Conference Paper No. 4

Mali's White Revolution: Smallholder Cotton from 1960 to 2003

by

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paper presented at the InWEnt, IFPRI, NEPAD, CTA conference
"Successes in African Agriculture"

Pretoria

December 1-3, 2003

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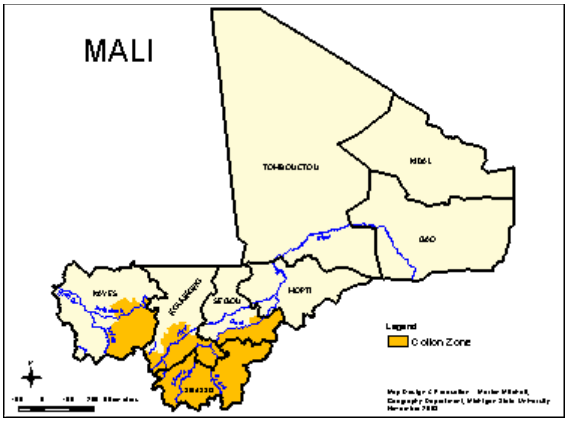
1. Introduction

In 1960, cotton production in the CFA franc zone in West and Central Africa[i] represented 11% of total cotton output in sub-Saharan Africa (SSA) and only 1% of the fiber produced in the world. Over the next four decades, the cotton sector in the CFA zone grew rapidly so that by 2000, cotton represented 4.4% of total world production and 70% of cotton lint produced in SSA. The CFA countries' share of the international cotton fiber trade rose from 2% in 1960 to 13% in 2000 and represented three quarters of SSA's cotton exports (see Table 1 in Annex). In 2003, fiber exports reached 16%, making the CFA zone the third largest exporter after the United States and Uzbekistan.

The story underlying this rapid growth is an interesting one. Cotton in francophone Africa is grown exclusively under rain fed conditions and hand picked by smallholders in rotation with coarse grains. State cotton companies have historically managed the sector, offering a guaranteed market for this high value commodity. The cotton sector has proven successful in generating foreign exchange and fiscal revenues at the macroeconomic level and access to equipment, high yielding varieties and inputs, increased cereal production, higher incomes and greater capitalization at the farm level. Higher rates of capital accumulation and productive reinvestment by farmers have contributed to improved productivity and welfare and spurred growth linkages in the non-farm sector in cotton zones. Revenues from the integrated systems have also helped finance infrastructure, such as roads, health clinics, and schools in the production zones, which increase welfare and productivity beyond just the cash crop/food crop systems. In addition, the cotton companies (particularly in Mali) have sponsored functional literacy and numeracy programs, which have greatly contributed to the ability of village associations to take on new economic activities, including handling the primary assembly of cotton. It is for these reasons that cotton is viewed as a "strategic" industry in most countries in the franc zone.



This paper examines the historical development of cotton production in Mali. Mali is the largest producer and exporter in the zone and considered to be the most fully integrated in the region. It provides an interesting example for understanding the factors affecting the success of cotton in the CFA zone as well as those helping to define its future.

This paper is organized in five parts. The following section briefly describes the historical development of cotton and the organization of the sector in Mali. The second section presents aggregate production trends and a brief analysis of the world cotton market. The third and largest section then looks at factors affecting performance of the sector in four periods over the last forty years. The fourth section discusses the key challenges facing the sector. The final part centers on the implications of this experience for other sectors and countries.[ii]

2. Description of Mali's Cotton Sector

2.1 Historical Origins

Historians trace the origins of cotton production in Mali to Arab influence in the 11th century (Kergna et al. 2001). Its modern development originated in French efforts in the early 20th century to develop an independent supply of raw material for its textile industry (Fok ; Dione 1989; Dequecker 1998).

The French colonial administration opened the first experimental farm in 1919 to test imported seed varieties and perfect cropping practices destined for use in the irrigated perimeter under development by the *Compagnie de Culture Cotonniere du Niger* (later the *Office du Niger*). Through settlement and organization of farmers by coercion, cotton production reached 8,000 hectares before giving way to irrigated rice production (Dione 1989). Following the difficulties and high cost of developing irrigated cotton production, the French government turned its focus to expansion in rain fed areas of the French Sudan. Although several cotton gins were operating in central and southern Mali in 1936, it was only after the Second World War that French cotton efforts began to move forward. In 1946, the French government established a research institute (*Institut de Recherche Cotonniere et des Fibres Textile Exotiques* - IRCT) followed by a cotton development company (*Compagnie Francaise de Developpement des Textiles* - CFDT) in 1949. Shortly after its establishment in 1946, IRCT opened up the N'Tarla experiment station and farm school in Mali to carry out applied research, breed new varieties and train extension agents (de Carbon Ferriere 1969; Kergna and Kebe 2001; Fok ?; Dione, 1989).

As the majority shareholder and director of CFDT activities, the French government viewed the cotton company as a specialized technical company to promote and develop rain fed cotton production as well as to assist in the implementation of France's development and cooperation efforts in West and Central Africa (Vinay, 1999; Dione 1989).[iii]

2.2 Structure of CFA Zone's Cotton Sector

The cotton industry in the CFA franc zone is characterized by varying degrees of integration of the production, ginning and marketing functions under the control of the state-owned cotton company. Although this integrated sector approach is often attributed to the French cotton experience, Fok notes that it is actually a collective European invention initiated in the 1920s by Belgium, Great Britain and Portugal (1999). An anti-merchant bias and propensity for direct state intervention prevailing in Sudanese political circles prior to as well as the French colonial legacy of central planning are additional factors contributing to the use of this approach (Dione 1989).

Most countries in the franc zone established state cotton companies after independence, with the CFDT as a minority shareholder. The integrated approach used to produce cotton in the franc zone begins with a varietal breeding and agronomic research program managed by national agricultural research systems in a network of franc zone countries

developed by IRCT and more recently coordinated by France's international agricultural research center (*Centre de coopération internationale en recherche agronomique pour le développement* – CIRAD). In Mali, the *Institut d'Economie Rurale* (IER) manages cotton research activities. In addition to supplying inputs (seeds, fertilizer, pesticides) on credit and facilitating the acquisition of animal traction equipment, cotton companies have used an extensive network of field agents to closely monitor all phases of production.

With a monopsonist-monopoly position, state cotton companies have guaranteed the purchase of farmers' seed cotton at panterritorial and panseasonal prices and assure credit reimbursement. They have traditionally controlled collection, ginning, baling and export.

Continued partnership with the CFDT has allowed national cotton companies to receive technical expertise for their ginning operations and sector management expertise. Over 95% of seed cotton grown in the franc zone is sold as cotton lint on the international market with the remaining 5% sold domestically to textile manufacturers. The majority of cotton in the franc zone is graded as middling 1 1/32" and has commanded a 9.3% quality price premium above the Cotlook A index (Gillson 2004).[iv] COPACO, a CFDT marketing subsidiary and major international trading company, has historically sold the majority of CFA zone cotton on international market to spinning mills. COPACO, which is owned partly by the CMDT and other franc zone cotton companies, has benefited from scale economies (15% of world trade) in helping to establish a market identity for franc zone cotton (ICAC, 1996; Bingen et al. 1995). Cotton companies' association with the French multi-national has also facilitated access to international credit markets, not to mention development assistance from France's bilateral organizations (Ministère de la Cooperation[v], Agence francaise de developpement or AFD).

