serious adjustment efforts began in 1988, following earlier half-hearted episodes. Apart from restoring macroeconomic balance in the fiscal and monetary areas, the programme aimed at rebalancing government spending (capping payroll costs,

favouring social sectors, directing more towards O & M), reforming parastatals (including privatisation and restructuring) and improving private incentives across the board. The cotton sector was specifically targeted for reform, and the cereals market was liberalised. Measures were also taken to improve the efficiency of education and public health services.

There has been some improvement in economic performance. In the 1980s there were large year-to-year fluctuations in GDP, due to climatic changes, events in neighbouring countries, and movements in international terms of trade. Average growth in the first half of the 1980s was c. 2%. Compared to this, growth in the period 1988–92 was 3%, not enough to reverse the net decline in income per head witnessed in the 1980s.

The overall fiscal deficit has been reduced slightly, but is still 9.5% of GDP (1993). This lies at the heart of the country's macroeconomic problems. One reason for the disappointing progress of adjustment is that the exchange rate of the CFA franc remained unaltered until the devaluation of January 1994, and in the meantime the real exchange rate became seriously overvalued.

Starting in 1991 the political system in Mali evolved towards a multiparty democracy, which came into being in June 1992. There has been a vigorous reaction to the repression of the past, and in asserting its new democratic freedoms and rights the population has made it very difficult for the new government to take the necessary strong actions to continue the reforms and control the economy.

1.2. Methodology

Structural adjustment programmes (SAPs) are undertaken in response to pressing economic problems. Environmental objectives rarely feature in their conception or design. Any environmental effect is usually an unintended by-product.

So far, there has been little attempt to incorporate environmental aims into SAPs:

- the relevance and impact of adjustment on the environment are still poorly understood
- the urgency of the economic and social problems being addressed by SAPs drowns out environmental considerations
- incorporating new environmental features in SAPs would complicate programmes that are already problematic enough. SAPs have had a very mixed record, many African countries have applied adjustment weakly and half-heartedly, and many SAPs have been too complex.

However, understanding the adjustment-environment link can serve useful purposes:

- uncovering trade-offs and conflicts between economic, social and environmental aims, which can help in designing future SAPs or compensatory/complementary projects (e.g. if adjustment encourages the production of an erosive crop, its support price can be adjusted or taxed, or anti-erosion measures introduced). The trade-off may be very acute, e.g. the need for export revenue may lead to pressures for timber exports, or mass

Big Game tourism. In other cases, the trade-off may be minor, and a major gain in environmental aims could be achieved with a relatively small sacrifice in economic terms.

- identifying 'win-win' policies that fulfil both economic and environmental goals (e.g. increasing logging concession fees, promoting exports of tree crops, raising energy prices).

The main methodological problems encountered in this study have been the following:

- the difficulty of isolating the impact of adjustment from that of underlying social and economic trends. Adjusting countries are, by definition, suffering economic and social problems before SAPs are formally introduced. Adjustment cannot be blamed for pre-existing economic problems, or for the growth in underlying poverty. This is especially true where adjustment has been weak and/or flawed.
- exogenous factors intervene. During the course of adjustment, Mali has been affected by crucial changes in national policies, changes in international commodity and financial markets, and its transition to a more democratic political system. Mali, in common with other Sahelian countries, has experienced a trend towards growing aridity, punctuated by shorter, severe droughts.
- in short, some view needs to be taken of the counterfactual case, which is difficult to specify and can always be challenged.

There is growing interest in the use of computable general equilibrium (CGE) models which enable alternative policy scenarios to be tested for their possible effects on natural resources and the environment. However, these models have a huge appetite for data, are often based on outmoded structural features and behavioural relationships, and are rarely calibrated in sufficient detail to display environmental factors. A suitable model for Mali was not, in any case, available.

The approach followed in this study was eclectic. Researchers identified links between adjustment and the natural environment which seemed plausible on *a priori* grounds, based on their knowledge of adjustment, environmental processes and local circumstances. These were tested by the use of time series evidence, reinforced by field surveys and local professional opinion. The analysis conducted from a macro perspective was complemented by a review of the issues at the 'grass roots' level in three different, but important, regions, namely the cotton-growing area of Koutiala in the South, the rice-growing region around Segou and Niono, and the livestock economy of Sikasso.

The method used, like any other, was greatly constrained by the supply of data and its quality. Evidence on environmental status and trends is imperfect in all countries, and Mali is no exception. Intuitive and impressionistic views are difficult to match with robust, quantified evidence. Data are patchy, impressionistic, sometimes anecdotal, and culled from various sources. The results of the study should be regarded as suggestive rather than definitive. They identify promising lines of enquiry and, in some cases, provisional conclusions based on the data at hand. Further research along these lines is desirable.

2. The environment and macroeconomic policy in Mali

2.1 State of the environment and its evolution since 1975

2.1.1 *General features*

Located between 11° and 25° latitude North, and 3° and 12° longitude West, the Republic of Mali is an intertropical country with a highly contrasting natural environment. The northern part of the country (almost three-quarters of the territory) belongs to the saharan and sahelian zones, whereas the southern part belongs to the soudano-guinean zone. In the heart of the sahelian zone, the inner delta is good for livestock, thanks to the favourable hydrographic regime of the Niger river. The country is divided into seven administrative regions in addition to the district of Bamako and covers a total area of 1,240,000 km².

2.1.2 *Climate*

Mali has a tropical climate affected by two contrasting winds: the harmattan, hot and dry, which blows from the Sahara during the dry season; and the humid monsoon, which blows from the Gulf of Guinea during the rainy season.

In the extreme south of the country, where the climate is of a semi-humid, soudano-guinean type, the dry season lasts for about six months, (five months at some stations), from November to the end of March or April. The rainy season lasts six to seven months, with the maximum rainfall in July–August.

The central part, located between 500 and 1,200 mm isoyets, has a sub-humid to semi-arid type of climate. The dry season lasts six to eight months, from October–November to the end of April. The rainy season lasts four to six months, with the maximum rainfall in July–August.

The sahelian region, limited to the south by the 600 mm isohyet, has an arid climate. The dry season is long (from seven to nine months), with very low atmospheric humidity. The short rainy season runs from June–July to August–September (three or four months), with an average of 30 days of rain per year.

2.1.3 *Water resources*

The Malian hydrographic system, consisting of the Upper Senegal and the mid-Niger basins, results from both the country's geographical configuration and its relief and climate (Table 1). Permanent waterways are concentrated in the centre

Table 1 **Maximum height, highest and average flows of the main waterways**

<i>Waterways/ Reference station</i>	<i>Maximum height (m)</i>	<i>Highest flow (m³/s)</i>	<i>Average flow (m³/s)</i>
Niger			
Ansongo	303	1976	1078
Tossaye	526	1998	954
Senegal			
Kayes	776	2964	462
Bani			
Mopti	671	3203	1170
Douna	774	2338	532
Bafing			
Daka saidou	561	1585	257
Oualia	652	1206	135

Source: Meteorological Service

and south of the country, whilst the north is characterised by the existence of a number of fossilised valleys, such as the Tilemsi. This imbalance in the location of water resources helps to explain the unequal human occupation of the territory.

The river Senegal, 1,700 km long, 700 km of them in Mali, has its source in the Fouta Djallon plateau in Guinea, at 900 m altitude. It crosses two main falls: the Gouina and Felou. Upstream, it is called the Bafing up to Bafoulabé, where it takes in the Bakoye enlarged by the Baoulé. Downstream from Kayes, it receives other tributaries: the Kolimbiné, Ouadou, Karakoro and Falémé. The average flow is 669 m³/s at Galougo – 15 m³/s at low water and 2,800 m³ at the flood.

The river Niger, 4,200 km long, 1,700 km of them in Mali, drains a 1,500,000 km² basin. Its source is on the northern side of the Fouta Djallon, at 800 m altitude. Its upper reaches (the Djoliba) take in Sankarani. It then passes through a rocky valley obstructed by the Sotuba rapids. From Ségou to Kabara, it runs through a slightly undulating plain which, during periods of flood, resembles an inland sea: this is the inner Delta. In Mopti, it takes in the 900 km long Bani. In Diafarabé, it divides into two: the western branch called the Diaka which runs into Lake Debo, and the eastern branch called the Issaka which meets the Bani at Mopti. Two overflow channels come out of Lake Debo (250 km²): the Issa ber and the Bara-Issa. The latter and the Koli join up with two lake systems, the most important one being the Faguibine (630 km²). Upstream from Bourem, the river is cut by the

Tossaye sill. The highest flood occurs in September - October at Bamako, at the end of October at Mopti, in December at Kabara, and at the end of January at Gao. The average flow at low water is 70 m³/s at Koulikoro and 5,290 m³/s at the flood (the highest flood observed - 9,700 m³/s occurred in 1925). The annual average flow is 1,550 m³/s.

These two waterways play an essential role in the geography and the economy of the country (with flooded and low-water agriculture, fishing, transhumance). However, apart from the zone of the Office of the Niger, they are still under-utilised, due to lack of adequate management.

2.1.4 Soils

According to the French soils classification, six types of soils can be found:

- *entisols* and *ustalfs* (according to US soil taxonomy), linked to hard plates, mainly visible in the south of the country (soudanian and soudano-guinean zones, rarely in the southern sahelian zone);
- *aridisols* (brown sub-arid soils, reddish brown sub-arid soils), common in the northern soudanian and southern sahelian zones. They are associated with alluvial plains and can present a deep hydromorphy.
- *argids* (tropical eutrophist brown soils) relatively less common, mainly visible in the northern soudanian zone;
- *alfisols* (tropical ferruginous soils), also common in the soudanian and soudano - guinean zones;
- hydromorphous soils, less common but visible in the country as a whole.

2.1.5 Vegetation

Forestry: extent and production

According to PIRL, in the part of the country which is exploited, i.e. from the extreme south to the latitude of Timbuctu, forests broadly defined cover 25% of the territory, or about 31,000,000 ha ; their production is estimated at 512,000,000 m³. In this area, 5,700,000 ha are cultivated. As for the area, it covers 340,000 ha and produces 27,000,000 m³ of wood per year.

In the soudanian and soudano-guinean zones, the forage produced is substantial (2 to 5 tons per ha), but its quality is poor except during the rainy season. Forage is scarce around villages and on degraded soils. In the sahelian zone, the quantity of forage produced is less substantial but of better quality, varying between 1,000 and 2,500 kg per ha.

Table 2 **Vegetational zones in Mali**

<i>Rainfall</i>	<i>Ecological zones</i>	<i>Approximate area km²</i>	<i>%</i>	<i>Vegetation type</i>
Less than 50mm	Saharan	372,000	30	Desert
50–200 mm	Saharan	260,000	21	Sub-desert steppe
200–400 mm	Sahelo-saharan	99,000	8	Thorny sahelian steppe (<i>Acacia</i>)
400–600 mm	Sahelian	198,000	16	Steppe or savanna with <i>Balanites</i> , <i>Euphorbia acacia</i> and doum-palms
600–800 mm	Soudano-sahelian	98,000	7.5	Shrub and tree savanna with Ronier, Balanzan and Kapokier
800–1,000 mm	North-soudanian	75,000	6	Soudanian savanna with <i>Combretum</i> , Karité, Néré, Caï cedrat
1,000–1,200 mm	South-soudanian	68,000	5.5	Tree savanna, woodland.

Source: DNEF, 1982.

2.1.6 Plant formations

Biodiversity : ligneous biomass and forests.

There are 8 zones of natural vegetation from North to South (Table 2). The basic feature is that 30% of the territory is in a desert zone and 51% in the sahelian zone.

With regard to forestry production, the ligneous capital varies from 3.9 m³ per ha (in the sahelian zone) to 10.5m³/ha in the soudano-guinean zone. Furthermore, for the same zones, the potential production varies from 0.13m³ to 0.35m³/ha per year (Table 3).

Plant formations range from woodland in the soudano-guinean zone to the thorny steppes of the sahelian zone, through tree and woodland savannas. They can be classified into two main groups: the closed plant formations of the soudano-guinean zone and the open plant formations of the sahelian zones.

Table 3 Forest production

<i>Ecological Zones</i>	<i>Woody biomass (m³/ha)</i>	<i>Potential Production (m³/ha/year)</i>
Sahelian	3.9	0.13
Soudano-sahelian	5.4	0.18
North-soudanian	7.2	0.24
South-soudanian	8.7	0.29
Soudano-guinean	10.5	0.35

Source: DNEF

The soudano-guinean zone

Vegetation in the soudano-guinean zone is a mosaic of savanna, woodland, dry dense forests and gallery forests along waterways. Savanna and forests are regularly subject to bush fires.

Gallery forests can be found along waterways in three different places. Their woody biomass is enormous, reaching 200m³/ha on the banks of large waterways; on hydromorphous and/or flooded soils, the volume in wood varies between 150 and 200 m³/ha; on the flood banks and terraces of some waterways, on deep, well-drained soils and on very hydromorphous soils, the volume in wood reaches 180 m³/ha. These gallery forests are exploited to a moderate extent for carving.

The dry dense forests

There are only two authentic types, threatened with disappearance in a more or less short time: *Gillettriodendron Gandulosum* and *Guibourtia copallifera* dense forests. The closed ligneous cover, often with lianas, is generally dominated by only one species. The graminaceous stratum is scarce or even missing altogether. These forests, visible in the ravines of rocky escarpments of the Manding Plateau, are currently very little exploited.

Woodlands

This type of vegetation is well represented in all zones but is coming under more and more human pressure. It is generally visible south of isoyet 900 mm, and

reaches its maximum development south of isoyet 1,200 mm. It colonises all topographical positions and numerous types of soil, apart from hydromorphous soils. It is either dominated by *Isobertinia doka*, together with a very poor herbaceous flora comprising only a few *andropogoneae*, or by *Azelia Africana*, *Pterocarpus lucens* or *Daniella Oliveri*.

In the typical forms, the wood volume reaches 55m³/ha, with an average density of 1,300 plants. However, for the degraded forms, these values represent only 34 and 680 respectively.

The soudanian zone

This zone is occupied by grass formations which, according to Descoings (1973), are plant formations affected or not by the action of annual fires and characterised by:

- the compulsory presence of a regular herbaceous layer, discontinued at soil level, and essentially composed of gramineae and annual or perennial cyperaceas, of varying height and density, mixed with other herbaceous plants;
- the non-compulsory presence of a regular ligneous or subligneous community (bushes, shrubs, trees, palm-trees) of varying height and density, that can more or less strongly influence the structure of the graminea layer without destroying it.

This definition encompasses the concept of savanna, steppe, and meadow, with their different variables.

Savanna woodlands are either ancient formations, or formations evolving towards a forest appearance, or recently degraded formations of woodlands. They are also visible in the soudano-guinean zone.

Their floral composition varies from one zone to another, but a constant floral base can be found mainly comprising *Pterocarpus arenaceous*, *Daniella Oliveri*, *Bombax Costatum*, *Lannea velutina* and *Lannea microcarpa*.

These savannas produce an average of 22–46m³ of wood in the soudano-guinean zone, as compared with 25–57m³/ha in the southern soudanian zone ; they are strongly exploited for wood and pasture.

Tree savannas can be found in the northern soudanian zone in very diverse ecological conditions. On hydromorphous soils, their wood production reaches 16m³ as compared with 8m³/ha on non-hydromorphous soils. They are also subject to strong exploitation for pasture and wood.

The sahelian zone.

The Sahel is a zone of thorny steppes. It can be divided into three sectors :

- the northern sahelian 200 mm < P < 300 mm
- the central sahelian 300 mm < P < 450 mm

- the southern sahelian 450 mm < P < 600 mm

In each sector, it is the water balance of the soil that determines the composition of the vegetation. This balance is in turn influenced by the texture of the soil.

However, in some areas, even when the vegetation is influenced by the bioclimatic gradient, its effects are more difficult to measure because of the interference between climatic zoning and geomorphological particularities linked to the mode and age of the setting up of surface alluvial formations. This is the reason why the ancient flood plain, which corresponds today to the 'dead delta', has a vegetation different from that of the continental peneplain. Similarly, the Niger inner delta's vegetation is very different from that of the neighbouring sahelian zones.

Generally speaking, the vegetational cover comprises two strata: a grassy stratum essentially composed of annual species, (especially *graminae*), with some perennial *graminae*, and a ligneous bushy stratum, mainly dominated by thorny acacias, and *combretaceae*. It is devastated by overgrazing, over-exploitation of wood, bush fires and drought.

In the 'dead delta' numerous plant formations can be distinguished, depending on the type of substratum.

The low plains are dominated by the shrub, *Pterocarpus lucens*, while, in the depressions and shallow basins with vertisols, the ligneous vegetation is dominated by *Mitragyna inermis* or *Acacia Seyal*.

On the *sandy soils*, the vegetation is dominated by diverse species: *Sclerocarya birrea*, visible on sandy massifs and also on the dune groupings; *Acacia seyal* and *Schoenefeldia gracilis* on the sandy colluvium; and *Combretum ghasalense* and *Andropogon gayanus* in the sandy shallow basins.

In the continental zone, the sandy landscapes comprise the following: on the *dune groupings*, a plant formation of *Acacia raddiana* shows up in the form of a very open community. The density per ha is 16 plants and the maximum foliar biomass reaches 40 kg/ha. On the *fixed dunes*, the plant formation is dominated by *Euphorbia balsamifera* or *Combretum glutinosum*.

In the first case, the ligneous community is often distributed in the form of a regular mosaic comprising densely wooded depressions and thinly wooded dunes, dominated by *Euphorbia balsamifera*, together with *Commiphora africana*, and some *Acacia raddiana*. The density per hectare is 65 plants and the maximal foliar biomass reaches 60 kg/ha.

In the second case, the ligneous community is both regular and uncertain, with small concentrations in interdune depressions. The density per ha is 10 plants, and the maximum foliar biomass reaches 16kg/ha.

On the *plains and slopes*, the existing plant formations are dominated by: *Pterocarpus lucens* in the famous 'brousse tigrée' pattern; *Boscia senegalensis* and *Maerua crassifolia* on the fossil lacustrine plains. The extremely open ligneous community, regular and uncertain at the same time, is almost exclusively shrubby. The density reaches 34 plants/ha. *Acacia nilotica* or *Acacia seyal* can be found on the alluvial flood plains.

The ligneous community can be regular and uncertain, almost mono-specific,

Table 4 **Annual rainfall at selected stations**

Stations	Latitude in degrees	Rainfall (mm/year)			
		1951/60	1961/70	1971/80	1981/85
Kidal	18	142.5	132.5	128.8	95.8
Gao	16	305.6	216.8	195.2	160.5
Mopti	15	624.2	535.1	450.8	378.1
Ségou	13	777.4	733.0	619.7	496.9
Bamako	13	1111.3	1092.0	995.7	820.5
Koutiala	12	1099.2	1010.2	864.4	754.8
Sikasso	11	1328.8	1231.4	1128.6	974.6

Source: Meteorological Services

with a density per ha of 48 plants for *Acacia nilotica*, and 116 for *acacia seyal*, with corresponding foliar biomasses of 1,300 and 1,100 kg/ha.

The Niger Inner Delta

Located astride the sahelian and the northern soudanian zones, the Niger inner delta is a singular zone. Its vegetation presents great floral originality.

In this zone, the bioclimatic gradient gives way to flooding following the rise of the Niger river. This temporary submersion, whose characteristics vary according to zones and years, stamps a particular physiognomy on the landscape. Apart from the vegetation of non-flooded reliefs and of some plains which are flooded irregularly or late, pastures in the delta are made up of grassy savannas and aquatic meadows whose floral composition varies with the duration of the flood.

When the period of submersion varies between three and six months (with the height of the water more or less equal to 1 metre), the herbaceous layer is dominated by the graminea *Oriza longistaminata*. Low basins flooded for more than six months are devoted to 'bourgou', the Fulani word for flooded pastures, and the plant formation itself is called 'bourgoutière'. The height of the water varies

Table 5 Number of permits for charcoal exploitation issued.