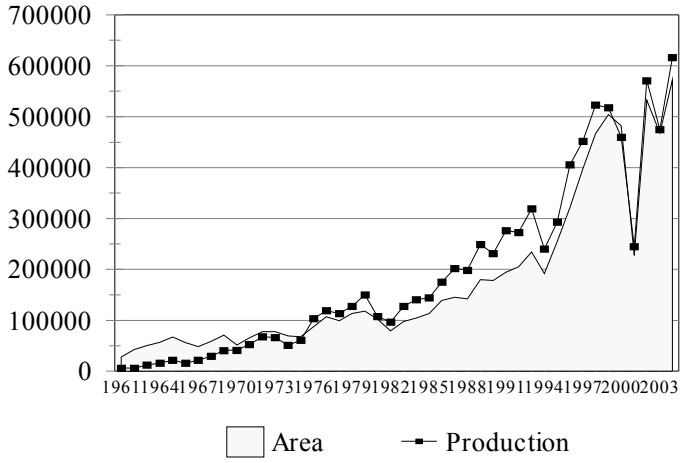
Cottonseed (separated from lint during ginning) is transferred or sold to subsidiary oil processing firms that manufacture soap, edible oil and animal feed, raw material for two domestic textile mills

2.3 Aggregate production trends in Mali

Cotton is produced primarily in southern and central Mali under rain fed conditions averaging between 700 and 1200 millimeters per year. In 1960, Malian farmers planted 28,360 hectares and produced 6,381 tons. Over the next 40 years, yields grew at a 3.6% annual rate and area planted expanded annually by 5.8%. In the 2003-2004 season, Mali produced 616,443 tons of seed cotton on over ??,000 hectares, representing a ??% annual growth rate. Average seed cotton yields have risen from 225 kg/ha in 1960 to over 1 ton in 2003.

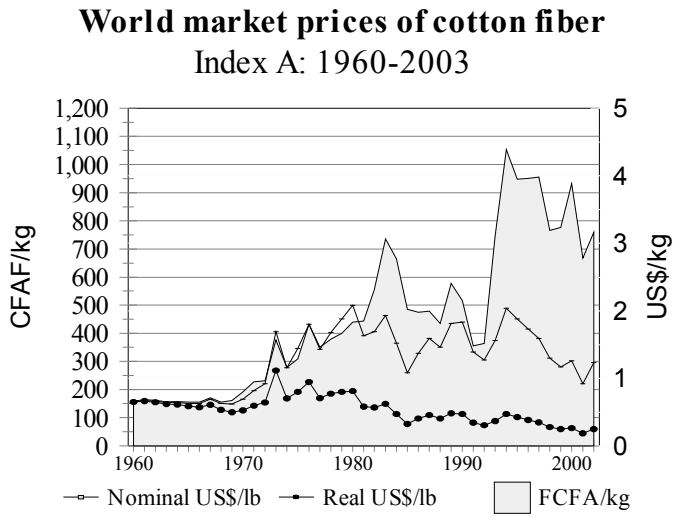
Cotton fiber production followed a similar trend as seed cotton, growing annually by 9.9% over this period. Growth in ginning outturn, the percent of fiber or lint derived from seed cotton during the ginning process, improved from 35% to 42% over the last forty years, a 0.5% annual growth rate.

Cotton area and production: 1960-2004



This phenomenal growth in cotton production had a large impact on Mali's economy. Cotton's share of GDP rose in real terms from 4.23% in 1980 to 8% in 1999; during the same period, agriculture value added decreased slightly from 42% to 40% (DNP, 2003).

With over 98% of Malian fiber exported, the cotton sector has historically accounted for a large share of total export earnings. They have ranged from 40% in the early 1990s to over 70% after the devaluation of the CFA franc in the mid 1990s. Cotton fell from its position as Mali's top earner of foreign exchange in 1997 following a large increase in gold production and drop in cotton production. In 2002, gold, cotton and livestock represented respectively 64%, 23% and 4% of Mali's total foreign exchange earnings. Taxes paid directly and indirectly by the cotton sector have been one of the largest contributors to the national budget. In 1998, the cotton sector in the aggregate contributed 15.3% of the government's total fiscal revenues, the CMDT and producers representing respectively 11.5% and 3.4% (PAMORI, 2000). Cotton's historically large shares of both export earnings and fiscal revenues underline the "strategic" importance of cotton to Mali's economy.



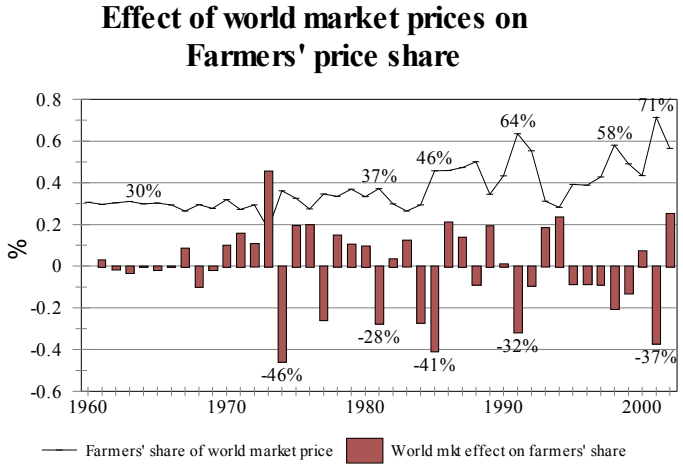
2.4 World market and price incentives

The effect and response to world market price variability has had a large role on the performance of Mali's cotton sector over the last forty years. As Figure 3 shows, the world market for cotton fiber (Cotlook Index A in US$) has been characterized by large annual fluctuations over the last thirty years.[vi] Expressed in real terms, international cotton prices have exhibited a significant downward trend since the 1960s, the result of slowing demand for cotton relative to synthetic fibers. By 2002, the real price of one kilogram of fiber was one third of its 1960 level.

Cotton prices have also become more volatile. After a period of relative price stability in the first twelve years after independence, cotton prices were 4.5 times more volatile in the 1973-85 period relative to the 1960-73 period and more than twice as variable between 1985 and 2002 (Baffes 2004).

The effect of the 50% franc devaluation in 1994 on the price of fiber is clearly evident when Index A is expressed in CFA francs. This macroeconomic shock coincided with a large upturn in international prices which together pushed the fiber sale price to over 1000 CFAF/kilogram. Between 1995 and 2002, however, the appreciation of the US dollar relative to the Euro partially moderated the 52% drop in cotton prices in the CFA zone (Bourdet 2003).

The administered price system used by the CFDT and CMDT has basically shielded Malian cotton farmers from the direct effect of world prices. During a relatively rare period of stability on the world market between 1960 and 1972, Malian farmers consistently received 30% of the world market price. As recent studies have shown, this level is quite low relative to other producing countries (Purcell, 1997). Cotton farmers in Zimbabwe and India received 37 and 60 percent more for similar types of seed cotton between 1983 and 1995 and 80 to 100 percent more since 1994 (Baffes 2004).



During periods of falling world prices over the last twenty-five years (e.g., 1985, 1992, 1995, 1999), since the CMDT did not feel they could decrease producer prices, farmers' share of world prices jumped rapidly (Figure 4). In combination with the relatively high cost of maintaining an integrated system, producer price rigidity exacerbated operating losses incurred by the CMDT. French development agencies (i.e., AFD, Ministry of Cooperation, CFDT) together with the Malian government and the European Union provided financing to cover these deficits. Inversely, during the upturn in world prices following these crises, administered producer prices have not been immediately adjusted upward, thus providing a window of opportunity for the French and Malian governments to generate large profits and recover their losses (Dorey, 1999). This interaction between world market prices, institutional price rigidity and deficit financing/profit taking behavior of the two main shareholders has been a reoccurring cycle over the last three decades and one reason underpinning efforts by the World Bank to reform Mali's cotton sector (Badiane 2001).

3. Four periods

Upon examination of the aggregate production trends and consideration of the effects of institutional, technological and policy factors underlying growth, four periods can be delineated in the evolution and performance over the last forty years:

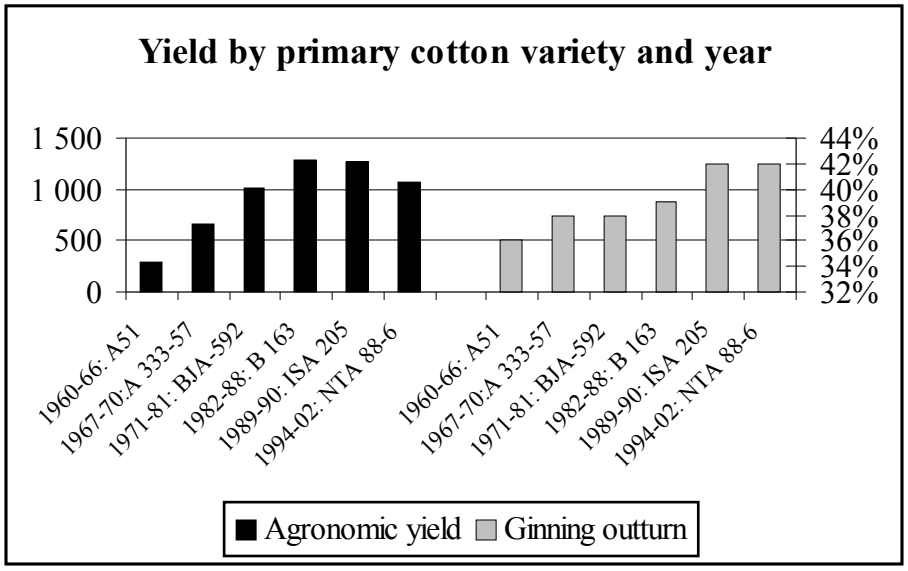
1960-1973: CFDT: the early growth years
1974-1993: CMDT, crises and farmer organizations
1994-1998: Devaluation
1999-2004: Growing pains

The following section looks in detail at the evolution of the sector during each period. For each period, this section identifies the forces (incentives and production possibilities) driving change in farmer behavior and performance, the actions and responses of farmers and other key sector actors and the implications for farm and overall sector performance.

3.1 The early growth years: 1960-1974

Contrary to other countries in the region that created state cotton companies at independence, Mali did not nationalize cotton production until 1974. Based largely on the experience and expertise developed by the CFDT in the 1950s, the Malian government maintained the colonial system after independence in 1960 eventually signing a 10-year formal contract with the CFDT in 1964 to manage the sector (Bingen et al. 1995; Kergna and Kebe 2001). During the first five years, the CFDT's doubled acreage to 56,000 hectares and increased average seed cotton yields from 225 to 322 kg/ha.

It was also during this period that the scope of the intervention of the CFDT as a rural development agency was progressively broadened into an integrated rural development program. The establishment of programs in livestock production (1969), in rural functional literacy (1971) and for blacksmiths to manufacture animal traction equipment (1970) complemented the CFDT's cotton program (Dione 1989). This broader mandate did not however affect the focus on increasing productivity through the promotion of mineral fertilizer and pesticides, the development and adoption of high yielding varieties and improved cultivation techniques and the acquisition and use of animal traction equipment.



3.1.1 Improved seeds and pesticides

Mali's success in developing a continuous stream of new technology over the last four decades is directly related to the effective collaboration between the French and Malian agricultural research institutes (i.e., IRCT, CIRAD, IER) and cotton companies (i.e., CFDT/Dagris, CMDT) as well as regional cooperation with similar institutions in neighboring franc zone countries. These partnerships resulted in the production, multiplication and successful adoption of six new seed varieties with progressively higher agronomic and ginning yields and improved fiber quality characteristics (length, fineness, color, strength, maturity and impurity content) that were desired by the textile industry (Dembele 1996; Kergna et al 2001; Follin 1999). This steady progression of improved varieties underlines the consistent effort by breeders to breed higher yielding varieties that responded to both agronomic concerns of Malian farmers as well as ginning and quality concerns critical to overall sector profitability and export sales.

The success achieved by Mali's cotton sector in developing increasingly higher performing varieties cannot be attributed exclusively to breeding efforts in Mali. Only one of the six varieties adopted as the principal variety (over 80% adoption rate) in Mali was initially bred in the Malian research system (NTA 88-6) (Dembele 1996; Kergna et al. 2001), the others originating from Chad, Central African Republic and Cote d'Ivoire. The cross national manner in which cotton breeding has taken place in the franc zone underlines the important synergies that can be gained both from a collaborative intra-regional approach in agricultural research as well as partnership between national and international research organizations.

In addition to improved varieties, the increase in the use of pesticides, the widespread adoption of ultra low volume pesticide equipment (ULV) and the introduction and use of pyrethroid pesticides have been major factors contributing to improved yields. The introduction of the ULV method in the early 1970s freed farmers from transporting large quantities of water to the fields to apply pesticides, providing an additional incentive to

expand acreage and improve yields. The introduction of pyrethroid pesticides in the late 1970s also contributed to important improvements in yield. These developments in the pesticide area were estimated to have contributed 35 to 50% of seed cotton yield growth in the francophone zone in west and central Africa (Follin et al. 1999).

3.1.2 Fertilizer Response

Fertilizer promotion was also a major focus of the CFDT and CMDT during this period. The use of subsidies on NPKSB complex and urea fertilizers through 1984 was a major incentive encouraging farmers to purchase them on credit and apply them to their fields. Although detailed farm level data is not available for the period between 1960 and 1974, more recent analysis over the last twenty years has shown that Malian cotton farmers have been applying quantities 30% below recommended levels (Section 3.3.3).