<i>Year</i>	<i>Kati</i>	<i>Koutiala</i>	<i>Sikasso</i>	<i>Bougouni</i>
1980	394	101	401	52
1981	355	350	319	24
1982	511	20	228	17
1984	859	2	216	6
1985	886	114	223	15
1986	529	217	187	61
1987	6466	196	223	57
1988	3057	260	279	19
1989	1868	274	305	17
1990	2608	287	468	14

Source: DNEF

between one and three metres. The flora are dominated by *Echinochloa stagnina* and *Vossia cuspidata* in association with some hydrophytes.

To these main plant formations can be added various combretacea fallows and savanna parks dominated by karité, néré, balanzan and baobab. These savanna parks cover a surface of 52,000 km², or about 90% of the arable land (PIRL, 1988).

2.1.7 Forest reserves

The zones protected by law include the complex of the loop of the river Baoulé, subdivided as follows : the National Park of the loop of the Baoulé (3,500km²), the Kongossambougou fauna reserve (920 km²), the Badinko fauna reserve (1,930 km²), and the Fina fauna reserve (1,360 km²). Furthermore, there are: the Gourma reserve, covering about 12,000 km²; the Ansongo-Menaka giraffes fauna reserve (17,500 km²); two reserves in the soudanian zones and a few small fauna reserves (Kanie, Baoulé and the Faya classified forest). In all about 100 forests are identified in Mali, covering an area of 6,450 km² in the soudanian zone and 710 km² in the Sahel.

2.1.8 Changes in the environment since 1975

Climate

Data supplied by the different synoptic stations indicate a diminution of rainfall since the 1960s, and more severely so, as one goes northwards (Table 4).

Vegetation

In Mali, the unclassified forest area is considered by the population as a reserve of potential land, and a source of raw materials (wood, forage). This area is therefore exploited without thought for the future. The estimated reserves are considerable, notably in the soudano-guinean zone, in that the classified area alone covers 4,600,000 ha, or 8.6% of the non-desert area. For example, in southern Mali total wood volume is estimated at 270,000,000 m³, and annual wood consumption represents only 40 % of the annual wood productivity of 8,952 m³; hence the surplus is quite high. However, taking into account the consumption of less well endowed zones, this surplus is in fact not so high.

The situation with regard to firewood is not the same throughout the country. Nowadays, in the district of Bamako, annual consumption is 1,536,000 m³, whereas productivity is almost nil. A comparison of the number of permits for charcoal exploitation issued in Kati, Sikasso, Koutiala and Bougouni confirms this statement (Table 5). In Kati, a strongly exploited zone, the number of permits issued went up from 394 in 1980 to 2,608 in 1990, thus implying growing pressure on forests, in particular in 1987 when the number of permits issued exceeded 5,000. In Koutiala, during the same period, the number has varied from 101 to 287. In contrast, in the Sikasso area which is little exploited, the pressure on the environment for charcoal production is less marked; it went down from 1980 to 1986, before returning to the 1980 level.

As of now therefore, it must be admitted that, for the supply of the district of Bamako alone, 1,500,000 m³ of wood will be cut down each year in the neighbouring forests.

As a consequence of population growth, unaccompanied by a corresponding intensification of farming systems, the needs of land for cultivation and of wood have led to an increased exploitation of the forests. It is estimated that each year about 30,000 ha of forest are destroyed for wood and cultivable land; this represents about 0.5% of the total wooded area, according to PIRL estimates. From 1975 to 1990, without taking into account the influence of the drought, 15% of the forests were destroyed in this way. This loss could have been more important if wood consumption elsewhere had not fallen slightly, notably because of the increased use of improved stoves and of subsidised gas. For example, in the district of Bamako, the number of improved stoves made available has gone up from 2,219 in 1986 to 9,247 in 1990. The number of gas-rings sold by Shell and Total petrol stations has gone up from 4,495 in 1991 to 8,207 in 1993. Such actions, minor though they may be, have a certain impact on the environment.

A few decades ago, traditional farming methods appeared well adapted to the existing ecological conditions. Indeed, the practice of a shifting agriculture with long fallow periods enabled the balance of the environment to be maintained. Moreover, the exploitation of pastoral resources followed the rules of transhumance in livestock rearing, thus enabling the normal regeneration of the vegetation. This balance has been disturbed by: increased demographic pressure, the development of commercial crops, and the introduction of badly adapted technologies, which have led to the expansion of cultivated areas, a reduction in fallow periods, and the

development of inappropriate cropping patterns; uncontrolled bush fires; and the irresponsible use of wood.

For example, the area under cotton went up from 80,000 ha in 1976 to 140,000 ha in 1983; the areas in the arid zones cultivated for legumes increased by 80% (Tables 6–8). This led to a considerable reduction in forest area.

The exploitation of pastoral resources has been disturbed by three factors: a slight increase in the number of cattle following advances in veterinary medicine and the creation of waterpoints; the reduction of pastoral space; and the breakdown of the traditional hierarchical organisation of herders. This has led to: a reduction in the productivity of grazing areas; overgrazing characterised by the disappearance of some species of vegetation which can now be found only as isolated individuals; and an acceleration in soil erosion.

Table 9, giving the evolution in the sizes of livestock herds, indicates that, despite the drought years 1972–73 and 1982–84, cattle in Mali remain numerically important, with a domination of small ruminants. This can be explained by the practice of cattle-raising on the part of all socio-professional categories.

The last census of herds in 1991 gave the following figures: cattle, 5,092,000 head; sheep/goats, 11,522,000 head. Speaking generally, the main observations can be summarised as follows: a strong concentration in the Mopti and Sikasso regions; a predominance of the Fulani zebu breed (among the cattle) and of the Sahel breed among small ruminants); livestock raising is practised by all ethnic groups, with a particular emphasis on the Toucouleur Fulanis; herd size is bigger in the areas of concentration than in the sedentary areas.

On a national level, animal production represented 16.8% of GDP in 1987, and cattle exports amounted to CFAF 22 billion. The economic importance of livestock is therefore in covering domestic needs for products of animal origin (milk and

Table 6 Areas (in 10³ ha) and yields (in kg/ha) of food crops in arid and semi-arid zones.

	1974–76	1981	1982	1983	1984
Millet/sorghum					
Cultivated area	1212	1420	1362	1300	1250
Yields	703	563	776	692	640
Dry leguminous					
Cultivated area					
Yields	30	45	48	53	54
	1088	1044	1065	1063	926

Source: FAO 1994

Table 7 **Cropped areas (ha) under millet/sorghum and rice 1982-90**

<i>Crop</i>	<i>1982</i>	<i>1983</i>	<i>1984</i>	<i>1985</i>	<i>1986</i>	<i>1987</i>	<i>1988</i>	<i>1989</i>	<i>1990</i>
Millet /Sorghum	1,300,000	1,477,000	1,600,000	1,875,000	1,900,000	1,910,000	1,785,000	2,400,000	2,300,000
Rice	56,000	63,300	90,000	83,750	89,000	94,000	98,000	119,000	140,000

Table 8 **Areas (in ha) and yields (in kg/ha) of cotton in southern Mali, 1957-87**

	<i>1950-1960</i>	<i>1961-1964</i>	<i>1965-1975</i>	<i>1976-1980</i>	<i>1980-1982</i>	<i>1983-1987</i>
Area (ha)	32,000	85,000	80,000	120,000	80,000	140,000
Yield in kg/ha	300	360	1,100	1,250	1,050	1,300

Source: Agricultural Sector Review of Mali 1987

Table 9 **Sizes of livestock herds (x 1,000)**

	<i>Cattle</i>	<i>Sheep/goats</i>
1977	4,058	8,582
1978	4,334	8,563
1979	4,765	9,533
1980	5,850	11,587
1981	6,663	12,437
1982	5,676	11,244
1983	4,899	10,582
1984	4,344	9,847
1985	4,475	10,340
1986	4,589	10,529
1988	4,703	11,056

Source: DNE Reports

meat) and contributing to the balance of payments.

The evolution of herd sizes can be explained by: animal health problems, since herd size and productivity are affected by different pathologies; the low rate of vaccination leading to high mortality rates; and the problem of feeding the cattle which rely on natural pastures. Forage availability is limited and varies in quantity and quality from one zone to another and from one period to the other.

Perennial *graminae* have disappeared in most of southern Mali. For example, in Kaniko (Koutiala), the contribution from perennial *graminae* was only 3% in 1987, with serious consequences for the availability of forage.

Loss of soils through erosion in some of the zones is also important. For example, soil losses from erosion in southern Mali vary from 5 to 10 tons/ha/year for cultivated areas, or an annual loss of 0.3 to 0.7 mm of topsoil. Under permanent cultivation, this would lead to a loss of 3 to 7 cm per century, exceeding by far the rate of soil formation, which, according to Bennet (1939), is estimated at 1cm per century.

Water resources

Water resources are strongly connected with the local and sub-regional climate. Since the 1970s, Mali has been faced with a threat of drought characterised by a marked diminution in rainfall.

A comparison of some measurements of the main waterways with the average established 30 years ago, shows a perceptible and continuous fall in their levels.

This has had enormous consequences, particularly in the inner delta. That is why the areas allocated to the 'bourgoutières' have considerably diminished to the benefit of paddy-fields. Similarly, on the less flooded or dry plains, *Andropogon gayanus*, *Vetiveria nigriliana* and *Panicum Anabaptistum* have disappeared to the benefit of less productive and less sought-after annual species. The ligneous communities have not been spared; there are large areas where there is almost a complete disappearance of acacia communities, particularly the older ones.

2.1.9 Conclusion

The environment in Mali has experienced a great deal of change over the last few decades, owing to numerous factors the most important of which are climatic and anthropomorphic. This has led to: a reduction in the vegetational cover, following the expansion of cultivated areas and the irresponsible cutting of trees for firewood; a degradation of pastures due to the reduction of pastoral space, the increase in herd sizes, bad management practices and bush fires; and an impoverishment of soils through erosion and the introduction of unsuitable cropping techniques.

2.2 Institutional framework of environmental management

The Malian economy is based essentially on the rural sector which contains the majority of the population. Agricultural, livestock and forestry production rely on the use of the natural resources of soil, water, flora and fauna. Technical institutions that deal with the organisation of these activities originate in the Ministry of Rural Development and the Environment. However, the activities of these institutions are complemented by those of regional and local co-ordination structures and of non-governmental organisations.

Mali belongs to the sahelian sub-region which is characterised by the irregularity and insufficiency of its rainfall. Years of drought occur frequently and jeopardise the development of the countries in the sub-region. In effect, these drought years wipe out the production efforts made by farmers, with falls in production and drastic reductions in cattle due to the shrinkage of pastures and waterpoints. As a result, Mali and other Sahelian countries are subjected to the phenomena of desertification and desertisation.

The importance of these phenomena has awakened people's awareness. Thus, institutions have been set up at the regional and international level: the Sahel Institute; the Inter-State Committee for Drought Control in the Sahel (CILSS); international NGOs, etc.

At the national level, mass associations of the 'Green Sahel' type have been set up and concerns related to the environment have been integrated into development plans for the control of 'desertification and the advance of the desert'. The

following plans and programmes are examples of this: the plan to control desertification; the natural resources management programme; the national programme for the control of desertification; village soils management projects (about fifty of them), etc.

The current decentralisation policy seeks to involve farmers more in the management of natural resources. In other words, national opinion is actively mobilised around environmental problems, since it is in effect a question of survival.

2.2.1 *Technical institutions*

These can be classified into three groups: government technical departments or National Departments with branches throughout the country; rural development operations (ODR) funded by external donors whose activities are directed to the regional or local level; and NGOs which are increasingly numerous and whose activities complement or reinforce those of the preceding structures.

Government Technical departments

These are vertical sectoral structures within the Ministry of Rural Development and the Environment. They comprise the following:

- the National Office of Agriculture, represented at all levels of the administration, region, *cercle* and *arrondissement*. It monitors all vegetational production and is responsible for the elaboration and implementation of national policy in this field;
- the National Livestock Office, also represented at all levels of the administration. It is responsible for the development and implementation of national policy in the field of animal production;
- the National Office of Rural Engineering, represented at the regional level. It is responsible for the development and execution of rural engineering works;
- the National Office of Co-operatives and Regional and Local Development, which exists down to the level of the *arrondissement*. It assists co-operative and pre-co-operative structures and organises all matters concerned with stimulating rural affairs;
- the National Plant Protection Service, represented in high-risk zones where the invasion of locusts and grasshoppers remains a permanent threat;
- the National Office of Water and Forests which exists down to the level of the *arrondissement*. It occupies itself with the formulation and implementation of national forestry policy. This office has always been responsible for the protection of the national forest heritage (the classified forests, the agricultural and pastoral domain). It was responsible for the enforcement of the Forestry Code and its links with the other codes. It was particularly known for its coercive actions. That is why the Forestry Code has been considered repressive. Indeed, the forestry police came down with the utmost energy on all deviations

from the Forestry Code. Following the start of the democratisation process in March 1991, the Forestry Code has been regarded as obsolete, since it did not sufficiently enlist the support of the general population, who did not feel themselves entirely masters of their own territory. The Code is currently under review, as are the functions of the National Office of Water and Forests. The latter will be likely to move towards the fields of education, advice and awareness-raising. There is even talk of transferring the functions of the forestry police to the local population, for traditionally in certain regions (Dogon country) peasant organisations have had to take over this kind of function. The new code will therefore strive to empower the people who are the real actors in the management of natural resources.

- the Institute of Rural Economy, which has permanent agricultural research stations and sub-stations throughout the country set up according to research needs and production systems.

Rural Development Operations (ODR)

Training the rural population can only be done through development operations that are governmental structures, and national agricultural policy instruments. Numerous ODR exist, scattered throughout the country. Their activities are well defined in a given space. The main ODR are the following:

- ON (Office of the Niger)
- CMDT (Malian Textile Company)
- OHVN (Office of the Upper Valley of the Niger)
- ODEM Mopti (Office of Livestock Development in the Mopti region)
- ORM (Mopti Rice Office)
- ORS (Ségou Rice Office)
- ODIMO (Office of Integrated Development of West Mali)
- ODIK (Office of Integrated Development of the Kaarta)
- OARS (Sikasso Management and Reafforestation Operations)
- PRODESO (Livestock Development Project of Western Sahel)
- North-east Mali Project
- PGRN (Natural Resources Management Project)

These different projects are under the supervision of either the National Offices (to which they are often attached) or of the Ministry of Rural Development.

The Non-Governmental Organisations

A number of NGOs are involved in the training of rural populations in the fields of: agricultural production; community health; preservation of the environment; village hydraulics, etc. There are more than 450 NGOs in Mali. Their activities reinforce or complement those of the technical departments and the ODR.

2.2.2 *Horizontal co-ordination structures*

Development committees at regional and local level co-ordinate all the central technical departments, which are supposed to co-operate in order to bring more coherence into their activities. NGOs and projects are generally part and parcel of these committees, which are chaired by the development adviser of the Governor at the regional level, the *cercle* commandant at the *cercle* level, or the head of the *arrondissement* at that level.

2.2.3 *Law and land tenure*

In Mali, ownership of land is characterised by the coexistence of customary tenure and modern land legislation.

Customary land-tenure regime

The United Nations defines this as 'the rights to use the land or to dispose of the rights to its use; rights that are based neither on the exercise of force pure and simple nor on rights guaranteed by written law, but rather on the fact that they are recognised as legitimate by the communities, the rules regulating the acquisition and cession of the said rights being habitually spelled out and generally known, although not generally put into writing'. This long definition demonstrates that customary law has resulted from agrarian societies which have developed management practices according to their know-how. In effect, each society has its own values, forms of organisation, and succession which define the relationships between its members in relation to the land.

Thus, in the customary system, one can have access to land through the following:

- **Right of hatchet or fire**
This is the right of first come first served, and the first person to cultivate a plot has a 'right' to that land.
- **Inheritance**
The person who has the right of hatchet or fire to a piece of land can transmit it to his descendants. Thus male descendants inherit lands controlled by their parents or forefathers.
- **Loans**
These are forms of temporary utilisation whose enjoyment can be granted to no matter who by the person who has the direct right of hatchet or has inherited it from his antecedents.

The majority of arable land (more than 90% of the cultivated area in Mali) is managed on a customary basis. Villages are, thus, real centres of decision-making as regards land ownership. The main decision-makers vary from village to village. They are essentially: village chiefs who are in many cases from the founding family

of the village and chief of the lands; or heads of households; or extended village families.

Land is a sacred good and its use is more community-based than individual. It is not for sale in the customary system.

Land and land-ownership code

Customary rights are recognised so long as the State does not need the lands on which they are exercised. The State cannot transfer lands unless they are registered in its name (Article 131 of the Constitution).

Article 132 confirms that once the registration is established, communal and individual rights disappear and give way to the juridical land regime which is in effect written law in which private ownerships are recognised and protected. Lands submitted to the juridical regime are less important. In any case, they represent less than 10% of the cultivated area.

2.2.4 *Environmental policy*

In Mali, environmental management policy overlaps that of the rural economy sector, which is responsible for the orientation of agricultural development as a whole. Indeed, agricultural development policy is closely linked to that of natural resources.

The last ministerial intervention (Decree No 94-065/P-RM of 6 February 1994), which authorised the integration of the Ministries of Rural Development and of the Environment, bears out this approach. This integration can be explained by the situation on the ground: the problems of development cannot be distinguished from those of the environment, the one conditions the other. That is why development projects each have their 'environmental' dimension. Thus actions undertaken against erosion, or in the management of pastoral or agro-pastoral space, or reafforestation with forest species or fruit trees, are only components of production activities conceived both to raise the standard of living of cultivators and to preserve or improve the state of natural resources. By this integration the State gives itself the means of controlling or intervening in all the development activities which have a negative influence on natural resources, the co-ordination of actions being easier to manage within one ministry than in two different ones.

Agricultural policy consists of strategic aims and specific policies for different sub-sectors.

Strategic Aims

The main objectives are: food security and the conservative management of natural resources, which are the foundation of all production activity. In order to achieve these objectives, the following strategic actions are currently being pursued: more farmer involvement and transfer of responsibilities to farmers; decentralisation of

decision-making; and democratisation and transparency in the decision-making processes and in the State's management of resources.

Research into food security is dependent on strategies for the growth of productivity, extension strategies and the diversification of production. The objective will be to spread adequate technologies aimed at improving the quality and quantity of agricultural production in all its dimensions, by means of strategies securing production. The purpose will be to secure, come what may, a certain level of production. In other words, agriculture should be made less vulnerable to climatic hazards, through appropriate production techniques.

At the same time, marketing channels and the processing of agricultural products should be developed in order to ensure a certain level of income for farmers.

Conservative management of natural resources requires first of all the use by research of technical packages in order to improve not only the level of production but also, and above all, the sustainable exploitation of natural resources. The purpose will be to develop farming systems that will integrate aspects of water and soil conservation, reproduction and fertility and the preservation of genetic resources.

It also requires more farmer participation and the transfer of responsibilities. There is a need to reinstate to farmers, and to the population in general, what rightly belongs to them. Indeed, the local populations must be made aware of all the measures taken in their favour. To this end, they need to be involved in the elaboration and implementation of strategies. Certain tasks must be assigned to them because they are the ones best qualified to implement them.

Decentralisation is necessary to realise all the measures for farmer participation. The local population should be the decision-makers on all matters to do with their future. Only decentralisation can provide this opportunity. In this respect, all laws and codes (forestry, domanial, land and pastoral) are being reviewed in order to adapt them to the new environment.

All the current reforms in the rural economy sector are in conformity with the above guidelines. They concern: the cereals market structuring programme; the structural adjustment programme for agriculture (restructuring of ODR) and livestock (reorientation of cattle-raising activities); and restructuring of agricultural research, etc.

2.2.5 Reforms in other sectors of the economy

The rural economy sector cannot be considered in isolation. The reforms planned can only succeed when measures are taken in other sectors. That is why the structural adjustment measures address the secondary and tertiary sectors.