Throughout the continent, fertilizer has been shown to result in a marked difference in seed cotton production (% increase in yield), with yields increasing more than 50% in over 60% of the trials analyzed (Yanggen et al., 1998). Available data on cotton's response to fertilizer has shown a decline over the last four decades. From the 1960s through the 1980s, various station trials recorded yield increases ranging from 2.6 to 11 kilograms of seed cotton per one kilogram of fertilizer nutrient (nitrogen or N+P205+K20). Ratios, which are equal to or greater than 10, are considered efficient (Pieri 1989; Henao et al. 1992). These studies suggest that response rates have declined over time; one study show rates decreasing from 10 to 2.6 kilograms between 1969 and 1982. They also note that on-station results may exaggerate the response obtained by a typical farmer who does not always use optimal cultural techniques (Henao et al. 1992). For example, a Malian farmer may see a 5 kg increase per kilogram of nutrient compared to 10 kilograms on station (Gigou 1989). More recent studies of the response per kilogram of fertilizer (rather than kilogram of nutrient), while complicating comparisons, show a 3.2 kilogram response compared to 6 kg for maize and 3.3 to 4.3 kg response for rice (Kieft 1993). Trials in Cote d'Ivoire also showed cotton response rates at half the level of maize (5kg versus 10 kg) (Gigou 1989).

Given the low output/nutrient ratios (kilograms of output per kilogram of nutrient), the seed cotton producer price must be high relative to the cost of fertilizer for production to be profitable.[vii] Numerous analyses undertaken in Mali throughout the 1980s showed that the gross income attributable to fertilizer relative to its cost (value/cost indicator – V/C) is quite low. Value/cost ratios ranged from 0.5 to 1.9, levels that are inferior to the benchmark rate greater than 2 at which farmers' financial incentives are considered to be adequate (Yanggen et al., 1998). These results appear to be consistent with Malian farmers' practice of purchasing fertilizer on credit but applying less than the recommended level. Farmers often prefer to sell part of it, use it on maize or spread it over a larger area of cotton fields.

3.1.3 Animal traction

Farmers' adoption of draft oxen and equipment was influenced by the CFDT's promotion, heavily subsidized prices and widespread belief that the use of animal traction increased farm profitability. The certainty of a guaranteed market for seed cotton provided farmers a reliable income stream thereby reducing the risks of investing in this new technology. Since few farmers had access to formal credit to finance their initial purchase of a plow and draft oxen, investment in capital consuming technologies was a gradual process that averaged four to five years. But once farmers had purchased their first piece of equipment, they had a greater chance to obtain formal loans for additional agricultural material since the formal lender perceived that better equipped farms had a higher capacity to reimburse the loan (Dioné 1989).

Farmers' enthusiasm for animal traction multiplied since its laborsaving effects allowed farmers to expand their area cultivated and increase yields. Studies conducted in the 1980s point to a 40% extensification effect of animal traction (the difference of landholdings per worker between non-equipped to well-equipped farms) and a 30% labor savings for fully equipped over manual farming (Dioné 1989; Whitney 1981; Cisse 1987; Doumbia et al. 1986). In other words, equipped farms had a greater cultivated area per worker and greater labor savings relative to non-equipped farms.

It is important to note that the extensification effect of animal traction equipment was both "accompanied and restricted by a simultaneous intensification effect" in which increasingly mechanized farms become familiar with and adopted other technological improvements (Dioné 1989). More recent research has confirmed that animal traction also has a positive effect on yield growth. By facilitating more timely and improved land preparation as well as early planting and well-timed weeding, ownership of animal traction equipment enables farmers to respect the cropping calendar and increase yields (Giraudy 1999; Follin 1999; Sargent et al. 1981).

The acquisition of draft oxen also resulted in a consistent source of manure whose application was being promoted by the CFDT to improve productivity growth and soil fertility. CFDT/CMDT efforts to supply animal feeds – cotton seed cake, a by-product of cotton seed oil extraction - and veterinary services were critical inputs to combat cattle disease and promote good animal nutrition in the zone. Their animal husbandry programs emphasized the good management and care of draft animals so they would be available to work at the start of cropping season. The financing, equipping and training of blacksmiths to manufacture spare parts, plows and other equipment were an equally key input into agricultural mechanization efforts.

CFDT efforts were so successful that by 1974, 56% of cotton farmers were using animal traction to plow their fields, 70% applied fertilizer and 84% used pesticides (Coopération Française 1991). Malian farmers owned over 100,000 draft oxen and 37,500 plows (Boughton and de Frahan 1994). The FAO estimated that Mali had more than half the total number of plows 2% of the ox-carts and 40% of all draft animals found in seven Sahelian countries. These levels indicate approximately 25 to 30% of Mali's farm households used their own animal traction in the mid 1970s (Dione 1989).

This progression toward increased mechanization of cotton households continued over the next two decades. In 1985, 46% of CMDT farmers owned a complete set of animal equipment, with 32% owning a partial team (either an oxen team or plows) and 22% still without equipment. By 1993, the percentage of equipped farms (combining Type A and Type B farms in the CMDT's farm classification system based on equipment levels) had increased to 71% while the semi equipped and non-equipped farms dropped respectively to 13% and 15%. There is more recent evidence pointing to the break up of very large, well equipped farm households (those with multiple animal traction teams) into smaller autonomous but less well-equipped farms (e.g., brothers splitting off from cousins and other members of an extended family to produce cotton independently albeit with a smaller number of equipment assets) (Kebe and Kebe 1996).

Table 1: Evolution of farm equipment levels and land holdings

	Phase 1 (1960-1973)	Phase 2 (1974-1993) 1985	Phase 2 (1974-1993) 1993	Phase 3 (1994-1998) 1998	Phase 4 (1999-2003)
Number of farms		93,094 (1989)	135,111	182,489	.200,000
% Farms by equipment level					
Type A		46%	30%	30%	
Type B			41.5%	44%	
Type C		32%	13%	14.4%	
Type D		22%	15%	11.5%	
Draft oxen	110,000		347,022	493,447	
Plows	37,500		123,746	198,035	
Cotton area cultivated (ha/farm)					
Type A			3.3	4.3	
Type B			1.8	2.8	
Type C			0.8	1.2	
Type D			0.7	1.4	

The 1985 results classifies farms as follows: equipped farms own a plow, weeding and transportation equipment plus animals; semi-equipped lack part of the draft equipment and/or animals and non-equipped owns no draft equipment (Dione 1989). Since the early 1980s, the CMDT stratify farm households into four groups based on the following: Type A – Owning at least 2 traction teams (a team consists of two oxen and a plow or multicultvateur) and at least 6 head of cattle; Type B: 1 traction team without any cattle; Type C: an incomplete traction team with animal traction experience; Type D: non-equipped farm with no animal traction experience (Kebe et al. 1998)

3.1.3 Performance

The CFDT's early intensification efforts proved very successful. Between 1960 and 1974, seed cotton yields grew at annual rate of 15%, tripling average yields to 833 kilograms per hectare. The area under cotton cultivation expanded at an annual 5.5% rate over the period reaching 69,000 hectares in 1974. The combined effect of large productivity gains and sustained rapid expansion in area cultivated (arising primarily from the increasing number of farmers growing cotton) resulted in 20% annual growth in seed cotton production. Improvements in ginning yields were more modest, rising from 34% in 1960 to 36% in 1974 (0.75% annual growth). Consequently, with cotton fiber production

growing annually at 21%, Mali exported tons of lint in 1974, an eightfold jump from 1960 levels.

Table 2: Growth rates by Development Period

	Phase 1 1960-1973	Phase 2 1974-1993	Phase 3 1994-1998	Phase 4 1999-2004	Total 1960-2004
Area growth	5.5%	5.5%	22%	4%	5.9%
Yield growth	15%	2.1%	-2.5%	1.3%	3.3%
Output growth	20%	7.7%	20%	5.2%	9.2%

Farm-level data do not exist for this early period to permit any analysis of the profitability of cotton production. But as the following sections explain, in addition to their perception of cotton's profitability relative to other crops, farmers' interest in growing cotton stems as much from its reliable market and cash payment at harvest and access to credit and inputs that were not available to those who did not grow cotton in the zone.

3.2 1974-1994: CMDT, Continued Growth and Crisis Management

Following the gradual development of Malian capacity to manage the sector in the first fourteen years following independence, the Malian government nationalized the cotton sector in 1974 by creating the *Compagnie Malienne pour le Developpement des Textiles* (CMDT). The CFDT retained a 40% stake in the new company, thus allowing the sector to benefit financially and technically from the continued association with the French company (and government) and access to external capital for rural development programs in the CMDT zone (Bingen et al. 1995; Dione 1989).

This period marked the start of activities recommended in Mali's 1972 Rural Development Operation strategy in which the CMDT received the mandate to promote integrated rural development. Between 1976 and 1988, the CMDT carried out two successive projects (Mali-Sud I and II) co-financed by the World Bank, IFAD and French development agency funds (FAC and AFD[viii]) (Dione 1989). Under these projects, the CMDT began to provide key public services that were viewed as a complement to their cotton-specific actions. These public development interventions included both new and accelerated initiatives in the area of animal traction support, training and equipping blacksmiths, animal health, cotton research, maize production, rural roads, health and potable water infrastructure and support to farmer organizations. (Deveze 1994 ; Bingen et al. 1995). These complementary public programs, in responding to many of farmers' multiple needs, also served to strengthen the institutional and political position of the CMDT in Mali.

In discussing the performance of Mali's cotton sector during the first twenty years of CMDT's role as national cotton company and public development agency, this section focuses on three main issues:

- The emergence and growing role of farmer organizations in the cotton sector;

- The positive effect of the cotton/coarse grain production system on food security;
- And the impact and response of Mali's vertically integrated cotton sector to ever-constant world market price variability.

3.2.1 Farmer organizations[ix]

The advent of farmer groups was triggered in 1974 by a protest organized by a village-level CFDT agent in response to "dishonest cotton grading and weighing practices" (Bingen et al. 1995). His protest actions eventually led to the start of a process in which the assembly and weighing of seed cotton grading in villages was transferred from CMDT agents to cotton farmer organizations. After several successful years of carrying out these operations under informal arrangements, the CMDT formalized their relationship with these farmer groups or *associations villageoises* (AV). At the behest of the CMDT, farmer organizations also eventually agreed to assume responsibility for credit management and distribution of agricultural equipment and inputs among its members (Bingen et al 1995; Dione 1989).

Contrary to many previous efforts to organize farmers through top down initiatives characterized by compulsory membership and expert management, village associations grew out of farmer initiatives that were built on local traditions that allowed direct farmer participation (Bingen et al. 1995; Dione 1989). In agreeing to assume these new responsibilities for primary cotton assembly, village association involvement resulted in lower CMDT operating costs and higher credit recovery rates. The CMDT was also spared the prospect of having to tarnish its image through coercive intervention for recovery of production and input credit (Bingen et al.1995; Dione 1989). While clearly beneficial to the CMDT, the creation of farmer associations had huge benefits for equity and well being in cotton villages. The fees paid to village associations by the CMDT for services rendered in the assembly of seed cotton have been used to finance investment in community infrastructure (e.g., schools, health centers, wells) (Tefft et al. 2000). The CMDT supported this process and the growing role of farmer associations by providing literacy and management training (Bingen et al. 1995).

The number of village-level farmer organizations or *associations villageoises* (AV) expanded rapidly during this period, increasing from the first one in 1974 to 404 in 1981 and 950 in 1987. Farmer organizations had to meet a number of criteria established by the CMDT in order to be formally classified as an AV. The number of AV continued to grow so that by 2002, there were over 4,500 AV in the cotton zone.

In May 1991, only months after the popular overthrow of president Moussa Traore at a time when Mali was experiencing a "wave of political freedom", a group of leading CMDT farmers joined together to present the CMDT with a list of grievances related to specific cotton pricing and marketing practices. When the CMDT refused to consider these demands, the farmers called a cotton strike. Through the direct intervention of the Ministry of Rural Development, the government quickly agreed to nine of the twelve demands (with agreement to continue negotiations on the other three points). As part of a

series of steps to "restore a spirit of trust", certainty and control to the sector, a roundtable discussion between farmers, the CMDT, the Malian and French government and other major donors in September 1991 resulted in several agreements related to production quotas, preplanting announced cotton prices, farmer organization participation in cotton grading and access to animal feed. The participants also approved the creation of a representative, legally binding farmers' organization that would be party to all "relevant CMDT decision-making units"(Bingen et al. 1995). This organization would eventually become the Union of Cotton and Food Crop Producers (SYCOV).

3.2.2 Credit

Farmer associations' increasing and successful involvement in credit management and input distribution built on the earlier success achieved by the CFDT and CMDT in managing the importation and distribution of inputs and facilitating the provision of credit by the Malian banking system. Credit has been essential to the cotton companies' goal of promoting the adoption of technologies needed to improve productivity and increase the supply of seed cotton. By tying credit to the delivery of seed cotton at harvest, the interlocked credit, input and output markets that are tied to the CFDT/CMDT's monopsony provided a direct way for banks to get reimbursed by farmers for input and equipment loans.

Due to the CFDT/CMDT's strict credit discipline and outstanding solvency record in addition to the strategic importance of cotton in Mali, the sector always had priority access to funds of the banking system. The lower risks created by a reliable output market and annually fixed prices for seed cotton helped to increase demand for input credit. Improved farm profitability that was driven by productivity improvements emanating from the adoption of new technologies also contributed to increasing farmer's interest in inputs. In fact, growing cotton has largely been the only opportunity to obtain production credit and to purchase inputs in the CMDT zone. The cotton sector's success in establishing an interlocked credit, input and output market system for its farmers has however inhibited the development of independent credit and input markets in the zone.