At the level of the secondary sector, the orientation of structural adjustment is towards a reduction of State enterprises. The aim is to reduce the importance of State enterprises and to move resolutely towards their privatisation or liquidation as the associated social problems are currently being addressed (unemployment of heads of families, laying-off of salaried workers, etc). This policy will help to

reduce the burden on the State arising from the weak performance of State enterprises. With the withdrawal of the State, it is hoped that this sector will improve and that the private sector will be enhanced.

At the level of the tertiary sector, the policy aims at improving the performance of public administration through the reorganisation of public finance and a reduction in the number of civil servants. The latter aspect has been implemented through a programme of voluntary 'early retirement' which applies to all categories of civil servants. Limitation of recruitment and the freezing of all promotion are among the measures taken in order to redress the situation in this sector.

2.3 Analysis of macroeconomic policy

General characteristics

As a Sahelian country, landlocked and poorly endowed with natural resources, Mali has an economy which is fundamentally based on agriculture. The main task of agriculture is to feed the rapidly growing population (growing at the rate of 2.5% per year), and at the same time to release surpluses for export. The primary sector represents over 80% of total export earnings, with cotton alone accounting for half of these earnings.

Despite progress recorded in the secondary and tertiary sectors during the past few years, the primary sector remains the prime indicator of the country's economic and social level of development. However, this primacy of the rural sector in the economy has less to do with the efficiency of agriculture than with its importance and the roles that it plays at the level of economic and social indicators. A brief description of the main indicators will help to explain their orientation and evolution in the socio-economic situation in Mali. This analysis mainly covers production, education, the birth rate, mortality, literacy, employment and migration.

2.3.1 Production

Production has shown a slow but regular growth during the 1980s, apart from the 1982 drought. With agriculture playing such an important part in domestic production, this drought had important repercussions on production as a whole. During the period 1982–85, the expansion of the secondary and tertiary sectors apparently compensated for the fall in agricultural production.

An analysis of the evolution of GDP from 1980 to 1990 (see Table 10) indicates a 3% growth in real terms. With population growing at a rate of 2.7% (MDR, 1991) during the same period, Mali experienced a positive per capita growth of 0.5% in real terms. However, strong annual fluctuations related partly to climatic conditions have to be taken into account.

The main exports are cotton, cattle and groundnuts. Tables 11 and 12 show the

Table 10 **GDP in CFAF bn and its nominal and real growth (1980-90)**

	<i>GDP (CFAF bn)</i>	<i>Annual growth</i>		<i>Price Index</i>	
		<i>Nominal</i>	<i>Real</i>	<i>GDP Deflator</i>	<i>Retail Prices</i>
1980	300.5	-	-	-	-
1981	370.8	23.3	-	-	-
1982	403.6	8.8	6.3	2.5	2.2
1983	411.3	1.9	-5.4	7.3	9.8
1984	463.5	12.7	0.7	12.0	12.4
1985	475.4	2.6	-0.8	3.4	7.8
1986	528.2	11.1	14.8	-3.7	-3.9
1987	570.7	8.0	2.0	6.0	-14.2
1988	612.2	7.9	3.7	4.2	13.1
1989	649.9	7.4	7.5	-0.1	-0.1
1990	683.3	3.3	2.4	0.9	-
1991	691.4	1.2	-0.2	1.4	
Average 1980-90		6.7%	3.0%	3.7%	

Source: Internal Government sources, supplemented from data calculated from the Malian Customs, DNSI and BCEAO (Central Bank of West Africa) reports.

predominance of cotton, however, for certain years (1981-4), though the most important export product remains live cattle. Here again, this export lost its primacy after 1984. This unfavourable development seems to be linked to competition from the European Community, through imports of non-African meat and the non-competitiveness of the Malian livestock on export markets.

Table 11**Weights of Main agricultural exports
as % of total exports (1980-89).**

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Live cattle	37.5	42.8	36.0	31.2	39.2	24.8	29.2	21.1	21.5	23.3
Cotton	40.6	29.0	26.4	29.8	37.4	48.2	34.5	41.4	36.2	45.2
Groundnut	2.5	5.5	1.5	0.7	1.0	1.6	1.2	3.0	2.7	2.4
Total agriculture	95.8	90	79.3	86.5	92.3	75.2	89.4	77.2	77.0	82.1
Total export	100	100	100	100	100	100	100	100	100	100

Source: *FAO Yearbooks* 1981 to 1989 – Tables 7, 83, 97, 99, 109, 118 + Country tables

Table 12 **Main agricultural exports (1989)**

	<i>In Value US\$ '000</i>	<i>% of total exports</i>
Live cattle	70,000	23.33
Cotton ^a	135,690	45.23
Groundnut ^b	7,125	2.38
Total agriculture	246,381	82.13
Total exports	300,000	100.00

a. Cotton (seeds), oil-cake and fibre

b. Unroasted groundnuts (seeds), oil-cake and oil

Source: FAO Yearbook, 1989

Cotton

Since Mali is not a large exporter of this product, it cannot, as a result, have any impact on its price in world markets. However, the evolution of the cotton price indicates that, during the years when prices were favourable (1983–5), the economy did, at least, function well.

Cattle meat

The sale of cattle to neighbouring countries like Niger, Senegal, Côte d'Ivoire, which constitutes an important element in the country's exports, has fallen in absolute and relative terms during the past twenty years, as has the price in CFA francs. The main reason is competition from non-African meat imports.

Groundnuts

The evolution of the international price of groundnuts is much more favourable than that of cotton. This situation should have stimulated groundnuts production compared with that of cotton. However, this was not the case. Failure to seize this opportunity can be explained by the fact that the main area for groundnut cultivation is located in the first region to be hit at the climatic level, and where agricultural income is perceptibly lower than that of southern Mali.

Education

Education in Mali is characterised by a very low school attendance rate, especially for girls, poor results from the whole school system and high costs as compared with results (UNICEF, 1989). The reasons for this situation can be attributed to several factors: lack of teaching materials, low level of training of teachers, the remoteness of schools, the low socio-economic and educational levels of families, the non-existent outlets, and the insufficiency of budgetary means.

According to the 1987 census, the adult literacy rate is 18%. In the rural areas, this rate falls to 8%, whilst it reaches 36% in the urban areas. On the other hand, women are very disadvantaged and their literacy rate is estimated at 9%, or 5% in the rural areas and 18% in the urban areas.

These low rates reflect the conjuncture of low attendance rates and very high drop-out rates. However, from 1981 to 1990, school attendance increased by 22.7%, while the actual number of children of school age only increased by 16.7%.

Health

Health indicators put Mali among the world's most deprived nations (World Bank, 1993). In 1984, there was one doctor for every 25,000 inhabitants, far below the average for low-income countries. However, some indicators have shown some progress:

Indicator	1972-6 out of 1,000	1977-81 out of 1,000	1982-6 out of 1,000
Infant mortality	170	156	108
Child mortality	229	185	159
Mortality before age 5	360	311	249

Source : Population and Health Survey, 1987, CERPOD.

These data show a continued decrease of the rates and confirm an improvement in the health sector. However, this general picture can vary depending on the area. For example, the mortality rate before the age of 5 shows the following figures according to the 1987 census: rural areas 202/1,000; urban areas 120/1,000; Bamako 87/1,000.

According to the same source, the gross mortality rate and the life expectancy ratio have shown a perceptible improvement. The mortality rate has fallen from 18 to 12/1,000 and life expectancy has risen from 47 to 56 years.

Employment

The 1987 census estimated the active population at about 44.7% of the total population, distributed as 99.2% employed and 0.8% unemployed. The primary sector alone accounts for 82% of the employed active population, followed by the

handicraft and commercial sectors with 5.4% and 4.7% of the employed active population respectively.

In the rural areas, the primary sector is predominant. In the urban areas, lack of data limits the analysis. However, in the District of Bamako which accounts for 43% of the urban active population, data from the Manpower and Employment Office indicate the existence of an important gap between supply and demand in terms of employment (see Table 13).

At 0.8%, open notified unemployment does not seem to be a serious problem in Mali. However, it is a real problem in the urban areas which register unemployment in the modern sector. The 1987 census reveals 28,218 unemployed compared with 184,746 employed in the modern sector, or an unemployment rate of 13.2%. A recent study of employment in 1993 evaluates this rate at 20%. Therefore, one can say that there has been a deterioration resulting partly from the difficulties of certain public and para-public companies and the competition for recruitment into the civil service.

Just like the other countries of the sub-region, the employment situation in Mali, especially for school-leavers, is very disturbing. The State remains the main employer for those who come out of the educational system with some qualifications. But since the implementation in 1983 of adjustment measures to reduce the number of civil servants, recruitment is limited to a total of 40,000 (25% of the active population). Moreover, this figure is constantly diminishing with the number of voluntary departures from the civil service and their systematic non-

Table 13 **Labour market evolution in the District of Bamako**
Official demand and supply of employment

	1988	1989	1990	1991
Demand registered	6,352	5,230	5,385	6,083
Supply registered	340	402	650	245
Satisfied demand	338	402	650	249
Demand not satisfied	6,641	4,828	4,735	5,938

Source: ONMOE

Table 14 **Number and % of active persons per sector and activity.**

<i>Fields of activity sector</i>	<i>Number of active persons in the sector</i>	<i>%</i>
Primary sector	2,802,722	82.21
Industry	6,483	0.19
Mine	1,524	0.04
Handcraft	182,917	5.37
Construction & Public Works	13,065	0.38
Secondary sector	203,989	5.98
Transport	6,174	0.18
Commerce	158,892	0.66
Services	84,125	2.47
Administration	74,899	2.2
Others	78,447	2.3
Tertiary Sector	402,560	11.81
TOTAL	3,409,271	100

Source: BCR, Economic Activity Analysis, Vol. 3, June 1991, p.40.

replacement. Thus, the agriculture, commerce and handicraft sectors remain the ones which offer most employment opportunities, even though they belong in most cases to the informal sector.

The distribution of the active population in the different sectors of the economy is shown in Table 14.

At 82%, the primary sector plays a substantial role. However its productivity is very low as compared with other sectors, as shown below for value-added per active person in 1986:

Table 15 Employment between formal and informal sectors

<i>Years</i>	<i>1960</i>	<i>1976</i>	<i>1983</i>	<i>1989</i>
Formal	84	38	32	21.8
Informal	16	62	68	78.2

Primary sector	97,505 CFAF
Secondary sector	330,825 CFAF
Tertiary sector	415,250 CFAF

The main feature of the current employment situation is, without doubt, the evolution of the informal sector. This is a sector not controlled by the fiscal administration. It is also called the non-structured sector, and constitutes a safety valve in times of economic crisis. Surveys carried out in Bamako show its importance and rapid evolution (see Table 15).

The informal sector engenders substantial incomes. Official statistics estimate its contribution to GDP at 33%.

Migration

The importance of migratory flows is a major demographic feature in Mali. Thus, between the last two censuses carried out, i.e. in 1976 and 1987, the growth rate has been 1.8% out of a natural growth rate estimated at 3.7%, the remaining 1.9% covering the external migratory flows.

The number of migrants remains controversial due to difficulties in carrying out the census. The 1987 census estimated the number as 24% of the total population. According to the study carried out by CINERGIE (1987), this population is characterised by the following features: males comprise 51.4%; the migrants are young; 65% are under 25 years of age; and the youngest migrants are females.

Internal migrations are more important and are orientated towards the District of Bamako and the cotton-producing zone. The causes of the migrations are: food security (45% of cases) and search for employment and education (41% of the cases).

There are different types of migrations:

Table 16 **Migratory flow by destination**

Countries	1960s	1970s	1980s	1990s	1992 estimate
West Africa					2.5–3.0m
Côte d'Ivoire		353,500	800,000	1,200,000	1,500,000
Ghana	18,000	400,000			200,000
Senegal	.....	.....	25,618	800,000	800,000
Guinea				2,000	
Elsewhere in Africa					
Maghreb	.....	.....	.....	35,000	100,000
Central Africa	.....	.....	.....		500,000
Southern and East Africa	.....	.....	.....		200,000
Europe among which France	.....	....	.....	30,000	80,000
Others	.....	.....		.....	....
TOTAL					3,500,000

Nomadism

This is a way of life of the populations of northern Mali and of some pastoral people whose main activity is cattle-raising. They are on the move depending on the seasons, the availability of pasture and the existence of waterpoints. The ethnic groups concerned in this phenomenon are Fulani, Moors and Touaregs.

The internal migrations

They are of different orders.

Rural migrations towards the urban areas, the rural exodus, have caused the depopulation of the rural areas. The migrants come to the urban centres either seasonally or permanently. They give rise to the overcrowding of urban centres whose total population increases four times more rapidly than normal. The presence of migrants creates a number of problems: high rates of unemployment, growing insecurity, the creation of shanty towns, the problem of professional training and precarious hygienic and health conditions;

Rural migrations towards other rural areas: The drought phenomenon and the availability of arable land explain this type of migration. The migrants move southwards (towards the zone with the highest rainfall) and towards irrigated areas such as that of the Office of the Niger and Sélingué.

The other forms of migration are minor migrations from town to town, and from town to rural area.

An overview shows that most regions have a negative migratory balance, i.e. they receive fewer migrants as compared with those who leave. The district of Bamako and the Sikasso region have a positive migratory balance and can be regarded as immigration zones.

The external migrations

These are very important. Historically, Mali is a country of travellers. However, constraints linked to the structural adjustment programme have certainly played an important role in the emigration of Malians. The main destinations are : Côte d'Ivoire, Ghana, Senegal, Guinea, the Maghreb, Central, Southern and East Africa, and Europe (Table 16).

2.3.2 Measures and programmes of economic reform

During the last two decades, the Malian economy has experienced serious difficulties which have slowed its growth. This situation seems to be closely linked to the implementation of a policy based on the public sector, which has required funding by external debt and by the accumulation of important internal arrears. The result has been an economic imbalance, a marginalisation of the private sector, a poor distribution of resources, and low economic growth. For a landlocked country, the effects caused by the rises in oil prices, the deterioration in the terms of trade and the long, difficult years of drought doubtless explain a large part of these imbalances, but the essence of their origins resides in the implementation of inappropriate economic policies.

Faced with these economic and financial imbalances and the imperative need to resolve them through reform measures, it has been decided since 1980 to implement a series of stabilisation and adjustment programmes aimed at rectifying the economic situation and mitigating the persistent difficulties in terms of the budget, the balance of payments and economic growth. The major programmes implemented so far have been initiated by the IMF, USAID and the World Bank. The objective of these programmes was to:

- reduce the various economic and financial imbalances in the budget and the balance of payments;
- create a market economy through the liberalisation of prices and trade;
- reduce the burden of the parastatals on the economy and the public finances, and improve the economic and financial performance of these enterprises;
- restructure the ODR (Rural Development Operations) by disengaging them from

productive and commercial activities;

- improve resources management in the social sectors in order to increase education and health coverage.

Among the most important measures, the following can be noted

- 1980–85: Launching of reforms in the agricultural field with the start of the restructuring of the cereals market ;
- Implementation of a policy of liberalising the economy, with a rigorous management of public finances;
- 1985–7: A halt in the reform programme due to the effects of the second drought (1983–4) and the collapse of cotton prices on the world market in 1985–6;
- 1987: Fresh negotiations with the Bretton Woods institutions for financial support;
- 1988: Adoption of a mid-term programme covering the liberalisation of the economic framework;
- Rehabilitation of certain financial establishments (BDM);
- Improvement in the efficiency of the management of public resources. This programme was extended to 1991 and received the support of an Enhanced Structural Adjustment Facility (ESAF) funded by the IMF.
- Sectoral Adjustment Programme for State Companies (PASEP);
- 1989: Structural Adjustment Programme with the World Bank covering the following two fields: taxation reform (simplification and elimination of export taxes); improvement of public resources allocation.
- Agricultural Sectoral Adjustment Programme (PASA).

2.3.3. *Socio-economic impact of the measures*

Economic impact

Since 1982 GDP appears to have increased in volume by an annual average of 3%, slightly above the growth rate of the population (2.5%). However, this growth has experienced some fluctuations. Thus: between 1982 and 1987, GDP increased on a yearly basis, to reach 8.4% by 1986, with smaller increases in 1985 (1.3%) and 1987 (1.2%). After a fall in 1988 (-0.2%) and a sharp rise in 1989 (11.8%), it stagnated in 1990 (0.4%) and fell in 1991 (-0.6%), going up again by 8.1% in 1992.

These fluctuations are mainly due to changes affecting the activities of the primary sector (agriculture, livestock, fishing, etc). In the field of agriculture, between the 1985–6 and 1992–3 seasons, cereals production increased by 9% per year, with the production of paddy increasing twice as rapidly as this. Cotton seed production increased by 11% per annum during this period.

As for exports, the prices and terms of trade suffered a deterioration during the 1982–93 period, in fact a negative growth of -0.65% and -1.8% respectively.

Over the same period, consumption per capita fell by an average of 1.04% per

year in real terms (1987 prices). However, this trend was interspersed with periods of positive growth, varying between 2.8% and 10% between 1982 and 1985, with a negative growth fluctuating between -7% and -2.5% between 1986 and 1988. A positive growth of 6.3% in 1989 was followed by almost nil growth in 1990, a substantial growth in 1991 of 4.1%, and a negative growth in 1992 of -6.3%. Consumption exceeded GDP in 1985 and 1986 (in nominal terms) and represented 93.6% of the aggregate in 1987 and 94.4% on average during the 1988–90 period. It went above this average in 1991 (99.7%) and reached 100% in 1992 and 1993 (Ministry of Economy and Finance, 1993).

Gross Domestic saving (in nominal terms) was negative in 1985 and 1986, and represented on average 5.6% of GDP between 1988 and 1990. In 1991 it went below this level before again becoming negative in 1992 and 1993. On the other hand, the average investment rate was 17.4% between 1982 and 1986 improving to an average of 21.4% from 1987–90 (*ibid.*)

According to the same source and during the same periods the GDP deflator increased on average by 2.4% per year, with positive growth between 1982 and 1985 and again between 1990 and 1991, and negative growth between 1986 and 1989 and again in 1992. The consumer price index for households in Bamako registered a negative growth of -0.16% in 1989 and -5.82% in 1992, with a positive one of 1.62% in 1990 and 1.49% in 1991. Liberalisation of fuel prices has brought a fall in the price of petrol at petrol stations.

The private investment rate reached 17.1% in 1989 and 16% in 1990 and then fell to under 10% in 1991 and 1992. During the 1988–90 period, 31 private industrial companies were created (*ibid.*).

Development aid increased from US\$ 215 m. in 1983 to US\$ 321 m. in 1984, an increase of 43.3%, and then by 17.1% to reach US\$ 376 m. in 1985. Thereafter it fell to US\$ 372 m. in 1986 and US\$ 366 m. in 1987, going up again in 1988 to US\$ 421 m. and US\$ 467 m. in 1990. According to the 'Economic and Financial Policy Framework' for 1992–5, external financial assistance in donations and loans, including debt reduction and the moratorium on debts vis-à-vis China and the former Soviet Union, should amount to some CFAF 595 billion during the 1992–5 period.

The global budget deficit in absolute value and as a percentage of GDP was reduced year by year from 1986 to 1990. It went from CFAF 66 bn and 11.7% of GDP, to CFAF 57.6 bn and 8.4% of the GDP in 1990. Though these figures increased in 1991 following the loss in revenues caused by the destruction of equipment and administrative facilities in the political upheaval of March and the slowing down of economic activity, the deficit as a percentage of GDP (12%) has remained below that scheduled (13.4%). This figure was reduced to 11.4% in 1992 but has been all the time above that scheduled (10.7%). This is mainly due to the fact that the performance criteria on revenues at the end of December 1992 could not be met, the level of revenue having been lower than CFAF 11 bn as compared with that scheduled, as a result of difficulties encountered in the recovery of revenue and the abolition of the per capita tax as well as problems of implementing VAT. As for expenditures, they remained below the planned level.

The overall balance of payments, which was negative between 1981 and 1986, has been positive since 1987, with a peak in 1991 of CFAF +38.7 bn. However, this achievement remains fragile, since it remains linked to the continuing inflow of aid and transfers in kind.