Prior to 1980, input and equipment distribution and credit provision was exclusively managed by the *Societe de Credit Agricole et d'Equipement Rural* (SCAER), a government parastatal. Management difficulties, heavy subsidies, ineffective risk sharing mechanisms and weak contract enforcement contributed to its bankruptcy in 1980. The Banque Nationale de Developpement Agricole (BNDA) was established in 1981 to administer credit with the responsibility for input procurement and provision assumed by the CMDT and other rural development agencies (Dione 1989).

The CMDT's policy to prohibit new loans to farmers with unpaid credit (with the exception of crop failure) resulted in high loan repayment. Between 1980 and 1988, repayment rates never dropped below 90%, and reached over 97% in 1987 and 1988 with increasing involvement of farmers' associations in credit management (Dione 1989).

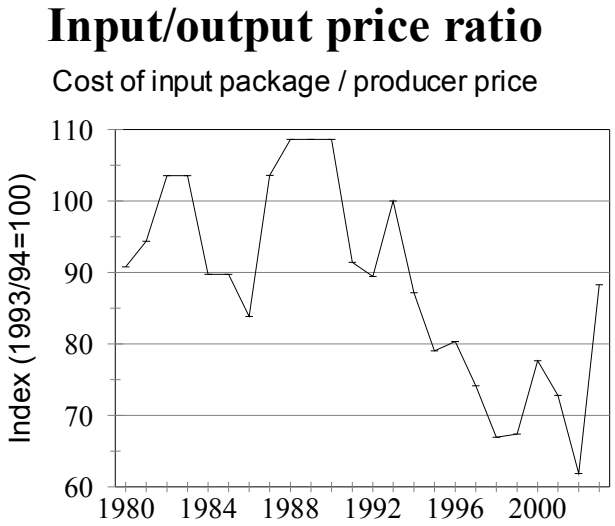
Based on the principle of group solidarity with joint liability to guarantee loan repayment, farmer associations' revenues were used as collateral to guarantee credit reimbursement

thus allowing a higher level of risk sharing. Since farmer associations were in a better position to determine the potential production capacity of individual farms and to collectively bear the risk of sponsoring more households, they were able to extend formal credit to individual small farm households that otherwise would not have been eligible for loans. Village-based farmer organizations were also able to obtain credit for hunger relief and collective cereal marketing activities in their villages (Dione 1989; Deveze 1994).

3.2.3 Farmer incentives and performance

The CFDT and CMDT understood early on that the successful development of cotton production in Mali would require a positive incentive environment to guarantee farmers' adhesion to growing cotton. They also realized the importance of being attentive to the needs and constraints of farmers and farmer organizations. This strategy aimed to establish a productive relationship with farmers that would reward them for their membership in the "cotton club" (Deveze 1994). The cotton companies understood, as many analysts have pointed out, that for most cotton farmers, production decisions and cropping practices are strongly determined by their concern with assuring their families' food needs and maintaining a certain standard of living in the least risky way possible. For many farmers who remain confronted with the basic problem of survival, they may assess the potential short-term benefit of using the recommended technologies, not only with respect to cotton but also as they contribute to the overall attainment of their objectives (Tefft et al. 1998).

As stated earlier, access to credit to purchase inputs and equipment, and the guaranteed market to sell their seed cotton at fixed prices have been major incentives for farmers to grow cotton. The socio-economic environment in general and the relative input and output prices in particularly have been major determinants affecting farmers' decisions on their cropping practices. Faced with producing cotton in a risky climatic environment, farmers have adopted strategies that minimize credit risks and cash expenditures on increasingly expensive inputs (Follin et al.1999; Giraudy 1999).



In the mid 1980s, rising input costs relative to seed cotton prices increased the input/output ratio by 20% (a rough indicator of incentives to use inputs) thus contributing to farmers' preference for extensification strategies over intensification practices. Stagnant output prices and reduced profitability also constituted a brake to the adoption of innovative new techniques including equipment use, cover crops, animal fattening and the purchase of carts (i.e., for manure transport and application).

3.2.4 Cotton and Cereal production

Contrary to a popular perception that cash crops have a negative effect on food crop production and household food security, cotton production has proven to be a boon to coarse grain production in Mali. While the levels of cereal production for the country as a whole have varied widely since the 1960s, per capita coarse grain production has been much higher in CMDT zone.

Average Annual Gross Cereal Production, per capita (kg per person) by Region and CMDT production zone (1989/90 – 1997/98)

Region	Regional average	CMDT zone
Kayes/Kita	**133**	223
Koulikoro/Fana	**225**	407
Sikasso	**311**	241-454
Segou	**306**	132-314
National	**184**	314

Source: DNSI, 1999; CMDT, 1999.

Table 3

Cotton farmers traditionally cultivate cotton in rotation with coarse grains, particularly maize and sorghum. Unlike coarse grain production outside of the cotton zone, cereals grown by cotton farmers' benefit from the residual effect or direct application of fertilizers received and financed through the CMDT's cotton-based input/credit system. Maize, millet and sorghum fields also benefit from improved farming practices through the use of animal traction equipment that is financed by cotton income.

The results in Table 3, comparing mean annual per capita cereal production of CMDT farmers with the regional averages, reconfirm findings from previous studies showing that coarse grain production is higher among cotton farmers than non-cotton producers. Net per capita cereal production has been approximately 70% higher for cotton farmers compared to the regional averages in the zones where cotton is produced. For example, in 1985/86 and 1986/87, a sample of farmers in the CMDT registered a net per capita production of 282 and 392 kilograms, two to three times higher than farmers outside the zone. The net coarse grain availability of farm households in the CMDT zone covered on average 15.5 months of adequate consumption (at 188 kg per capita per year), with the better equipped farms possessing up to 22 months stock. Regression analysis estimated that a 10% increase in per capita cotton area was associated with a 12% to 13% increase in net coarse grain availability per capita (Dione, 1989).

The higher historical performance of maize production in southern Mali was fostered by farmers' access to early maturing, disease-resistant maize varieties whose adoption was promoted by the CMDT's extension network primarily over the life of the Mali-Sud I (1977-84) and Mali-Sud II (1983-1990) projects. Well-equipped cotton farmers were able to satisfy maize's demanding husbandry requirements, such as frequent plowing and weeding and to purchase and apply fertilizer (Boughton, 1994).

Between 1960 and 1985, maize production increased annually by 3.5% while millet/sorghum grew a more modest 2.2% rate with the largest supply responses occurring during periods of relatively high prices (i.e., guaranteed prices in the early 1980s and after the 1994 devaluation). The total area planted to maize in the CMDT zone grew from 6000 hectares in 1975 to 51,000 hectares in 1987. With the use of fertilizer and selected local seeds, maize yields rose during the 1980s to reach 1.6 tons/ha in 1985, double their 1960 level (Dione 1989).