Social measures

The government's strategy for dealing with the social aspects of the adjustment programme aims to ensure an economic development which affects the greatest number. For this, it intends to implement long-term programmes aimed at the development of human resources. Social protection measures for laid-off workers have been set up in the short term to include: redundancy payments, funds to start up small projects, and retraining; for those taking voluntary retirements departure bonuses; assistance for project preparation; funds guaranteeing loans contracted from primary banks to cover 50% of the principal on loans granted by the World Bank and 25% of the principal on loans financed by the African Development Fund (FAD); and the signature of a tripartite agreement between the State, the banks and insurance companies in order to facilitate access to bank credit for those leaving the civil service voluntarily.

3. Analysis of the impact of structural adjustment on the economy and the environment: case studies

3.1 Introduction

In line with the terms of reference for this study of structural adjustment and sustainable development, different case studies have been conducted to achieve the stated objectives. These studies are related to the following fields: cotton cultivation in the CMDT zone; rice cultivation in the zone of the Office of the Niger; pastures in the Sikasso region.

3.2 Case study: cotton

For this case study, the data collected relate to the following aspects: the symptoms of change in the environment, the immediate causes and the determinants of these changes, sectoral policies affecting cotton cultivation and the evolution of macroeconomic policies.

The CMDT region is well placed for interpreting these changes because of the long history of cotton cultivation in this zone and the importance of cotton in the national economy.

As regards the main objectives of the study, data have been collected at different levels: the CMDT management structure, farmers' organisations, the administration and certain NGOs involved in the development of the zone. In addition to interviews, the existing data and documents were examined in order to deal with the different issues. Questions relating to macroeconomic policy were examined with officials at the CMDT head office. As for the management structures, village associations, and credit agencies, discussions covered land use, population growth, institutional aspects and sectoral policy.

3.2.1 Results of the study

The CMDT (Malian Textiles Company) was set up in 1972, after the departure of the French textile company (CFDT). The CMDT is a joint venture of the Malian company and the CFDT. Its actions are oriented on the production and marketing of cotton and it has the monopoly in cotton marketing.

Within the structural adjustment framework, it has been judged necessary to refocus the activities of the CMDT on its main task: cotton production, to the detriment of other crops and activities it used to perform – sesame, dah, soya and livestock. The processing of cotton seeds into oil and cattlefeed has been assigned

to an independent company (HUICOMA). The present case study relates to the CMDT region of Koutiala.

The CMDT region of Koutiala is located astride the two administrative regions of Sikasso and Ségou and comprises 3 *cercles* (Koutiala, Bla and Yorosso). With an area of 23,561 km², the population of this zone is estimated at 456,000 inhabitants or a density of 19.3 per km² in 45 villages.

The region has two road axes that favour the development of trade (Bla-Koutiala-Sikasso and Sikasso-Koutiala-San). Several activities have been developed within the framework of the whole zone, among them the organisation of the local population, the use of intermediate technology, cattle-raising activities, and the production, above all, of cotton and dry cereals. Furthermore, the region is starting light industrialisation (flour-mills, threshers, shea-nut mashers and cotton-shelling machines) that will have a definite impact on the area. In the light of the team's investigations, the main observations and trends observed in the field cover the following:

Land situation

As regards soil fertility, Koutiala is currently experiencing an over-exploitation of land due to demographic pressure, overcrowded pastures, cropping practices and desertification. In fact, the drought has led a great many people to settle in this zone. This situation has led to:

- land degradation in the region, resulting in the stagnation of yields of the main crops. Generally speaking, the lands in the zone are subjected to over-exploitation, unaccompanied by compensatory measures such as organic fertilisation, and anti-erosion measures;
- a high erosion rate in the zone. All forms of erosion (hydric and eolian) are present. A soil restoration project and the Department of Farming Systems Research have worked out guidelines to combat soil degradation;
- a system of cotton-cereal-cotton rotation that impoverishes the soil to the extent of leading to the abandonment of certain areas. According to the technical adviser of the soil restoration project, 36–40% of marginal land is used. This reflects the scarcity of good land in the zone.

The poor state of the land has reached such a level that, despite the use of inputs (organic manure and chemical fertilisers), there is a stagnation in cotton yields. Indeed, areas under cotton have increased in this zone from 13,997 ha in 1960–61 to 63,042 ha in 1993–4. Over the same period yields increased from 263 kg to 1,256 kg/ha. It is to be noted that since the 1975–6 season, cotton yields have remained stationary at around 1,100 kg/ha. (See Table 18).

The overall situation is as follows: good arable land does not exceed 35% of the land available in the zone. Earnings from cotton have led farmers not only to increase their area but also to use marginal land, which has resulted in very rapid degradation. Another strategy of the farmers is to occupy all the land they possess under customary law so as to prevent other farmers from taking it over.

Nowadays, fallows are practically non-existent in the cropping practices of the

zone. Where they have been noticed, they have been of short duration (one to two years).

Inputs and agricultural equipment

Up to now, structural adjustment has brought no substantial change in the supply of inputs. However, the process of farmers' involvement started in 1972, according to which Village Associations (VA) have become CMDT agents in the supply of inputs and agricultural equipment, financing, and cotton collection and purchase. More than 90% of the villages have formed VAs in the CMDT zone. In 1987, the National Bank for Agricultural Development (BNDA) became responsible for the purchase of cotton and the provision of credit for inputs and agricultural equipment for the VAs. Analysis of the current situation shows a strong involvement of private operators in the supply of inputs and equipment, among them the: SMPC (Malian Chemical Company), SMECMA (Agricultural Research and Equipment Company), a workshop in Koutiala (for ploughs, seeders, carts) and blacksmiths' associations. The last two have made a considerable impact because of the high prices charged for the equipment by the larger companies.

The rainfall and hydrological situation

Incomes in the CMDT zone of Koutiala are dwindling because of soil erosion and degradation of the environment. A reduction in the rainfall in the zone has been observed for some time varying from 950 mm to 750mm. This has led to a fall in the groundwater often caused by the over-digging of wells and the drying-up of ponds and streams during the dry season (January to May).

**Table 17 Evolution of the population in the CMDT
zone of Koutiala**

<i>Years</i>	<i>1988/89</i>	<i>1989/90</i>	<i>1990/91</i>	<i>1991/92</i>	<i>1992/93</i>	<i>1993/94</i>
Total Population	455,907	455,907	455,907	483,450	484,231	447,800
Population covered by the study	414,180	414,180	423,442	472,564	472,564	435,363

Table 18

Cotton-seed production 1960 CMDT/Koutiala

<i>Years</i>	<i>60-61</i>	<i>61-62</i>	<i>62-63</i>	<i>63-64</i>	<i>64-65</i>	<i>65-66</i>	<i>66-67</i>	<i>67-68</i>	<i>68-69</i>	<i>69-70</i>	<i>70-71</i>	<i>71-72</i>	<i>72-73</i>
Area (ha)	13.997	21.196	23.734	24.680	28.155	27.465	18.815	27.998	31.546	29.616	28.662	31.307	31.299
Product. (Tons)	3.681	3.307	5.880	8.195	11.815	7.925	8.498	12.500	17.121	17.533	21.900	26.438	29.500
Yield (kg/ha)	263	156	248	332	420	289	452	446	543	592	764	844	944
<i>Years</i>	<i>73-74</i>	<i>74-75</i>	<i>75-76</i>	<i>76-77</i>	<i>77-78</i>	<i>78-79</i>	<i>79-80</i>	<i>80-81</i>	<i>81-82</i>	<i>82-83</i>	<i>83-84</i>	<i>84-85</i>	<i>85-86</i>
Area (ha)	29.447	29.344	35.101	44.320	46.703	51.626	52.417	45.095	37.837	48.609	50.833	50.050	58.627
Product. (Tons)	20.300	25.500	41.000	52.200	53.125	52.291	62.033	48.260	46.567	61.587	65.678	56.059	68.100
Yield (kg/ha)	689	869	1.166	1.256	1.155	1.013	1.183	1.071	1.231	1.267	1.192	1.120	1.110
<i>Years</i>	<i>86-87</i>	<i>87-88</i>	<i>88-89</i>	<i>89-90</i>	<i>90-91</i>	<i>91-92</i>	<i>92-93</i>						
Area (ha)	59.046	51.536	69.283	61.241	66.342	68.614	79.744						
Product. (Tons)	75.822	62.379	84.928	70.791	90.777	84.608	106.159						
Yield (kg/ha)	1.285	1.210	1.226	1.156	1.368	1.232	1.331						

The population of the zone

The population covered by this study has varied from 414,180 inhabitants in 1988–9 to 435,363 in 1993–4. This increase can be explained by the high natural birthrate, but also by the displacement of population from the 5th region into this zone during difficult drought periods. The situation is summarised in Table 17. Finally, it is to be noted that the rate of school attendance in the region is 28% for 1993–4. The number of schools has risen from 48 in 1981–2 to 109 in 1993–4.

Immediate causes of the changes

- Increase in the cultivated areas: with the introduction of intermediate mechanisation and the development of animal traction in this CMDT zone, the cultivated area has increased considerably. This situation has been marked by the clearing of new land which is often less fertile and the intensification of cultivation (of millet/sorghum and maize). An inadequacy of the cropping system with the use of marginal land has been observed, and this results in most cultivable land being taken up.
- Degree of land use: land is overexploited and, despite the use of fertilisers and organic manure, soils are degraded. Indeed, the rotation of cotton and cereals rapidly exhausts the soil and its reproductive capacity. The phenomenon of soil degradation has been described in the 1992 Long-Term Plan for Agricultural Research. Soil losses have been estimated at more than 10 ton/ha/year in southern Mali, compared with a national average of 6.5 tons/ha/year. This is essentially due to water erosion and the abusive use of certain equipment. To the problem of erosion can be added the loss of organic matter and mineral elements. All these factors translate themselves into a fall in yields under continuous cropping.

It should be noted that the zone has become a very important pole of attraction for migrants. This has favoured the use of marginal land. Furthermore, the techniques applied in terms of cropping are not adapted to this kind of land, which is also affected by the pressure from grazing animals which is increasing by 5% per year.

3.2.2 Determinants of change

- Cotton price : since 1985, the price of cotton has not changed perceptibly at the farmer level. This guaranteed and remunerative price (CFAF 85/kg) encourages farmers to use the major part of their land for cotton production.
- Prices of substitutes : the substitute for cotton production is cereal production. With the liberalisation of the market, cereal prices depend on the law of supply and demand, which is not the case for cotton. The price for millet/sorghum varies from CFAF 30 to 45 per kg and for maize from CFAF 20 to 35 per kg in a normal year.
- Input prices: a staggering increase in input prices has been noted since the January 1994 devaluation, despite efforts made by the CMDT. However, this has

not been compensated by an increase in the price of cotton.

3.2.3 Institutional measures

- As regards land management, customary chiefs (village chiefs or their representatives) are the ones who look after land distribution to outsiders.
- Training the local population is the responsibility of the CMDT extension service, the Women in Development project, BNDA and Kafo Djiguinè, etc.
- Up to now, decentralisation has not been put into effect in the zone. The credit system is looked after by CMDT and the Village Associations.
- Village Associations play the key role in the sale of inputs and agricultural equipment, and in the recovery of credit. They also participate in the purchasing, stocking and resale of cereals thanks to the credit system of the cereals market restructuring programme (PRMC).

It is noteworthy that the demographic pressure has increased in recent years in the south due to more favourable climatic conditions than in the north of the country, (leading to a displacement of farmers and cattle breeders towards the south). Other factors are the security situation, and the development of activities in the secondary and tertiary sectors on the one hand, and the development of health centres, and education, on the other; (indicators: population growth rate: 25%; school attendance rate: 52% in 1993–4).

- The zone of Koutiala has a higher standard of living than the average for the whole country.
- Several activities which used to be carried out by officials are now done by farmers through Village Associations. Thus, the VAs express their needs and the CMDT supplies the required inputs, and then recovers the costs after the products have been sold; only the technical training and advice activities are carried out by the CMDT.
- At the level of the land ownership system, a clear evolution has taken place in the way lands are managed and distributed. With the ideals of decentralisation, the local communities have begun to want to lay their hands on all the land in their possession (wood cannot be cut in the bush as before).
- To these internal factors, one has to add some external factors, among them the following: the effect of insecurity in the north of the country which has led to a mass displacement of population and their goods towards the south, and the proximity of the zone to Burkina Faso and Côte d'Ivoire which makes it a very important crossroads.

3.2.4 Sectoral policy

The fixing of cotton prices: the price of cotton has gone up from CFAF 45/kg to CFAF 75/kg and, since 1985, has been fixed at CFAF 85/kg. This freezing of the price paid to cotton producers would seem to be the cause of the setting up of a

system of rebates in order to compensate farmers. This system, adopted by the CMDT, is not at all understood at the farmer level.

The current credit system in the CMDT relies heavily on the VAs. As noted in the previous section, they express their needs and the CMDT supplies what they require and then recovers the cost after the purchase has taken place. The credit is not reimbursed with interest, and best of all, the inputs and equipment used to be subsidised. Today no credit is subsidised (credits are granted by the financial institutions such as the BNDA, Kafo Djiguinè, etc.) and as of this year, credits have to be repaid with interest.

Specific support projects have been elaborated in order to improve cotton production. These support projects are attached to the CMDT (Soils Defence and Restoration Division and the Rural Management project). This Division aims essentially at controlling erosion and soil degradation. The Rural Management project supports the VAs in order to improve the management of funds granted by the financing structures. As Table 18 shows for cotton yield, three main periods can be identified: levels were low from 1960 to 1970 (between 156 and 192 kg/ha) with fluctuations. From 1971 to 1975 they moved from 689 to 869 kg/ha, a situation linked to the level of equipment used and the introduction of new technologies. Finally from 1976 to 1993, they reached their peak, varying from 1,100 to 1,300 kg/ha. The overall level of production has grown due to the number of villages in the zone and the increase in cultivated area (see Graph 1).

From the 1986-7 season to that of 1989-90, the price of inputs remained frozen (Table 19). The variations observed from 1990-1 to 1994-5 are summarised in Table 20, which indicates a substantial increase in input prices during the 1994-5 season. This is due to the effects of the devaluation of the CFA franc, which led to a rise in the prices of imported products.

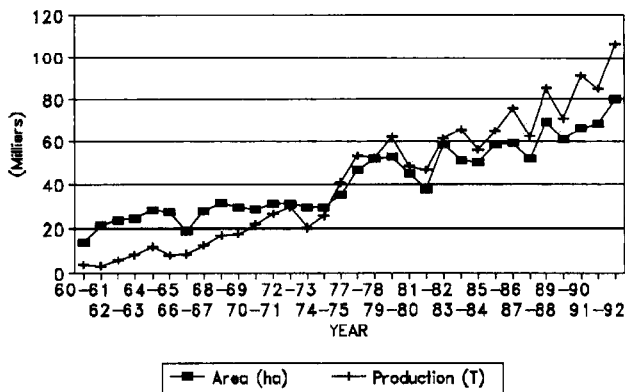
3.2.5 Conclusion

The structural adjustment programme introduced in the 1980s aimed at reversing the economic deterioration, notably the government budget deficits, through measures taken to alter the production structure and produce more tradeable goods in big quantities. Generally speaking, attention was focused on efforts aimed at improving agricultural growth and production, with production incentives playing an important role.

With regard to the production of cotton in the Koutiala zone, the SAP (with a cohort of measures which followed from it) has meant an increase in the cost of inputs for farmers and made the purchase of equipment and traction animals more difficult with the elimination of long- and medium-term credit. These increases have not been compensated by a proportional increase in the price of cotton. Moreover, public expenditure cuts have led to the cancellation of several extension programmes which benefitted the farmer. The liberalisation of the cereals trade in the zone did not lead to an increase in producer prices. In fact, farmers felt more secure investing in the production of cotton which offered a minimum guarantee.

Graph 1

Evolution of the area and production of Cotton from 1960 to 1993



This had the consequences of: a reinvestment by farmers of earnings from the sale of cotton in cattle; a bigger occupation of land by cotton; a migration of population from the north into the zone.

These different components are not without consequences for the environment. Thus, one can currently observe a pronounced degradation of land in the zone, with the growing number of farms and the occupation of marginal lands, a reduction in the period of fallow, and over-grazing.

However, the effects of the structural adjustment are not simply negative; one can sense a greater responsibility on the part of farmers in the management of their assets (with the disengagement of development institutions from certain activities).

3.3 Case study : rice in the zone of the Office of the Niger

The Office was officially set up in 1932 following primary studies conducted by the French engineer Emile Belime from 1919 to 1925. The objective was to irrigate 950,000 ha in the river Niger's central delta. This area was to be used to produce cotton on 500,000 ha and rice on 450,000 ha.

Table 19 **Evolution of input prices in the CMDT zone of Koutiala (1978/87) (CFAF)**

<i>Descriptions</i>	<i>1978-79</i>	<i>1979-80</i>	<i>1980-81</i>	<i>1981-82</i>	<i>1982-83</i>	<i>1983-84</i>	<i>1984-85</i>	<i>1985-86</i>	<i>1986-87</i>
Cotton compound fertiliser(kg)	63.50	72.50	105	105	105	105	115	140	155
Cereal compound fertiliser (kg)	60	65	102.50	102.50	102.50	102.50	105	135	145
Urea (kg)	20	20	25	25	25	25	25	25	30
Tilemsi phosphate (kg)					105	105	115	140	155
DAP (kg)							37.50	37.50	47
Super simple phosphate (kg)	60				102.50	102.50	105	135	125
Potassium sulphate (kg)	1250	1250			1100	1100	1100	1100	1100
Boracine (kg)	550	600	850	850	850	850	850	1000	1000
Cotton pesticide (l)	1950	1950	2000	2200	2200	2200	2200	3090	3090
Cotton herbicide (l)	1300	1300	1300	1300	1300	1300	1300	2295	2450
Maize weed-killer (l)								3305	3305
Rice weed-killer	1000	1000	1000	1000	1390	1390	1390	1390	2865
Cotton fungicide (kg)					1000	1000	1000	1000	2000
Cereal fungicide (kg)	350	350	350	350	350	350	350	350	1750
Groundnut fungicide (kg)	44400	44400	44400	44400	44400	44400	44400	44400	54000
Linda powder (kg)	26435	26435	26435	26435	26435	26435	26435	26435	35000
Multi-plower	29005	29005	29005	29005	29005	29005	29005	29005	51225
Plough	20000	20000	20000	20000	20000	20000	20000	20000	22500
Seeder	35530	35530	35530	35530	35530	35530	35530	35530	22735
Harrow								28275	28175
Tap 1,000 kg	11680	11680	62500	62500	62500	62500	62500	62500	62500
Assine Hoe	7635	7635	7635	7635	7635	7635	7635	7635	9970
Star Hoe	7590	7590	7590	7590	7590	7590	7590	7590	14620
App. ULV. Cotton	16200	16200	16200	16200	10000	10000	10000	10000	10000

The development of the land took place between 1934 and 1947. In 1959, 54,000 ha were allocated of which 44,000 ha are currently exploited for rice-growing activities. Today, the Office of the Niger contributes nearly 60% of the national production of rice in Mali.

Located in the southern sahelian zone between latitudes 13°50' and 14°55' North and astride the meridian 6° West, the Office of the Niger region has a climate characterised by a long dry season (8 to 9 months) and a short rainy season (3 to 4 months). The average annual rainfall is around 475 mm in the north and 572 mm in the south at Niono. The average annual temperature oscillates between 22°C in December–January and 32°C in May, with maxima exceeding 40°C.

Following some technical problems with drainage and parasitism, cotton cultivation was progressively abandoned in favour of rice up to 1970 when it was abandoned completely.

The sugar cane introduced in 1965 was under the Office's management. In 1984, the sugar cane areas were separated from the Office to constitute the sugar complex of the Upper Kala (SUKALA), whose management is jointly shared with Chinese personnel.

Data for this study, covering the same issues as for the cotton case study, were collected from the Office of the Niger at Niono, the BNDA, the FDV, and farmers.