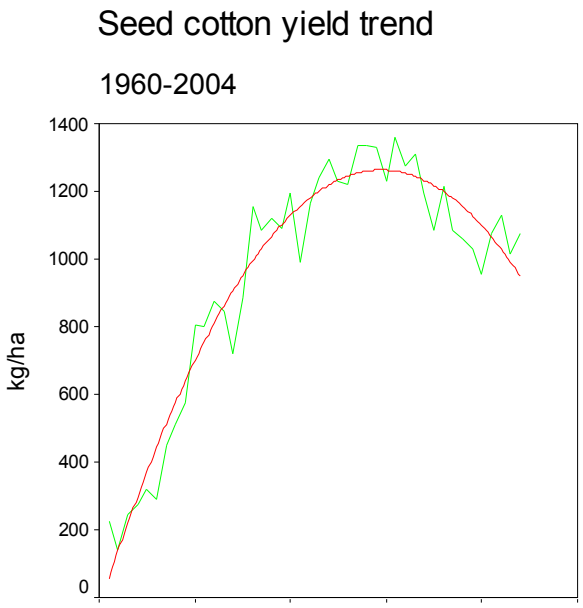
Research has shown that equipped farms obtain higher yields of both cotton and coarse grains than the semi-equipped and manual producers (Dioné, 1990; Raymond and Fok 1994; Kébé et al.,1998). Equipped farmers are also largely responsible for the majority of grain sales, primarily because of their higher per capita production. In 1986/87, farmers owning animal traction equipment accounted for 67% of grain sales in the CMDT zone; half of the total sales came from 6% of the farms (Dione 1989).

Finally, cotton revenues received at harvest enable households to meet their immediate cash needs (e.g., taxes, social functions) without having to sell cereal stocks immediately after harvest when prices are usually at a seasonal low (Dione 1989). And, the CMDT's construction of and annual maintenance of a network of feeder roads to facilitate the collection and transport of seed cotton has also been beneficial to food crop marketing, helping to lower marketing costs and integrate markets in the zone.

3.2.5 Yield growth

Between 1974 and 1994, agronomic yields continued to increase at a 2.1% annual rate, considerably lower than the 15% annual yield growth during the first 15 years. By the late 1980s, average seed cotton yields averaged over 1,300 kg/ha, (546 Kg/ha of cotton lint), a cumulative increase of over 600% since independence.

This growth was driven by the combined efforts of the cotton sectors' research and extension systems to maintain the flow and adoption of improved technology. The widespread application of pesticides and fertilizer, in addition to the continual improvement of seed varieties, are three of the main factors contributing to Mali's yield growth (each factor accounting for approximately one third of the yield growth. Other indirect factors such as animal traction and farmers' knowledge and respect of the cropping calendar including seeding dates and density, weeding, allowed farmers to maximize the benefits of these technologies (Follin 1999).



By 1991, productivity growth appeared to hit a peak after which yields began falling. Numerous factors have been cited as contributing factors to this drop in agronomic yields including the genetic potential of existing seed varieties and pesticide resistance (Follin et al. 1999). While many people point to the deteriorating producer incentives (input and output prices) as determining factors influencing farmer decision making and subsequently the decline in yield, the steady fall in the input/output ratio since the early 1990s would suggest that incentives have been improving (see Figure 6). Finally, between 1950 and 2000, annual rainfall levels have exhibited a statistically significant downward trend, declining annually by 6 millimeters in Sikasso.

3.2.6 Soil mining

Several soil fertility studies conducted in the early 1990s reported soil nutrient losses in the CMDT zone ranging from a few kilograms to over 100 kilograms per hectare. These results call attention to soil mining problem and risks of declining soil fertility to the sustainability of cotton production in Mali (Pieri 1992; van der Pol 1992; Smaling 1993).

In 1992, van der Pol estimated an average nitrogen nutrient deficit balance over the entire CMDT zone at 25 kilograms per hectare and predicted that at this soil-mining rate, soil nutrient reserves in southern Mali could only be sustained for thirty years. Subsequent studies in 1996, however, obtained less alarming results, namely a nitrogen deficit of 8.2 kg/ha in one area of the cotton zone with predicted soil lifetime of 95 years (Ramisch 1999). This study also underlined the complex methodological issues involved in making these estimates.

Based on a "historical snapshot" of a given year's agricultural practices, farm or village level case studies make numerous assumptions about soil processes and boundaries, including numerous environmental effects, crop rotation practices, the amount of grazing land that "supports the production of manure" and different agronomic, socioeconomic and cultural practices. This study highlights the variability of soil nutrient balances within a village (i.e., plot close to village: -11.9 kg/ha; parcels in distant hamlets: -4.7 kg/ha; livestock herder plots: +23.3). Although most researchers agree that soil mining remains a threat to the sustainability of cotton production in Mali, they also recognize that declining rainfall and other factors that affect farmer/herders' behavior (e.g., land tenure, cattle herders' watering rights) an important impact on results (Ramisch 1999).

3.2.7 Ginning performance

Over the entire two-decade period, the ginning outturn ratio advanced annually by 0.6%. This modest rate masks, however, important advances in cotton varietal breeding. In 1987, the CMDT began distribution of the ISA 205 variety, eventually displacing B163 as the sector's main seed cotton variety in 1989/90. Ginning yields jumped immediately and averaged 42% over the next five years, a 9% rise from the 38.6% level recorded during the preceding seven years of use of the B163 variety. These rates are among the highest in the world.

Although average seed cotton yields for the two varieties remained constant (i.e., B163 averaging 1,282 kg/ha and ISA 205 averaging 1,274 kg/ha), the higher ginning ratio of ISA 205 translated into higher profits for the CMDT. The 3.5% higher ginning ratio achieved with ISA 205 translated into increased lint production of 47.000 tons, relative to the quantity of fiber that would have been produced by B163. When valued at the existing sales prices over the five-year period in which ISA 205 was used, this quantity translates into an estimated gain of US$72 million, a 9% rise from what would have been earned had the CMDT continued to distribute the B163 variety. Although the increased ginning ratio reduced the share of cottonseed, ISA 205's higher oil content provided some compensation to the CMDT's subsidiary oil industry.

3.2.8 Price variability, cost inflation and cotton crises

Despite the improvement in agronomic and ginning yields, the 7.7% annual growth in seed cotton production during this period was driven primarily by an expansion in area planted, with average annual growth of 5.5%. The sector's performance continued to be strongly affected by world market price variability, rising production costs and the subsequent effect on farmers' incentive environment.

In the mid 1980s, the world price of cotton lint dropped precipitously following a structural shift in the United States' cotton support policy and China's shift from net importer to the world's largest exporter (McDonald 1997; Baffes 2004). The average market year price (Cotlook Index A) fell 21% between 1983/84 and1984/85 and a further 29% in 1985/86 (ICAC, 1999).[x] The vagaries of the market continued in 1986/87 when a 27% rise in world prices was canceled out by a 23% depreciation of the dollar relative to

the French franc. With the sales price of cotton lint hitting a 30-year low in 1985/86 ($0.49/lb or 375 CFAF/kg) and the sector's total delivered unit cost to produce cotton fiber averaging 505 CFAF, the CMDT lost approximately 130 CFAF per kilogram of cotton fiber. This situation naturally created a major crisis in Mali's cotton sector.