Environmental changes

As regards the problem of fertility, the most striking aspect in the zone is the salinisation of the land (especially in the Rétail) due to the increase in mineral elements arising from irrigation. Indeed, at the time of the creation of the Office of the Niger the groundwater was situated between 30 and 50 metres deep, whereas nowadays it is 1 metre and sometimes even less (ON Development Research Study, 1992). This rise of the groundwater would seem to be partly responsible for the start of the process of alkalinisation and sodisation which could jeopardise agricultural production. Thus, the following observations have been made: a sharp increase of PH up to 9; a sharp increase in the percentage of exchangeable sodium; white saline efflorescence (sodium sulphate : thenardite) or black (calcium carbonate: trona); patches of soil infertility.

Research conducted since 1980 has proved that the soils are undergoing degradation (sodisation and alkalinisation) ; this has been confirmed more recently (Keïta and Bertrand, 1991). This phenomenon leads to a dispersal of the clay, soil compacting and a reduction in permeability and porosity. Work conducted in Kolodougou (Niono) in 1986 and 1987 indicates that 75% of the soils are affected by sodisation and/or alkalinisation.

As regards erosion, the soils are either Moursi or Dian or a combination of both. During recent years periodical maintenance, because of silting up, has been carried out at the rice-racks. This is due to the lack of a protective hedge for the managed areas and the abusive exploitation of the land which makes it very fragile.

As for desertification, the phenomenon is found at two levels: vegetation and soil. At the level of the vegetation one can notice the disappearance of large trees

Table 20 **Evolution of input prices Koutiala**
/CMDT zone (1989/95) (CFAF)

<i>Descriptions</i>	<i>Season</i>					
	<i>1989/90</i>	<i>1990/91</i>	<i>1991/92</i>	<i>1992/93</i>	<i>1993/94</i>	<i>1994/95</i>
Cotton compound fertiliser (kg)	155	120	120	120	120	160
Cereal compound fertiliser (kg)	115	105	105	105	105	150
Urea (kg)	145	105	105	105	105	80
Tilemsi phosphate (kg)	30	30	30	30	30	-
Cotton weed-killer (l)	1000	1000	1000	1000	1300	2275
Cotton weed-killer (l)	3090	3090	3090	3090	3090	3915
Maize weed-killer (l)	2450	2450	2450	2450	2450	3640
Rice weed-killer (l)	3305	3305	3305	3305	3305	3270
Cotton fungicide (kg)	2865	2865	2865	2865	2865	9915
Cereal fungicide (kg)	2000	2000	2000	2000	2000	-
Groundnut fungicide (kg)	1750	1750	1750	1750	1750	-
Multi-cultivator	32400	32400	32400	32400	32400	32400
Plough	21000	21000	21000	21000	21000	21000
Seeder	51250	51225	51225	51225	51225	51225
Harrow	22500	22500	22500	22500	22500	22500
Hoe	28175	28175	28175	28175	28175	28175
ULV. Cotton application	9970	9970	9970	9970	9970	9970

which are giving way to shrubs (most of all in parts where water has receded). This is due not only to the lack of rain but also to population growth. Soil is becoming increasingly fragile and poor. This is attributed to the continuous exploitation of the same plot and the lack of sufficient contribution to maintain the soil structure and texture.

Certain land-use practices are non-sustainable. In the zone there are managed and non-managed areas. Within the latter, water is not totally controlled and the farmer is not constrained to respect methods recommended by technical advisers. Thus, the disregard of these methods leads to land degradation. Furthermore, it needs to be stressed that, even in the managed zones, levelling and drainage remain deficient. However, one has to admit that, with the Office's disengagement from the supply of certain products to farmers, this has brought some beneficial results. Liberalisation at this level equally has some negative aspects, because some agro-chemicals now being traded are of suspect origin and efficacy.

The immediate causes of change

From the creation of the Office of the Niger to the present day changes have taken place at several levels: increase in cultivated area, use of marginal land, greater intensification of rice-growing, evolution in the use of agro-chemicals, introduction of new technologies and cropping techniques, etc.

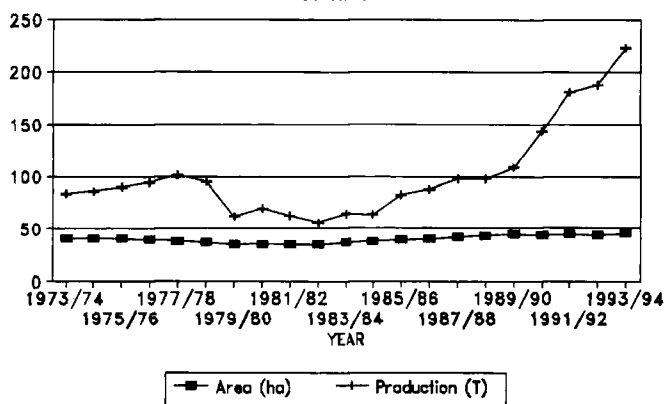
On the basis of data collected on areas exploited from 1973 to 1993, two trends are discernible (Table 21 and Graphs 2 and 3 below): a trend towards the reduction

**Table 21 Rice production and yields in the zone of the
Office of the Niger 1974/93-94**

<i>Seasons</i>	<i>Cultivated Area (ha)</i>	<i>Average Yield (ha)</i>	<i>Production (T)</i>	<i>Paddy sold by the Office of the Niger</i>
1973/74	40.139	2,071	83.128	54.862
1974/75	40.774	2,109	86.000	65.000
1975/76	39.916	2,254	90.000	63.880
1976/77	39.567	2,385	94.400	65.500
1977/78	37.946	2,662	101.000	58.044
1978/79	36.557	2,899	95.000	52.297
1979/80	35.104	1,775	62.314	50.756
1980/81	35.589	1,977	69.290	50.668
1981/82	34.802	1,780	62.801	47.450
1982/83	35.181	1,607	56.524	43.796
1983/84	36.920	1,751	64.663	43.148
1984/85	38.154	1,680	64.086	45.562
1985/86	39.433	2,100	82.957	54.111
1986/87	39.910	2,205	88.011	49.672
1987/88	42.125	2,346	98.194	47.522
1988/89	43.352	2,253	97.796	64.939
1989/90	44.251	2,411	108.593	50.794
1990/91	43.872	3,280	143.938	18.158
1991/92	44.435	4,071	180.909	41.521
1992/93	43.700	4,300	187.910	25.000
1993/94	45.600	4,900	223.400	10.000

Graph 2

Evolution of the area and production of Rice



of exploited areas from 1973 to 1981; and a trend towards the expansion of exploited areas from 1982 to 1993.

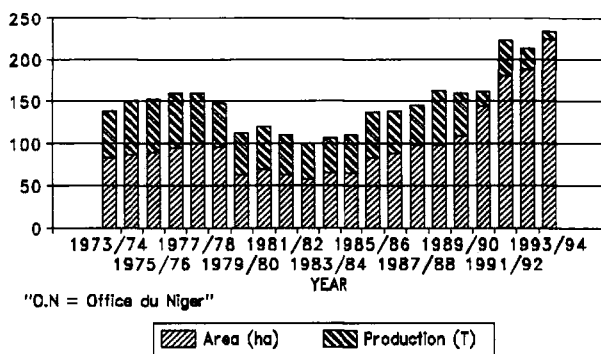
The first period, during which areas were on the decrease from 40,139 ha in 1973 to 34,802 ha in 1981, corresponds to the times of the great drought, on the one hand, and the degradation of the irrigation network due to insufficient maintenance, on the other. During this period, exploited areas diminished by 13.29%, whereas during the second period, running from 1982 to 1993, one can notice an expansion of 29.61%. This growth can be explained by the start of different allocations made at the ON and the installation of more secure conditions (the Rétail project, ARPON, World Bank, EDF).

Areas have been reallocated, taking into account the number of Agricultural Production Units and male workers per APU. With distribution being made on the basis of these two variables, farmers are not able to increase their areas as they wish. Thus, the newcomers and the original population wishing to obtain extra areas are obliged to limit themselves to the unallocated areas which are usually marginal lands. Market gardening and fruit growing are also practised on marginal land.

The reallocation has led to the practice of double cropping. Thus, farmers installed in the reallocated zones apply all the recommended cropping techniques

Graph 3

Total production of rice and total quantity commercialized at the O.N.



in order to obtain the expected yields. In fact, one can observe an increase in the use of organic fertilisers (at a still low rate) and chemicals, which has led to an increase in average yields. As a result, it can be said that from 1981 to 1993 yields have almost tripled (1,775 t/ha in 1981 compared with 4,900 t/ha in 1993).

This increase in yield is attributable to the new technologies of levelling and partitioning of fields and the application of new cropping techniques, such as use of fresh seeds, thinning out and replanting, and the use of fertiliser and chemical products.

Despite the problem of alkalisation and sodisation already noted, one can generally observe a growth in yields. This situation is especially due to the permanent availability of water and the application of a number of cropping techniques adapted to the zone. However, the long-term effects of such a phenomenon may well be negative for rice production.

Thus, replanted areas (Table 22) have increased from 2,859.5 ha in 1990 to 8,123.6 ha in 1993 in Niono, or an increase of 184%. As regards the equipment, the number of ploughs has increased by 19.34% from 1990, by 9.13% for harrows, 30.57% for carts and 12.55% for oxen over the same period.

Table 22 **Evolution of replanted areas and equipment in Niono zone.**

<i>Years</i>	<i>1989-90</i>	<i>1990-91</i>	<i>1991-92</i>	<i>1992-93</i>
Replanted areas (ha)	2,859.5	2,085.06	5,088.35	7,746.4
Ploughs (Number)	2,569	2687	2,713	3,066
Harrows (Number)	1,893	2104	2,116	2,066
Carts (Number)	1,293	1368	1,376	1,691
Oxen(Number)	5,495	6306	6,355	6,185

3.3.1 Determinants of change

The 1992-3 season was characterised by the continuing growth of paddy production (208,541 tons) to the point that the fall in the producer price at the time and the selling at a loss recorded in 1992 in no way affected the intensification process. Analysis of the evolution of yields (Table 23) indicates a continued trend in terms of growth in the reallocated areas, whereas results were slightly diminishing in the non-reallocated areas.

Up to the time of the devaluation of the CFA franc, the main problem facing rice-growing was the fall in producer prices. In 1992, the price of rice on the market in Niono reached CFAF 85/kg, whereas paddy was traded at about CFAF 55/kg. This fall in price seems to be strongly related to the massive imports authorised by the administration. Thus, in 1991 nearly 100,000 tons were imported, a figure representing almost half the production of the Office of the Niger. Coverage of national needs depends above all on the 'fluctuating component' in national production, that corresponding to rain-fed paddy, and traditional flood-recession methods. Table 24 shows the trend in national production, indicating the part played by the Office du Niger.

At the Office of the Niger farmers have access to seasonal loans for their agricultural inputs, medium-term credit for livestock equipment, and can benefit from different forms of assistance. These payments and credits used to be reimbursed in kind from their harvest. Any unpaid credit was carried over to the following season. Thus, in some cases farmers accumulated such high levels of credit that they were pushed into a situation of survival production.

Currently credit activities have been assigned to the BNDA and the FDV. The

Table 23 **Evolution of yields per zone (t/ha)**

<i>Years</i>	<i>Reallocated zone off-season</i>	<i>Total for the 2 seasons (double cropping)</i>	<i>Non- reallocated zone</i>
1986	-	-	1.7
1987	2.8	5.0	2.4
1988	2.7	5.7	1.8
1989	2.7	5.9	2.5
1990	4.0	7.7	4.2
1991	3.9	8.0	4.1
1992	4.0	8.6	3.9

Source: CIRAD - SAR N° 43/93

VAs sign loan contracts with the financial institutions and repay them at the end of the season in cash. Thus a channel of informal credit exists whose contents are not yet clearly delineated. This merits further study to achieve a better integration of the activities of the different institutions.

The continued growth of the population (Table 25 indicates the situation in Niono) in the zone, as a result of improvement in living conditions and the immigration has led to an increase in the labour supply.

As regards health and education, the VAs build literacy and health centres and schools, and manage to finance the training and employment of first-aiders and teachers in the villages. Some VAs have been able to build warehouses, mosques, and sheds and to bring about the electrification of their villages, as is the case up to 26km.

Generally speaking, the development of rice-growing in the zone and the use of untreated irrigation water are the origin of certain diseases, notably malaria, bilharzia, etc. The National Institute for Research into Public Health is conducting investigations in order to measure the importance of health problems.

3.3.2 Legal and institutional determinants

In the past, the Office of the Niger used to perform several activities in addition to agricultural production. This impeded the realisation of its great potential. In

Table 24

**Contribution of the Office of the Niger in
national rice production ('000 tons)**

<i>Years</i>	<i>81/82</i>	<i>82/83</i>	<i>83/84</i>	<i>84/85</i>	<i>85/86</i>	<i>86/87</i>	<i>87/88</i>	<i>88/89</i>	<i>89/90</i>	<i>90/91</i>	<i>91/92</i>	<i>92/93</i>
Other zones	73	97	141	44	102	161	137	197	227	139	264	224
O.N	62	56	75	65	83	88	100	91	111	144	181	200
TOTAL	135	153	216	109	185	249	237	288	338	283	445	424

Source: ON/DNA/PRMC.

Table 25 **Changes in the active population in the Niono zone.**

<i>Years</i>	<i>Number of families</i>	<i>Total population</i>	<i>Active population</i>
1989 – 90	1,937	22,898	13,352
1990 – 91	2,088	25,089	16,367
1991 – 92	2,235	25,440	16,524
1992 – 93	2,348	29,470	19,812

Source: Demographic and Equipment Report, Office du Niger 1993.

1993, the government decided to undertake a restructuring of the Office of the Niger and to limit its tasks to the following: supervision of work assigned for studies and works control; maintenance of land allocations; management of water; and technical advice on farming.

This refocusing of the ON's tasks implies that the new structure will disengage itself from all activities which are not part of its mandate: i.e. the purchase and processing of paddy, the sale of rice, new rehabilitation or maintenance operations with regard to allocations, agricultural credit, assembly of agricultural equipment, seeds production, management of reception centres, road and river transport, livestock, exploitation of orchards, and the management of the electric power station, of garages and of a training centre.

Besides structural reforms, in conformity with the general objectives of the policy of decentralisation and of popular participation, the government pledges to associate the users of the irrigation and drainage networks with the effective control of the costs of the maintenance of these networks for which they pay rent. It also pledges to delegate to associations the attribution and management of allocated plots and the surrounding land and to improve the land-tenure status of the growers (Presentation of Principles, Modality and Schedule of the Restructuring of the ON, 1993).

The trade in rice, which used to be carried out through the Office of the Niger, has been liberalised since the 1985/6 season. According to studies conducted by IER, 80% of growers are satisfied with the trade liberalisation. However, confronted by the coalition of private traders, some needy growers are forced to sell their product off cheap. This phenomenon is aggravated by the inadequacy of storage capacity, of weighing equipment and of financial resources at the local

level, as well as the limited intervention of the ON.

As regards physical determinants, there was a general reduction in rainfall from 1975 to 1993. However, this low level of rainfall does not significantly affect production, particularly in the managed areas. Thus, in 1991, despite a rainfall of 607. 7mm, the yield was 4,071 t/ha as compared with 4,900 t/ha in 1993 when a rainfall of 311. 5mm was recorded. (Table 26 shows the situation in the Niono zone).

3.3.3 Sectoral and macroeconomic policy

The fixing of the paddy price, which used to be done by the State, has become free since 1985/6. Parallel with sales by producers, we are now witnessing a greater participation by Village Associations in the marketing of paddy rice.

As regards agricultural equipment and inputs, subsidies have been abolished. Farmers manage to obtain equipment through credits contracted by Village Associations with the financial institutions. Currently the VAs use the BNDA credit lines or village development funds. As regards the organisation of the rural population, several projects have intervened in the zone with a view to improving rice production, among them the ARPON project, the EDF project, the RETAIL project.

It should be noted that the recent restructuring of the ON has led to changes in the extension system. Thus, certain activities previously carried out by the ON have been transferred to the Village Associations, such as: threshing of grain, primary collection of paddy, supply of improved seeds-R2. Dutch aid has offered 420 Votex threshing machines to the VAs. It is such action which is at the root of the ON restructuring. It has enabled the VAs to set up their own village funds for the financing of their activities (10 kg per ton threshed). Furthermore, the primary collection of paddy, in its turn, has enabled the VAs to obtain discounts from the ON. It is important to mention that the BNDA does not grant new credits until past credits have been reimbursed. That is why in 1993 the amount of input credits fell from CFAF 180 to 140 bn, and the VAs faced a financial squeeze despite the earnings obtained from the threshing and other activities.

On a macroeconomic level, government measures taken in favour of the rice channel on 15 January 1993 are the following:

- protection of national rice production, thanks to better TCI management; a limitation of food aid and imports; and implementation of follow-up and control mechanisms.
- farmers' participation in the management of allocations and land-tenure security for growers;
- restructuring of the ON through its disengagement from all industrial and commercial activities within a time-span of 2 to 3 years; and the creation of a new operational structure similar to the EPA (Public Administrative Enterprise) within 6 months.

Table 26**Rainfall in Niono (mm)***Years*

1975	629.7
1976	532.0
1977	597.1
1978	585.6
1979	431.2
1980	364.2
1981	395.0
1982	472.6
1983	286.1
1984	352.1
1985	308.6
1986	385.75
1987	369.2
1988	543.9
1989	496.7
1990	279.00
1991	607.7
1992	372.05
1993	311.5

3.4 Case study: pasture**Objectives**

The aim of this case study is to determine the influence of the SAP on the evolution of pastures. The zone chosen for the study is the Sikasso region where cotton-growing has favoured the introduction of animal traction and the use of fertilisers whose prices have increased recently. How did farmers react to the implementation of the economic measures? What incentives is the government offering to the private sector in order to stop the degradation of the environment?

The following data have been collected for the zones of Koutiala, Sikasso and Bougouni: total cropped area per farmer; area under cash crops; area under food crops; quantities of inputs used/ha (organic manure, various types of fertilisers, pesticides, weed-killers, fungicides); input costs; yield per ha; size of herds; and importance of fodder crops in the CMDT zone. Two types of data have therefore been collected in three different zones according to their degree of land use (cropped area/total area), namely: the Koutiala zone which is characterised by a high degree of land use (53%); the Sikasso zone characterised by a medium degree of land use (23%); and the Bougouni zone characterised by a low degree of land

use (5%).

Data related to the policy of fertiliser use enabled the team to study the influence of cotton-growing activity on the environment after the implementation of the economic reforms. Data collected cover the period 1976–90.

Data related to the encouragement of the private sector and covering the period 1985–92 deal with evaluation of the importance of forage crops in the CMDT zone, with a view to studying their incidence on forage potential and soil fertility, and of actions undertaken in the field of erosion control.

3.4.1 Results

Analysis of the different data collected leads to the following observations:

In southern Mali, pastoral resources came under strong pressures following the major changes that took place some decades ago in farming systems (see Appendix Graph I). In fact, the 1970s drought led to major migrations of people and cattle towards this zone. According to the DNSI (National Office of Statistics and Information), the population of the *cercles* of Sikasso, Bougouni and Koutiala was 317,126, 200,109 and 200,019 respectively in 1976. In 1987, the same localities had 374,611, 220,443 and 286,244 inhabitants respectively, or a growth rate of 1.6% in Sikasso, 0.94% in Bougouni and 3.47% in Koutiala.

Furthermore, cotton-growing has enabled farmers to accumulate savings in the form of animals, by using the monetary surplus from the sale of cotton. According to the DNE (National Livestock Office), in southern Mali as a whole, the number of cattle went up from 1,191,000 head in 1970 to 2,017,000 in 1983. In the Sikasso region, the number of oxen has gone from 18,500 in 1976 to 73,734 in 1980. The purchase of cattle by farmers has several objectives: the draught power of oxen; production of organic manure; financial security; use in barter and as dowry.

In addition to these purchases there are also cattle exports to neighbouring countries. Data available for the whole country do not cover 1993 and 1994 and do not allow us to draw conclusions on the influence of the devaluation of the CFA franc on cattle exports. In general, the devaluation enabled local producers to become competitive with supplies from the European Union, and increased exports, especially to Côte d'Ivoire, have been reported. Data from the district of Bamako, for instance, indicate that cattle exports have increased considerably since the devaluation. In 1993, sheep and cattle exports were 15,745 and 2,257 head respectively; from January to July 1994, these values reached 23,795 and 3,550 respectively.

Animal traction has resulted not only in an increase in the number of animals, but also in the acceleration of land clearing and the expansion of cultivation, since it is not generally associated with an adequate use of fertiliser, which means that although there is an initial increase in yield it is followed by a fall, consequent to a reduction in soil fertility.

Population growth, which creates growing food needs has led to a considerable expansion of cultivated area and thus a reduction of space reserved for cattle-

Table 27 Land use and pressure from human and animal populations in Sikasso, Koutiala, Bougouni and the CMDT zones.

<i>Land use</i>	<i>Sikasso</i>	<i>Koutiala</i>	<i>Bougouni</i>	<i>CMDT Zone</i>
Total area (100 km ²)	208	186	371	1058
% arable area	28	30	55	42
Cultivated area/arable area%	23	53	5	20
Number of inhabitants/km ²	21	26	12	19
Number of Livestock Units (1,000)	308	403	444	1512

Source: PIRT (1983), CMDT (1989), OSCE (1989)

raising. Tables 27 and 28 give information on land use in 1989. It appears that it is in the region of Koutiala where agriculture is most developed that the strongest animal pressure can be observed.

These different factors have led to an over-exploitation of the natural resources which has resulted in their degradation through: a diminution of the period of fallow and of the area in fallow; a reduction of soil fertility; a fall in agricultural yields and in animal production, which, at times, forces the farmer to further degrade soils in order to survive.

In effect, in earlier times the farming system was based on short cropping periods of 3 to 6 years followed by long periods of fallow of 15 to 30 years; this system was known as shifting cultivation. Nowadays, it has been replaced by an almost permanent cropping system in which fallow periods are relatively short (3 to 5 years), and have even disappeared in some places (cotton zone).

In southern Mali, arable lands have a rate of organic matter lower than 3% under natural vegetation; however, under crops, this rate falls rapidly to between 0.3% and 2%. There follows a subsequent fall in agricultural production.

The major constraint on the farming system is thus the reduction in soil fertility which affects forage production and, consequently, livestock production. The productivity parameters of herds in southern Mali indicate that animal production there is low. Indeed, the first calving does not take place before the age of 5, and the interval between calvings is almost two years (DRSPR, 1991).

The increase in number and cultivated areas leads to an imbalance between the

existing animal stocking rate and the carrying capacity of the grazing lands (Appendix Graph 3). There is thus an over-grazing of rangelands characterised by: the reduction, or disappearance, of some perennial species; the abundance of annual species which are often unappetizing; a speeding up of the erosion process.

The carrying capacity calculated for a production level of 50 kg of weight gain/year is 224,000 and 164,000 UBT respectively for Sikasso and Koutiala, whilst corresponding herds are 209,000 and 184,000 LSU. As a result, rangelands in the locality of Koutiala are affected by over-grazing. As in the other localities, there are three types of rangelands:

- rainy-season rangelands, essentially made up of annual *graminae* which are only useful for forage when the plants are growing. The most common species are: *Andropogon pseudapricus* and *Loudetia togoensis*.
- early dry-season rangelands made up essentially of crop residues.
- dry-season rangelands, comprising a mixture of annual and perennial *graminae*, among them: *Andropogon gayanus*, *Hyparrhenia rufa*, *Schizachirium brevifolium*, etc.

Analysis of Tables 29 and 30 enables us to observe certain trends related to fertiliser policy (see also Appendix Graphs 1 and 2).

In Sikasso, from 1976 to 1989, one can observe a growth of cultivated areas under cotton as well as food crops; however, the growth of areas under food crops is more important, with the growth factor being 3.30 as compared with 2.36 for cotton. The same trend can be observed in Bougouni, but there the growth factors

Table 28 **Spread of different crops in Sikasso, Bougouni and Koutiala in 1989.**

Crops	% of cropped area			
	Sikasso	Koutiala	Bougouni	Zone CMDT
Cotton	27	23	21	21
Millet/sorghum	30	55	35	52
Maize	22	7	23	11
Rice	5	+	2	2
Groundnuts	3	3	7	5
Cowpeas grain	7	6	4	5
Forage crops	2	1	2	2
Other crops	1	5	6	4

+ = between 0.0 and 0.5%.

Source: CMDT, 1989.

Table 29 **Cultivated areas (ha) and fertiliser cost
(cotton compound) in Sikasso 1976-90.**

<i>Years</i>	<i>Food crops (a)</i>	<i>Cotton (b)</i>	<i>Cotton area per grower</i>	<i>a/b</i>	<i>Fertiliser cost (cotton compound) CFAF/kg</i>
1976	17,107	16,791,22	1.09	1.01	62.5
1977	21,546	963	1.02	0.94	62.5
1978	32,135	29,890	1.25	1.07	62.5
1979	37,467	32,210	1.21	1.16	67.5
1980	-	-	-	-	-
1981	40,131	16,298	1.45	2.46	105
1982	31,665	18,465	1.65	1.71	105
1983	32,833	20,439	1.70	1.61	105
1984	44,116	24,164	1.85	1.82	105
1985	58,268	29,648	1.87	1.96	115
1986	95,569	30,868	1.89	3.09	140
1987	55,529	32,089	2.01	1.73	155
1988	55,882	35,976	2.09	1.55	155
1989	57,377	39,690	2.11	1.44	120

Source: CMDT

are clearly higher, with 12.9 and 11.22 for food crops and cotton respectively, which shows different land-use intensity for the two zones.

The considerable increase in the areas under food crops can be explained mainly by the maize boom, following the setting up of the Maize Project, which aligned the official maize price with that of other cereals and guaranteed its marketing. Thus, the cultivated area went up from 6,000 ha in 1975 to 51,000 ha during the 1986-7 season. However, with the liberalisation of prices in 1987, the cultivated areas under maize have sharply diminished at the same time as the prices. Two years are characterised by very important changes — 1981 and 1986 — during which the price of fertilisers increased considerably.

In Sikasso, the ratio between food crops and cotton was relatively constant and close to 1 during the 1970s, varying with the cost of fertiliser. The most spectacular growth was observed in 1986, whereas in 1989 one again witnesses a reduction in the ratio when the price of fertiliser hardly reaches CFAF 120.

Table 30 **Cultivated areas (ha) and fertiliser cost
(cotton compound) in Bougouni 1981-92.**

<i>Years</i>	<i>Food crops (a)</i>	<i>Cotton (b)</i>	<i>Cotton area per grower</i>	<i>a/b</i>	<i>Fertiliser cost (cotton compound) CFAF/kg</i>
1981	5,875	2,844		2.06	105
1982	6,395	3,455		1.85	105
1983	7,959	4,149		1.92	105
1984	16,005	6,209		2.58	105
1985	23,502	10,142	1.15	2.32	115
1986	31,571	10,546	1.20	2.99	140
1987	33,427	14,537	1.48	2.30	155
1988	41,898	19,493	na	2.15	155
1991	68,212	28,313	1.64	2.40	120
1992	75,804	31,907	1.65	2.37	120

Source : CMDT

na = not available.

In Bougouni the ratio is in general higher than 2, but it also grew considerably in 1986 before falling together with the price of fertilisers. Thus, it seems that, in order to avoid reduction in income, farmers make savings on fertilisers, but increase their cultivated areas with the help of animal traction (Appendix Graph 4). This increase is done through the clearing of new land, which in its turn reduces the vegetational cover and the pastoral space, and leads to over-grazing and the degradation of pastures. Empirical observations have confirmed the recommended quantities are not applied everywhere.

Numerous projects established in the zone have made big efforts to encourage the private sector, namely by the introduction of forage crops and the control of erosion. Among them, one can mention : the erosion control project (PLAE); the agro-ecological project; and the Soil Protection and Restoration Division, etc.

Villages concerned with the control of erosion number 184 in Koutiala, 113 in Sikasso and 80 in Bougouni. Among the measures carried out, one can mention stone bunds, live hedges, forage crops, the use of improved stoves and fire-belts (Table 31).

In the locality of Koutiala, which is characterised by intensive land use, the cultivated areas under fodder crops have increased considerably, in particular in the sectors of Koutiala and Zebala (Table 32). Whether it is a question of improved fallow or of a basis of forage crops, taking into account their influence on forage

Table 31 Village anti-erosion activities

<i>Locality</i>	<i>Stone bunds (m)</i>	<i>Live hedges (m)</i>	<i>Forage crops (ha)</i>	<i>Improved stoves</i>	<i>Fire-belts (m)</i>
Koutiala	168122	2216	1971	5544	3300
Sikasso	127179	1664	350	1362	450
Bougouni	268014	1311	630	1559	21377

Source: PLAE

potential and soil fertility, these crops have a favourable impact on the evolution of pastures.

For example, studies undertaken by DRSPR-Sikasso indicate that *Stylosanthes hamata* under mono-cropping improves soil fertility, notably through the ratio C/N, which after 3 years, is between 8 and 12, whereas it used to be between 21 and 30. The influence of forage potential is also very clear, in that *stylosanthes* production can achieve 5t of dry matter/ha, whereas that of the control plot never exceeded 3t.

3.4.2 Conclusion

Analysis based on the evolution of the cost of cotton compound fertiliser

Table 32 Evolution of cropped areas (ha) under forage crops in Koutiala zone.

<i>Year</i>	<i>Sectors</i>					
	<i>Koutiala</i>	<i>Mpessoba</i>	<i>Molobala</i>	<i>Zebala</i>	<i>Yorosso</i>	<i>Bla</i>
1987	503	721	457	390	328	289
1988	131	304	413	318	795	449
1989	2000	510	683	1062	816	645
1990	1459	454	552	1167	628	726
1991	962	523	651	970	560	699
1992	1001	455	784	816	425	611

demonstrates that the SAP has had a negative impact on pasture, in that it has pushed farmers to increase their pressure on the environment. By increasing the cultivated area, farmers reduce pastoral space, but at the same time release a certain quantity of crop residues.

By encouraging the private sector through various measures the SAP has had a positive impact on pastures and on the environment in a general way, leading to an increase in forage potential and soil fertility, as well as better soil protection.

3.5 Conclusion

This section seeks to draw some conclusions about the impact of recent adjustment measures on the natural environment of Mali. It draws together the analysis of adjustment measures contained in Chapter 2 with the results of the case studies earlier in this chapter.

3.5.1 *Overall impact of adjustment*

In an international perspective, Mali's adjustment effort is considered to be weak. The main reason for this, until January 1994, was the absence of devaluation, which led to the increasing overvaluation of the CFA franc. This led to a squeeze on the tradeable sectors, the opposite of what is normally aimed at during adjustment. Agriculture was a principal victim. The competitive position of the main export crop – cotton – was weakened, while domestic production of rice was undermined by artificially cheap imports. The internal terms of trade of farmers vis-à-vis urban producers and consumers deteriorated. For these reasons, adjustment, in the partial and distorted form that it took, is judged to have had a negative impact on poverty (World Bank, Country Brief, June 1994).

Although adjustment improved the government's fiscal position, the deficit remained high (9.5% of GDP in 1993). This has limited the government's ability to fulfil its aims in the education and health sectors. One adjustment measure entailed a reduction in spending on secondary education, and a corresponding increase in that on primary education, with the objective of raising school attendance to 36%. However, this measure has been delayed, partly due to agitation by students and teachers.

The fiscal situation also reduced the government's ability to contribute counterpart funding to crucial development projects. The financial position of agencies in the cotton and rice sectors was weakened by their growing uncompetitiveness related to the exchange rate and, in the case of cotton, by the effort to shield producers from this effect.

Employment in the formal sector has fallen for three main reasons. Industry was squeezed by artificially cheap imports, especially from neighbouring countries. The

public service dismissed several thousand employees. 29 public companies were liquidated, restructured or privatised, with consequent redundancies. As already noted, the tradeable sectors have been unable to expand and absorb this unemployed labour.

In social terms, the general level of poverty has probably increased during adjustment. Although some increase in hardship may have been unavoidable, the design and implementation of the programme has probably aggravated its extent and duration. Until 1994, the rural sector, on which 80 – 90% of the population depends, bore the brunt of adjustment. However, the unemployed from the formal and urban sectors have added to poverty both in urban areas and among their rural dependants. Since devaluation, the potential for growth in the tradeable sectors has improved, but until these effects work through a further increase in hardship can be expected amongst consumers as prices rise. Meanwhile, all social programmes, plus actions to compensate vulnerable groups, have suffered from the continuing fiscal crisis.

3.5.2 Effect of specific adjustment measures

The following measures appear to have had the greatest potential impact on the use of Mali's natural resources and environment:

Exchange-rate policy

The absence of exchange-rate adjustment until January 1994 depressed the agricultural terms of trade and deprived the sector of resources. In the case of cotton, the leading cash crop and export earner, producers have been protected from the decline in the CFAF denominated income from this crop by the actions of the intermediary agency, the CMDT. Hence cotton has remained an attractive crop to farmers, especially since it continues to have a guaranteed market and credit supply. But rice producers have had no such buffer against import prices, and cheap imports have seriously reduced the profitability of rice cultivation.

Devaluation has reduced the immediate threat of cheap imports to domestic rice producers and has potentially increased the resources available for this sector (e.g. for much needed drainage and rehabilitation of irrigation systems). In the case of cotton, if increased export earnings are passed through to farmers, existing trends –towards unsustainable extensification and intensification – are likely to continue.

Devaluation has led to an increase in the export of livestock to neighbouring countries, especially Côte d'Ivoire, since franc zone producers are now more competitive relative to European Union sources. In the short term, this has relieved pressure on Mali's pastures. However, it is to be expected that livestock numbers will recover in the course of time, and even increase over the previous level, reflecting their greater profitability.

Liberalisation of the cereals market

The attempt to allow domestic prices of cereals to reflect international levels has been largely successful. However, this has coincided with increasing exchange-rate overvaluation, hence the effect has been the perverse one of depressing CFAF prices to producers, especially of rice and wheat.

Privatisation of rice marketing and input supply

The Office of the Niger is being reformed with a view to reducing its losses, and making it more streamlined and efficient in the provision of core services to its farmers. The range of services offered to rural producers has been drastically reduced. Now the Office limits itself to operating and maintaining the irrigation system up to the edge of farmers' fields, and providing advice to farmers. Marketing and input supply have been left to private merchants.

There are preliminary signs that the balance of advantage in the purchase of rice has shifted away from farmers towards the merchants. However, this is in the context of improved CFAF prices since the devaluation. The higher cost of imported inputs, and in many cases their inferior quality, has dealt a blow to diversification and intensification. In 1994 positive interest rates were charged on some farm credit, which reinforced the above effects.

3.5.3 Impact on resource use

The above measures can be examined for their effects on farmers' production decisions, prior to assessing their environmental effects. From the environmental point of view, the following decisions are important:

- whether to extend the cultivated area (which in Mali's case would normally be on to inferior, or marginal, land) or to farm existing areas more intensively;
- in the case of more intensive farming, whether this is done in a sustainable manner, or in an exploitative way;
- the degree to which common property resources such as pastures, woodlands and wetlands, are used.

Adjustment has affected the following incentives directly: the price of crops realised by the farmer; the cost of inputs such as agro-chemicals; the cost of credit.

It has also altered the cost and supply of labour (but not in a straightforward way, since growing urban unemployment has been accompanied by net migration from rural to urban areas, hence the effect on farm labour is unclear).

The impact of these measures has been aggravated by: growing poverty in both rural and urban areas, a continued lack of clarity over land tenure, property rights, and responsibility for the management of communal resources, a deterioration in public services, especially health and education, and failure to provide programmes to protect vulnerable groups. The following conclusions can be drawn:

- Prior to devaluation, adjustment, in the form that it took, did not have an

unambiguous effect on the basic profitability of cotton to the farmer. The CMDT buffered the decreasing competitiveness of Malian production, until devaluation came to the rescue. The greater profitability of cotton is likely to have increased the incentive to farm new land. The greater availability of animals for land clearance and preparation is another factor.

- Growing rural poverty, a deterioration in the ratio of output to inputs price, and recently the devaluation, have reduced the demand for fertilisers and pesticides. However, the use of animal manure, related to the growing number of animals kept in the cotton zone, has partly helped to maintain soil fertility and crop yields up to now. The CMDT has maintained the supply of credit to its producers.
- For farmers without access to animal manure, the increased cost (and diminished quality) of chemical fertiliser, and the abolition of fertiliser subsidies, is another factor biasing production decisions towards the extensive mode. The recent abolition of credit subsidies in the rice area also raises the cost of all bought-in inputs.
- Underlying the above producer responses is the problem of land tenure. New land can be farmed at little cost other than that of clearance and preparation. In fact, leaving land fallow is discouraged by current official attitudes.
- Where extensive development was not possible, e.g. because of land constraints, the continued profitability of cotton encouraged greater intensity of production. Serious concerns have been expressed about the long-term decline in soil fertility from intensive cotton monoculture. The above-mentioned effects on the price of fertiliser have aggravated this problem.
- The greater freedom allowed to private operators in the farm supply sector has facilitated the growth of fodder production. In the long term this is highly desirable, but in the short term it has probably added to the competition for land by permitting larger animal numbers.
- Reforms in the rice sector, specifically divesting the ON of many peripheral functions, will increase the responsibility of farmers themselves for the proper management and care of their irrigation systems, which is the first step to solving growing problems of salinisation and waterlogging.
- Exchange-rate policy has affected rice more than cotton or other crops. Growing overvaluation led to a build-up of imports in the early 1990s, which seriously undercut local producers. This deprived the sector of resources which might have been applied to urgent remedial and extension work to the irrigation network, and the acquisition of more fertiliser and other inputs. Devaluation released this import pressure, and will allow margins to expand, but by the same token has increased the cost of buying fertiliser.

4. Structural adjustment and sustainable development

4.1 Introduction

The notion of development, no matter its content, inevitably aims at improving the living standards of the population in a particular country. However, economic growth remains essential in order to achieve these objectives. In the developing countries in general and in Mali in particular, no growth can be expected without a minimal use of natural resources, if not of the environment as a whole. Natural resources which are the basis of the necessary components of economic growth in Mali today are the same as those to be used for the development objectives of future generations. It should be noted that most of the resources of the environment are not inexhaustible. It is this idea which underlies the necessity of good management of natural resources and thus the notion of sustainable development.

In Mali it can be said, without doubt, that the current situation with regard to environmental problems remains the function of three basic components, namely, the level of development of the country; the economic policy followed from 1960 to date; and the institutional framework for managing the environment. The pursuit of inappropriate economic policies since 1960, the repeated droughts and the deterioration in the terms of trade in the 1970s and 1980s are the main causes of the economic and financial crises that shook Mali at the beginning of the 1980s. This situation forced the government to opt for a structural adjustment programme (SAP) in 1982 funded by the international institutions.

The objectives of the SAP adopted by the Government of Mali for the period 1992–5 aim at:

- attaining an annual growth rate of about 4.6%;
- containing the average annual inflation rate, as measured by the GDP deflator, at 2.5%;
- bringing the deficit in the balance of payments, before debt remission and excluding public transfers, to 10.2% of GDP by 1995;
- getting the balance of payments on to a sound footing by 1995.

This chapter aims:

- to analyse the trends of certain social, economic and environmental indicators since the start of the SAP, and their impact on development in Mali from 1982 to 1992;
- to project, from established rates, the long-term evolution of certain indicators. At this level different development scenarios are considered in order to identify their impact on the environment;
- to make proposals and/or recommendations capable of establishing the basis of sustainable development for Mali.

4.2 Trend analysis of indicators

According to the analysis of data collected by the research team, the SAP, since its inception in 1982, would seem to have given rise to positive as well as negative effects. The positive effects recorded are mainly related to performance in terms of economic indicators, whilst those related to social indicators and to the environment remain questionable, if not negative in certain cases.

4.2.1 *Economic Indicators*

The indicators discussed in this section are presented in Table 33.

From 1982 to 1992, the average increase in GDP was about 3%, but it must be admitted that there were a number of fluctuations over the same period. Thus GDP increased from 1982 to 1987, in 1989 and in 1992; 1988 and 1991 were years when it fell. These variations seem strongly related to the performance of the key productive sector, namely agriculture, which over the same period accounted on average for 70% of GDP and 84% of total exports. The average annual growth of income per capita was 0.5% during the same period.

The balance of payments did not improve significantly; its ratio to GDP remains high, running from 14% in 1980 to 13.6% in 1993. The ratio of debt service to exports was 20% on average. The inflation rate measured by the GDP deflator has been an average 3.7% per year.

The primary sector employs 74% of the active population. Formal jobs account for only 6% of total employment in Mali. The urban informal sector provides employment for almost 20% of the active population. The average unemployment rate observed at the national level is 0.8%. The percentage of fiscal receipts to GDP increased from 10.2% in 1981–7, to 11.6% in 1988–91. The percentages of investment and aid were on average 18.7% and 13.8% respectively over the same period.

4.2.2 *Social indicators*

Between 1982 and 1992, the population recorded an annual growth of about 2.5%. As regards health, the under-fives mortality rate fell from 184 per 1,000 in 1980 to 130 per 1,000 in 1992. This rate is still very high, in particular in the rural areas. The percentage of the population having access to safe drinking water is about 35% for the rural areas and 55% for the urban centres.

As regards nutrition, the daily energy intake is about 2,346 calories, 98% of which is of cereal origin. Cereal production per capita and per year varied from 191kg in 1980 to 279 kg in 1990. Agricultural production remains strongly dependent on rainfall.

The average adult literacy rate is about 18%, whereas that of women has fallen

Table 33 Economic indicators for the period 1982–92.

<i>Indicators</i>	<i>Possible measures</i>
1. Growth	GDP, 3%
2. Income	GDP per capita US\$227
3. Trade	B of P deficit 14% of GDP
4. Debt	Debt-service ratio 8%
5. Inflation	3.7% (GDP deflator)
6. Employment	<ul style="list-style-type: none"> • primary sector : 74% of active population • formal sector : 6% of employment • urban informal sector : 20% of active population
7. Income distribution	lack of data n.a.
8. Revenue	Fiscal revenue 14% of GDP
9. Investment	Gross domestic investment 22% of GDP
10. Aid	13.8% of GDP

to 9%. From 1981 to 1990 the number of children attending school increased by 16.7%. In the primary sector, this rate is 24% in public schools and 31% if the private sector is also included. In the formal sector, women constitute 16% of the active population, the average for all the sectors being 50%.

Environmental indicators

From 1975 to 1990, excluding the effects of drought, forests were lost at a rate of 300,000 ha. per year or about 1%. The average erosion rate in southern Mali varies from 5 to 10 tons/ha/year; at the national level this rate is in the order of 6.5 tons/ha/year. It is important to note that during the last 30 years, in Mali as in all the Sahel countries, a southward displacement of an isohyet of about 110 km. has been observed. This phenomenon has led to major changes in the vegetational and climatic conditions in the affected zones (IDA, 1992). According to the IDA's report, groundwater has decreased during the past 10 years by 6 to 12m throughout the country except in irrigated areas; fish catches in the Niger have fallen from

Table 34 **Social indicators for 1982-92**

<i>Indicators</i>	<i>Possible measures</i>		
1. Population Growth	2.5% per year		
2. Health	<ul style="list-style-type: none"> • 184 per 1,000 in 1980 Mortality of children • 130 per 1,000 in 1992 under 5 		
3. Health//water	<ul style="list-style-type: none"> • 35% for rural areas Access to safe water • 55% for urban areas 		
4. Nutrition	2,346 calories per day/person		
5. Food security	<ul style="list-style-type: none"> • 191kg per person in 1980 • 279kg per person in 1990 		
6. Education	<ul style="list-style-type: none"> • adult literacy rate 18% • primary sector: 24% in public schools, 31% in private and public schools 		
7. Women status	adult women literacy rate: 9%		
8. Social cohesion	no reliable data		
9. Social programmes		1980	1990 % of total Budget
	health	3.1	2.1
	education	15.7	9.0
	others	3.0	3.1
10. Level of participation in political life	no reliable data		

120,000 tons to 50,000 tons per year. The same report mentions that biodiversity has been reduced and forests degraded following the growth in firewood consumption.

4.2.3 Overall analysis of the SAP's effects on development

Generally speaking, it can be said that the macroeconomic policy followed during the SAP since the beginning of the 1980s has contributed to reducing the imbalance

in certain fields, among them: GDP, agricultural production, inflation rate, public resources management. Thus, the balance-of-payments and budget deficits have been brought further under control and gradually reduced. The SAP has also contributed to stimulating activities in the private sector.

However, the SAP has had limited or insignificant effects on the imbalance between investment and savings and between rural and urban areas. The latter could even be at the root of the increase in migration. Similarly, what has been observed with regard to unemployment is also not encouraging. The performances recorded for health and education are very low. As regards the environment, the degradation of soils and pastures, the increase of pollution in urban centres and the reduction in biodiversity persist.

Among the causes of these imbalances, according to the Ministry of Economy and Finance (1993), the following can be mentioned:

- the insufficiency of public savings, due to low budget revenues and the lack of total control of budget expenditures;
- the insufficiency of private savings, due to the low incomes of the population, the high demographic growth rate and fiscal pressure;
- the lack of follow-up of investment projects with, as a consequence, the inefficient use of resources;
- the fall in productivity, due to the lack of maintenance and renewal of capital equipment.

The lack of appropriate policy on the environment would seem to be the origin of soil degradation, deforestation, desertification, pollution and the reduction of the biodiversity. According to the case studies, the following points characterise current policies on the environment:

- insufficient co-ordination of activities related to natural resources management;
- lack of follow-up of the problems of biodiversity;
- insufficient monitoring and control;
- absence of environmental follow-up and of studies of the environmental impacts of projects and programmes;
- lack of adaptation and difficulties in applying laws and regulations;
- insufficient involvement of civil society in natural resources management;
- low capacity of institutions to manage operations.

In short, adjustment has had a mixed success so far, though it should not be judged too hastily in view of its short duration and the crucial impact of the devaluation of January 1994 whose effects are still being felt. Meanwhile, worrying underlying trends in economic, social and environmental indicators persist. Poverty, measured by income per head and other proxy indicators, is worsening. The economy remains as dependent as ever on a few natural resources, each of them vulnerable to drought and environmental pressures. Spending on public health, education and economic infrastructure is weakening. The condition of women, children and the poor gives cause for grave concern. It is clear that adjustment has done little or nothing to address these fundamental problems, which have been perceived as largely beyond its scope.

This study does not attempt to tackle all the economic, social and environmental

Table 35 **Environmental indicators for 1982-92**

<i>Indicators</i>	<i>Possible measures</i>
1. Forests	deforestation 1975-90: 1% p.a.
2. Ponds	reduction according to the literature
3. Erosion	<ul style="list-style-type: none"> • southern Mali: 5-10 tons/ha/year • national level 6.5 tons/ha/year
4. Biodiversity	reduction according to the literature
4. a. River (Niger)	reduction of catches of fish: from 120,000 tons to 50,000 tons per year
5. Energy	consumption of firewood in Bamako: 1,536,000 m ³ /year
6. Atmospheric pollution	not available
7. Hygienic services	" "
8. Groundwater/surface water	reduction of 6 to 12 m in groundwater: % use of water <ul style="list-style-type: none"> • surface: 12 • ground: 0.2
9. Mineral extraction	lack of data
10. Government expenditures related to natural resources	Apart from the Waters and Forests Service, this field has been principally covered by externally funded projects.

concerns that are implicit in the notion of sustainable development. Its more limited aim is to consider what is implied by the sustainable development of three of its key productive sectors – cotton, livestock and rice – and how current and future adjustment programmes can contribute, rather than detract, from this aim.

4.3 Trend analysis of indicators: projection to year 2010

Let us assume a development objective of an average annual growth of income per capita of 1% for a period beginning 1993 and ending in 2010. In the current situation and state of the economy and given the current demographic growth rate, to maintain this growth in per capita income would require an annual growth rate of GDP of 3.5–4% over the same period. In order to achieve this objective, two scenarios are considered: the first is essentially based on the contribution of the agricultural sector alone; the second is based on the hypothesis of a development of the agricultural sector, but strongly supported by the other sectors of the economy.

It must be stressed that, with the devaluation of January 1994, Mali can become more competitive with respect to national production in rice and sugar, and can raise incomes in the rural areas, win back the neighbouring markets for cattle and meat, and develop the processing of agricultural products. This economic recovery should help create more jobs and promote regional integration (World Bank Mission to Mali, 1994).

4.3.1 *Scenario 1*

In the structure of the Malian economy, and as noted earlier, growth of GDP depends strongly on the agricultural sector, which accounts for nearly 50% of GDP and three-quarters of export earnings (Ministry of the Economy and Finance, 1993).

Thus, in order to achieve the 2010 objective under this scenario, it is essentially the agricultural sector that could play the key role in the country's economic growth. Assuming that: cereals production at least covers the annual needs of the population, the population growth rate is lower than that of GDP so that it helps to maintain the rates mentioned, and the other components maintain their contribution as in the current situation, the question is, what are the options to be followed in order to achieve this objective as regards, cotton-growing, livestock and rice-growing?

In order to reach the 2010 objective, one can count on cotton, livestock and also, to some extent, rice production. In 1992 annual income per capita was US\$310; at a growth rate of 1%, income per capita will be in the order of US\$368.9 in 2010. As for GDP, it was CFAF 661 bn in 1992; at a growth rate of 4% per year, GDP will reach CFAF 1,335.2 bn in 2010.

Cotton

In view of the underlying degradation of land already in progress, the present level of production could be sustained in the medium term only by safeguarding the natural resource and soil fertility.

Under a normal rainfall pattern and if cotton remains competitive, there is a possibility of production keeping pace with the above-mentioned growth of GDP.

This can be done through expansion of the area under cotton, or intensification of cotton cultivation in the current cotton-growing zones. The first possibility implies a reduction of the period of fallow, with the possibility of abandoning fallow in the cropping system, and the use of marginal land. All these practices are signs of an over-exploitation of natural resources and can lead in the medium or long term to the degradation of these resources or of the environment itself. This situation, if it must persist, does not permit a sustainable production in the zone.

The second possibility, which is intensification, is essentially defined in the current context of the CMDT by the use of inputs (fertilisers, pesticides) mainly oriented towards the growth of production rather than the protection of the environment, and the application of the technique of deep ploughing of the soil. The latter is already experiencing a number of problems on the production side. In fact, for a number of years now, one has been able to see yields reaching their ceiling in a number of cases. This is a situation that cannot last for ever. Sooner or later, if appropriate measures are not taken to restore soil fertility, one will witness purely and simply a fall in the yields, and this will mean a degradation of natural resources in the cotton-growing zones. This alternative, if not corrected, will never permit a sustainable exploitation of resources or of the environment.

In short, there needs to be a shift to intensive modes of cultivation, limiting the expansion of the cultivated area and increasing inputs per unit of land. This will require the greater use of organic fertiliser alongside chemical compounds, accompanied by soil conservation and anti-erosion measures.

Livestock

As regards feed, according to the case study on pastures, Malian cattle depend to a large extent on the use of natural pastures which are in their turn dependent on rainfall and the amount of extensive cropping. In fact, the national distribution of livestock is not in line with pastoral and water resources.

Government strategies and actions oriented towards livestock have always been related to health protection and pastoral hydraulics to the detriment of the management of pastoral resources and the organisation of pastoral societies. They have encouraged cattle to the detriment of other species. Growth of animal production has only been sought through a rise in numbers rather than the improvement of production per head of cattle.

Thus, if livestock are to sustain GDP up to the year 2010, they will only be able to do so by the encouragement of extensive cattle-raising (which already exists), or through the development of intensive cattle-raising. The first alternative consists of encouraging the numerical growth of cattle, which, as in the past, will be the source of an over-exploitation of pastoral resources. This practice will not lead to a sustainable exploitation of pastoral resources. As for intensive cattle-raising which is practised here and there, it is not popular and, if practised on a large scale, is bound to create problems linked to social habits. It should be noted that the fundamental problem with livestock, as in numerous other fields, remains the uncontrolled use of communal resources.

Rice

Of all the cereals consumed in Mali, rice occupies an important place in the feeding habits of urban dwellers. By satisfying the demand for rice through domestic production, the loss of foreign currency is reduced by means of limitations on rice imports. The bulk of the rice produced in Mali is grown in the Office of the Niger zone. Currently, rice production through intensification is enjoying an unprecedented growth (high yield). According to the case study on rice and a recent study conducted by a research team (Rural Economy Institute/International Development Oriented Agricultural Research Centre), the following impacts related to certain zones of the Office of the Niger have been recorded: salinisation and alkalisation of land; permanent flooding of certain areas; reduction of biodiversity; reduction of pastures; reduction of ligneous resources; waterborne diseases; water pollution; etc.

Thus, if the rice produced domestically has to be competitive and play its role in the reduction of imports, intensification could still be encouraged. However, this option, as mentioned earlier, presents some weaknesses which are signs of non-sustainable production.

4.3.2 Scenario 2

Under this scenario, agricultural growth must be accompanied by a parallel development of industry in general and agro-industry in particular. Agro-industry is a component of the economy which is classified as being in the secondary sector. Its contribution to GDP on average for the 1982–92 period was 14.2%, which is a relatively low level compared with that of the agricultural sector. Up to 1990 the industrial sector showed a growth rate of 8.1% per year. This demonstrates the possibilities in this sector for supporting the agricultural sector in a sustainable manner. The sector experienced a significant slow-down in activity with the political upheaval of March 1991. The devaluation seems to provide an opportunity for recovery. Currently, for this sector to play its full role in achieving the 2010 objective, solutions need to be found to certain problems affecting a good many industries, namely: slump linked partly to fraud; shortage of raw materials; narrowness of the existing market; obsolescence and breakdown of equipment.

In order to develop this sector, emphasis needs to be placed, *inter alia*, on: the creation of an appropriate environment for the growth of the private sector and industry; the battle against fraud; the strengthening of links between industry and agriculture, taking into account the fact that Mali is a landlocked country; the search for greater competitiveness through the acquisition of technical know-how from international partners, and a good knowledge of the market; the installation of a performing legal regime; the development of business-like managerial and technical capacities through education, research and training (Ministry of the Economy and Finance, 1993).

Such an impetus needs to be sustained by regulations and laws that can do the maximum to reduce the pollution of the environment which is often a consequence of industrial development.

4.4 Proposals and recommendations for sustainable development

As indicated in a World Bank document (World Bank, 1992), degradation of the environment occurs when the economic operators who decide the use of natural resources ignore or underestimate the costs of environmental degradation to the community at large. In effect, in a number of cases concerning the use of resources and indeed of the environment, it is a market failure which is generally at the root of the abusive use of these resources. In some cases, State intervention only encourages these inefficiencies. In the case of Mali, some examples can be mentioned: the supply of electricity at a subsidised price, inefficient management of lands and forests, extensive cattle-raising, etc. Also, in most poor countries like Mali, poverty and economic instability lead to an abusive exploitation of natural resources. Thus, it can be said that factors such as ignorance, poverty and uncertainty all contribute in aggravating the degradation of natural resources, if not of the environment. In this respect, any policy of protection of natural resources requires a solution to these problems.

In Mali the fragility of the economy can be explained above all by the fact that it is strongly dependent on the agricultural sector in which certain key parameters are beyond its control: namely, the prices of products on international markets and rainfall. Thus, reducing this dependence by encouraging the development of other sectors is a very important step in moving towards sustainable development. This policy can be followed and at the same time important efforts towards the development of the agricultural sector can be maintained.

In the Ministry of Agriculture's guidelines for rural sector development (Ministry of Agriculture, 1992), in which agriculture is presumed to be the main motor of development, the strategy to be applied for sustainable development is based on: the diversification of production in order to secure a better sharing of risks in production, markets and trade; the search for competitiveness by the choice of farming systems on the basis of comparative advantage; and the maintenance and regeneration of natural resources as well as the development of financial and human resources in the rural areas.

Thus, by favouring specialisation and competition, and by encouraging technical progress, the policy of freeing trade and investment increases productivity and improves efficiency by inciting economic operators to use natural resources more efficiently.

In Mali, policies of State disengagement, liberalisation and decentralisation aim to make the population much more responsible for their own development. Among the measures to be taken to make some of the options more efficient, one can note the clarification of the land-tenure issue and the application of ownership rights. These measures could contribute in reducing the ill effects of the present communal

management of resources.

In order to manage the environment, it is necessary to set priorities, co-ordinate activities and settle conflicts. In order that decentralisation can meet all its needs and achieve its objectives for sustainable development, institutions conscious of their responsibilities must be set up. As mentioned in preceding chapters, decentralisation by its very nature must promote a sustainable management of natural resources through the elaboration of a national environmental policy, the revision of property, land, forest, pastoral and fishing codes and the establishment of a land-tenure monitoring system. Some institutional measures are necessary to establish, on the one hand, a sound information system accessible to all, and, on the other hand, a co-ordination of Malian policy in the field of the environment that will enable an efficient follow-up of the implementation of national and sub-regional strategies.

For agricultural production to be sustained, it must be based on the principles of sustainable management of natural resources. Any sustainable rice production in the Office of the Niger zone requires in the first place greater responsibility on the part of producers vis-à-vis the irrigated lands they exploit. The land rights currently enforced in the ON zone do not permit producers to invest in these lands for sustainable exploitation. A more realistic and reasonable redefinition of ownership rights would without doubt make producers more responsible in the sustainable management of this resource. To sustain rice production, agricultural research based on farmer participation must develop techniques for sound, profitable and sustainable production. Thus, the massive use of chemical inputs must be reduced in favour of the use of manure, compost, crop residues and green fertilisers. Diversification, good management of irrigation water (with an adequate system of drainage), appropriate integration of agriculture and livestock, are fields where applied research can be undertaken with the aim of sustaining rice production in a lasting way. Similarly, development of the post-production channels remains a field which needs to be organised in a more active and efficient manner.

The current system of cotton production, if it fails to take account forthwith, and on a large scale, of alternative techniques of production, will create unsustainable risks. Furthermore, in the cotton-growing zone, anti-erosion techniques can be used in order to avoid losses of soil and nutritive elements. The use of technical packages based on the contribution of manure, compost and crop residues must be encouraged. The minimum of chemical fertilisers should be used. For greater involvement of producers in the option of sustainable management of resources, land-tenure rights must be modified. Within the zone, the practice of intensive cattle-raising and a strong livestock/agriculture integration should be encouraged.

To sustain these actions in relation to the above-mentioned agricultural activities, and with a view to reducing deforestation and soil degradation, it is essential to further diffuse the techniques in the use of firewood that can reduce the consumption of this resource, and develop, at regional level, agro-forestry and soil conservation programmes.

In Mali, the degradation of the environment in general leads to costs for society for which no one is held responsible. This phenomenon is aggravated, in particular,

when the resources are communal and when the rules regulating their use fail to take account of the costs to be paid in the event of their use being abused. Thus, for any policy on the sustainable use of resources, the right to private property (individual or communal) must be clearly and accurately defined. These reforms at the level of land-tenure rights will without doubt encourage producers to manage the environment better and to invest more in order to protect the natural resources.

The adoption of the techniques of sustainable production, if not supported by the SAP, can pose a number of problems at the producer level. Producers in most poor countries such as Mali, because of their low standard of living, produce in the hope of making gains (income, food needs) in the short term. This objective is not always compatible with the immediate production results generated by the application of sustainable production techniques. Sustainable production techniques have in reality important production effects in the medium and long term; however, in their application, they require a transitional period during which production performance is often lower than that of conventional practices. It is at this stage that producers need a programme of compensation as an integral part of any future SAP. This could contribute greatly to the adoption of techniques of sustainable production.

4.4.1. Summary of recommendations

Experience of land conservation policies in the Sahel is that recommended practices need to be based on farmers' 'felt needs', to fit into their production system, and to offer tangible benefits to the parties involved. The responsible participation of the intended beneficiaries is much to be desired, rather than the 'top down' authoritarian tradition favoured by some agencies. Practices that have proved successful elsewhere should be tried in different regions. The use of trees and vegetation should be fully integrated into conservation practices. Integrated, non-sectoral policies appear to work best.

There is no real prospect of diversification such that the future importance of cotton will diminish. If this crop is to support future growth under the above-mentioned scenarios its cultivation will need to become more intensive, productive and sustainable – since farming new land is not a long-term option.

Studies of cotton production in the south have exposed the risks of depleting soil nutrients through prolonged monoculture of this demanding crop. In general, farmers do not use sufficient fertiliser to offset the underlying decline in soil nutrients fully, and there is inadequate application of manure and crop residue to maintain the soil structure.

In the long term, there should be diversification, better crop rotations, improved soil conservation, and the spread of anti-erosion techniques to maintain and enhance soil fertility. There is also a role for more and better fertilisation, but there should be a shift towards organic means such as manure, compost and crop residues. Despite the cogent fiscal objections, there is a case for subsidising fertiliser as an incentive to increasing its use in intensively-farmed and high-potential areas (e.g. Koutiala, Sikasso, Dioila). Property rights should be modified

to increase producers' incentives to practise the above measures. Livestock needs to be better integrated into farming, and itself become more intensive.

In the rice-growing areas further north there is scope for enlarging the irrigated area, especially through small-scale schemes. Some of the investment could be contributed in kind by local beneficiaries, including women. The need for investment in drainage on existing irrigation schemes is becoming urgent, otherwise yields will decline. Investment in public health in irrigated areas needs to be restored to combat the growth in water-related diseases. Water bodies in irrigated areas should be more fully exploited for aquaculture. Currently irrigated rice farmers in the ON region do not enjoy property rights that encourage them to invest in a more sustainable system.

The future for livestock will increasingly be as part of a mixed farming regime in sedentary farming areas. The successful development of fodder crops for stall-fed animals points the way, with animals contributing draught power and manure to intensive mixed systems. In contrast, pastoralists are going to be increasingly squeezed out of the regions of greatest agricultural pressure. Control of both the quantity and quality of livestock herds will be required, though this will be very difficult to achieve.

Mali's forests, though not lacking commercial potential (e.g. for construction), should be viewed mainly as resources available for the benefit of local people. Arresting the present trend of deforestation will require people's willingness to take responsibility for managing and safeguarding their local forests. This entails the spread of information and awareness locally, local involvement in decisions about managing and replacing forests, and the integration of trees into arable and livestock regimes. Afforestation will demand better control of livestock, and the substitution of fodder for natural forage.

The protection of fauna and flora from the present degree of exploitation could be partly achieved by extending the national network of wildlife reserves to the southern zone, where none exist at present. It is also desirable to bring hunting under the control of local associations under the aegis of village authorities.

The following actions are recommended to complement measures at the sectoral level:

- the completion and effective implementation of a National Environmental Action Plan, and improved inter-ministerial co-ordination on environmental matters.
- clarification and simplification of legislation relating to property. The aim should be to give the rural population sufficient security to encourage investment in farm improvements, tree planting, and the adoption of more intensive agricultural practices, and to encourage the development of a market in land.
- full implementation of political decentralisation, giving greater powers and responsibilities to local authorities, village associations (VAs), etc. with clarification of powers and responsibilities for the management of common property resources.

The following actions are recommended with specific reference to future adjustment programmes:

- SAPs should contain a balance of internal and external adjustment measures,

including action on the exchange rate if necessary. Otherwise, their success will be jeopardised and the onus of adjustment will fall on particular groups such as farmers, with potential harm to the environment.

- the timing and complementarity of SAP components need managing to prevent different elements interfering with each other's success. Reforms in prices, marketing, credit, input services, etc. should be undertaken consistently, to avoid giving conflicting signals to farmers, and maximising incentives to sustainable agricultural development.
- environmental aims and indicators should be explicitly included in SAPs.
- the recurrent budgets of public services critical for the environment, such as agricultural extension, forestry, conservation and anti-erosion officers, and other key farmer-support services, should be protected. This could be done either by earmarking revenues and budgetary guarantees, or by implementing sectoral programmes or projects closely synchronised with the SAP.
- in the above context, high priority should be attached to restoring subsidies on the use of commercial substitutes for woodfuel, and of fertiliser, as soon as the national fiscal position allows. In the case of fertiliser, subsidies should be offered as an inducement for the adoption of recommended packages, rather than as a general subsidy to all farmers.
- SAPs should provide for the continuation, or introduction, of key social and environmental programmes which would otherwise be neglected. Apart from environmental conservation and anti-erosion and anti-desertification programmes, basic health and education programmes should have resources to continue. Ideally, funding for these programmes should be covered by the original SAP programme, rather than left to separate, or subsequent, programmes. If this is impossible, such programmes should be closely synchronised with the SAP.

4.5 Prospects for the adoption of sustainable development policies

There are a number of serious constraints on the ability of the government and people of Mali to implement the above reform agenda. One of the basic tasks is to elevate environmental concerns to their appropriate place in a society that is very poor, which has serious macroeconomic problems to overcome, and which is undergoing a political transition to a democratic and decentralised regime. In the current political climate, small vocal groups find it easy to challenge the authority of the government.

Tackling the budgetary deficit is a fundamental, and urgent, precondition to any kind of progress. The dilemma is that the necessary actions may, in the short term, worsen the social and environmental problems noted earlier. This increases the importance of reordering public spending priorities and developing new and environmentally-friendly revenue sources (e.g. capture of resource rents, new levies on resource depletion, countervailing export taxes after devaluations, etc.).

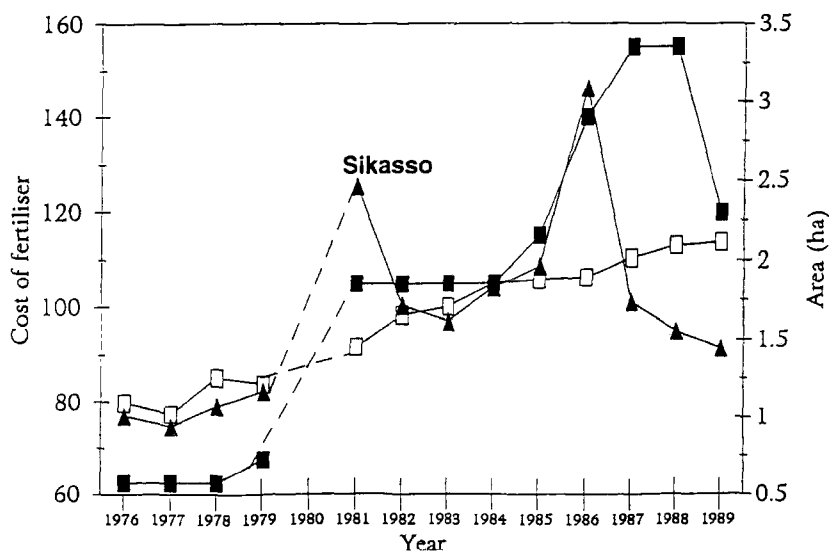
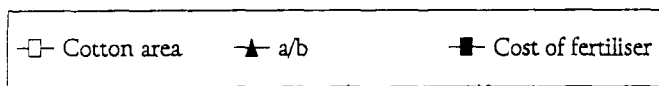
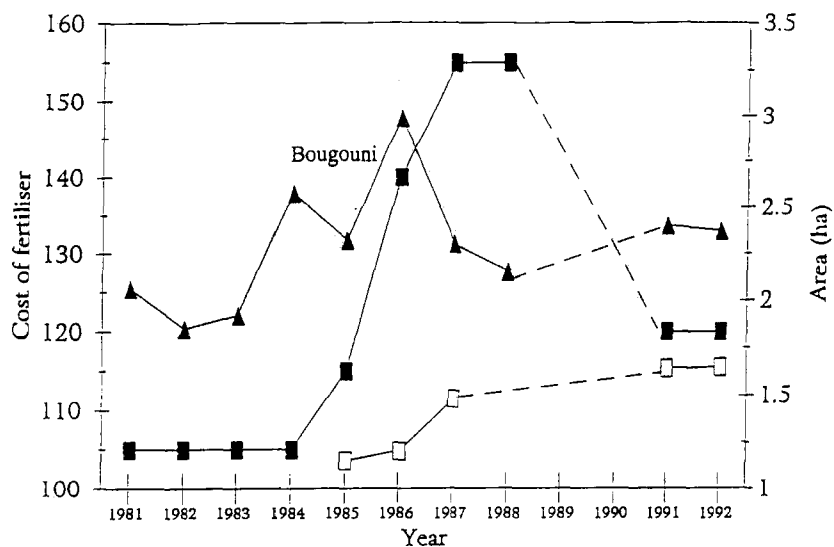
On the other hand, most Malians live close to nature, and environmental problems in their various guises do affect most of them intimately, and they would need little persuasion of their importance. Furthermore, the movement to

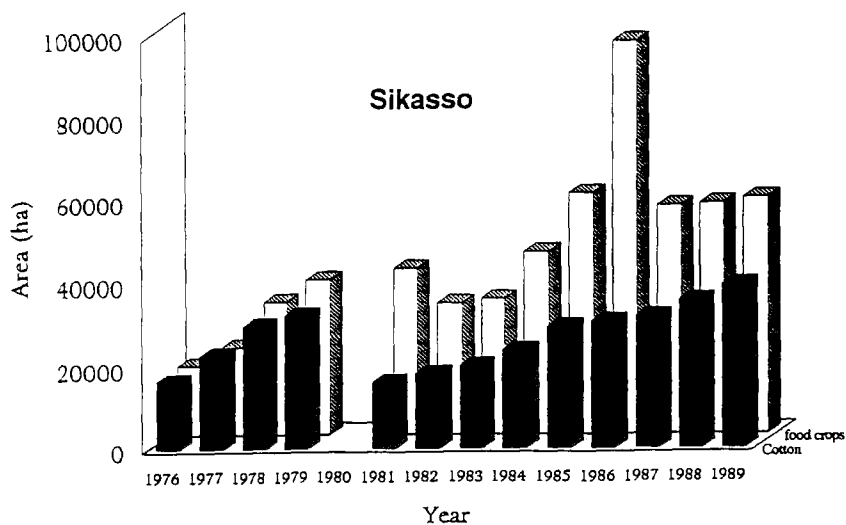
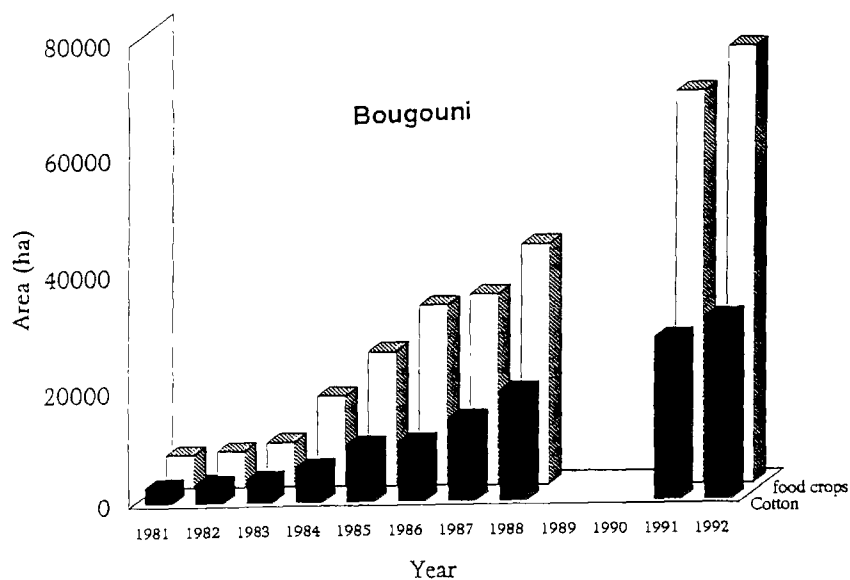
decentralise political responsibilities is potentially helpful to local environmental managers.

External donors, agencies and NGOs can assist in several ways. They should continue their level of support and adopt a realistic attitude to the adjustment timetable. They should consider increasing their level of support for local and recurrent costs in view of the government's difficulties in meeting its own commitments to projects. Finally, sustainability should become their constant criterion in judging what actions to take.

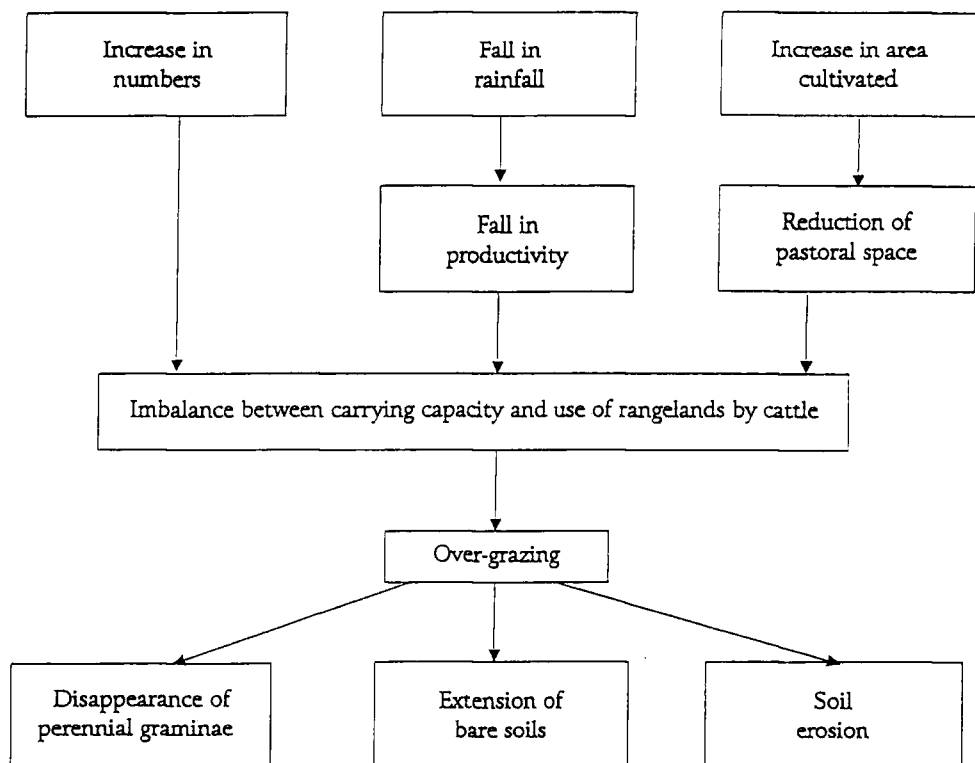
Appendix – Institutional Framework

Appendix Graph A1 Evolution of the costs of fertilisers and of a/b

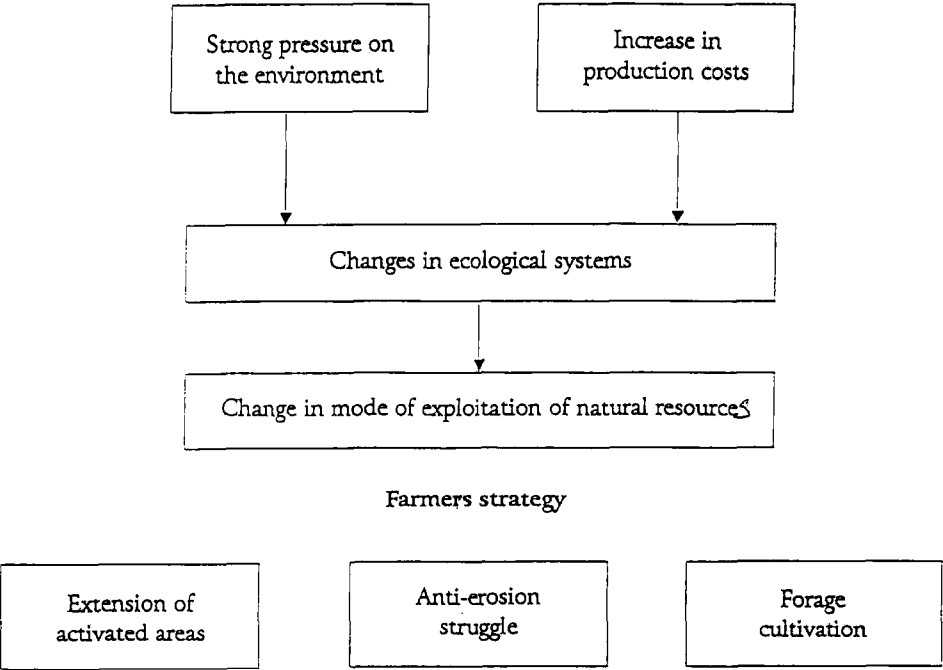


Appendix Graph A2 Evolution of cultivated areas

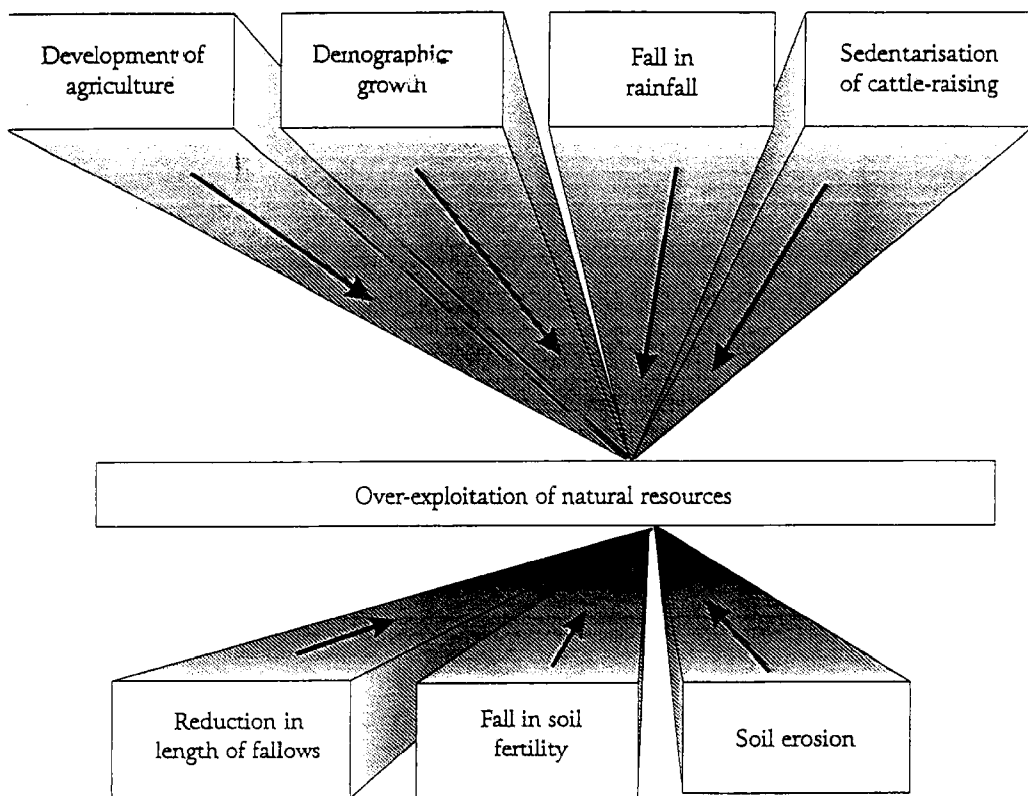
Appendix Graph A3 Causes and consequences of over-grazing on natural rangelands



Appendix Graph A4 Farmer reaction following change in mode of exploitation of natural resources



Appendix Graph A5 Causes and consequences of over-exploitation of natural resources



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