The onset of these crises created by the combined effect of falling world prices and growing cost of supporting the CMDT's cotton production and rural development activities revealed a growing frailty of the cotton sector. Audits showed that higher production costs were due to waste, overcharging, duplication of responsibilities, inadequate financial management and a lack of incentives to control costs (Cooperation Francaise 1991). Discussions between the CMDT, CFDT, Malian and French governments and other donors centered on several issues (The government-backed Chamber of Agriculture represented farmers' interests):

- The lack of management and financial rigor (i.e. lack of cost-control incentives in the negotiated cost structure (*baremes*) needed to curb cost inflation within the CMDT);
- The high cost of supporting production in low productive, marginal areas;
- A lack of commercial dynamism that resulted in less than optimal sales prices for cotton lint;
- Whether the increasing cost of these activities to support farming activities in rural Mali should be considered as a cotton-related production cost or state investment (and thus separate from the cotton budget).

Largely ignored during periods of high prices, many of these cost-related issues that became apparent in market downturns were intimately related to the structure of the CMDT-controlled sector and would continue to resurface over the next twenty years.

Several donors, as a condition of their financial assistance to the sector to help overcome its 9 billion CFAF deficit in 1985/86, required the CMDT and Malian government, as part of their agreement to implement structural adjustment measures, to undertake legal and economic reforms and a series of cost-saving measures needed to move toward financial equilibrium. These actions included more rigorous financial management, subcontracting part of seed cotton and lint transport to the private sector and giving CMDT direct control of lint exports (replacing SOMIEX, the state import-export agency). Perhaps most importantly for cotton producers, the CMDT modified farmers' incentive structure by freezing producer prices at 85 F/kg[xi] and reducing input subsidies (farmers' share of input costs increased from 75% to 94% of the actual unit cost) (Cooperation Francaise 1991). These initial cost reduction measures helped reduce the total delivered unit cost of lint by 14% to approximately 435 CFAF/kg and thereby allowed the CMDT to break even in the following two growing seasons (Coopération Française, 1991).

In 1989, with an eye to further increasing sector efficiency and productivity, the CMDT and Malian government signed a five-year performance agreement or "*contrat plan"*. In addition to separating the agro-industrial (cotton-related) functions from the public service development activities, this agreement set forth 1) production and marketing

quotas to maximize the limits of existing gin capacity, 2) price incentives to help meet the quotas that would be supported by a 3) stabilization fund and a 4) system for sector profit sharing with farmers.[xii] Farmers, while not signatories to the agreement, were represented on the CMDT's board of directors.

Limiting cotton production during this market downturn was not a new phenomenon since the sector had always been a meticulously planned supply chain. With the available ginning capacity as the determining or limiting feature of the system, every function in the vertically integrated supply chain was planned one year in advance. For example, the CMDT worked with farmer organizations to plan the quantity of inputs needed for the upcoming planting season (i.e. they estimated the inputs needed for the planned number of hectares, which - at the expected yield - would result in a given quantity of seed cotton that could be collected, ginned and baled before the start of the rainy season). Farmers' input needs were accordingly determined so that they could be ordered, imported and delivered to villages in the trucks collecting seed cotton in the preceding harvest (i.e., several months before planting).

This brief respite did not last long as a similar scenario transpired again in 1992-93 when world prices fell once again and the overvaluation of the CFA franc had eroded the competitive position of the Malian cotton sector. As in previous crises, the CMDT depended heavily on financial support from the Malian and French governments, the European Union and World Bank to cover their losses (Bocchino 2003). Deficit financing was provided during these market downturns because the governments and donors knew they could recuperate loans when world prices rose and the sector became profitable (Dorey, 1999). This was to occur particularly in the boom years after the 1994 devaluation of the CFA franc.

Up through the mid 1980s, there had been a convergence of views of the Malian and French government, farmers, CMDT/CFDT and World Bank vis-à-vis the role of cotton in promoting regional development. When the sector was forced to implement reforms to deal with the crises, this consensus began to unravel as the different actors sought to preserve their interests and claims on a reduced level of sector profits (Deveze 1994). One of the most important factors contributing to this change was the mounting dissatisfaction of cotton farmers with sector management and the growing power of their emergent farmer movement. As discussed in section 3.2.1, the 1991 farmer strike emanating from the CMDT's insufficient response to a list of farmer grievances led to "unprecedented political visibility" and quick resolution of their demands (Bingen et al. 1995). This action and subsequent agreements at a September 1991 roundtable meeting of sector actors resulted in the establishment of an independent producers' organization (Union of Cotton and Food Crop Producers - SYCOV) that would participate in all CMDT decision-making units and be a signatory to the second contract plan in 1994 (Bingen et al. 1995).

3.3 1994-1998: Devaluation

The 50% devaluation of the CFA franc was a monumental event in francophone Africa. Since 1947, the CFA franc had remained fixed at the exchange rate of 50:1 vis-à-vis the French franc. The January 1994 devaluation of the CFA franc was aimed at reducing the heavy dependence of the West Africa franc zone on imports, stimulating export production and import substitution and shifting consumer demand towards more locally produced goods and services. The ultimate goal was to stimulate self-sustaining, broad-based economic growth, which would reduce Mali's widespread poverty and food insecurity (Dibley 1995; Tefft et al., 1997).

This section looks at the impact of the devaluation on sector performance. It examines price transmission, farmers' response and sector performance. It also examines the effect of growing pesticide resistance and environmental degradation on sector productivity and longer-term environmental sustainability.

3.3.1 **Price transmission and the aggregate response**

The impact on Mali's cotton sector was immediate. Overnight, the CFA franc sales price of cotton lint doubled from 450 to 900 CFAF per kilogram of cotton lint. The devaluation coincided with a large upturn in world market prices (60% rise between 1993 and 1995), which together resulted in 189% nominal rise increase in the CFA price of fiber. The expected transmission to farmers of both the exchange rate induced price change and world market increases was however delayed. Even though the CMDT witnessed a 463 CFA franc net rise in the sales price per kilogram (kg) in 1994, given the rigidities in the producer price fixing system, farmers only received 30 CFAF/kg (the fiber equivalent of 12.5 CFAF/kg of seed cotton representing farmers' share of sector profits earned during the 1993/94 marketing year); and this amount was only received when farmers were paid in 1995 for their 1994/95 seed cotton harvest.

Over the next five years, the CMDT gradually raised the nominal base producer price of seed cotton 65% from 85 to 140 CFA francs per kilo or 39% in real terms. When farmers' share of sector profits ("ristourne") is included, nominal producer prices increased 100% between 1993/94 and 1998/99. Although the long lag in transmitting the price increases to farmers resulted in a large decline in farmers' share of the world market price below 30% in 1993/94, the subsequent producer price rises and world market price pull back contributed to a gradual increase of their share to 54% in 1998/99 (Figure 4).

The price of imported inputs also rose. In the first five years after the devaluation, input prices increased cumulatively by 35%, considerably lower than overall inflation (inflation of 54%). The cost of fertilizer rose 65% during this period but the nominal cost increase of the entire input package was moderated by a change in the type and quantity of pesticide used by farmers. This put downward pressure on the input/output ratio (cost of farmers' input package relative to the price of seed cotton), whose 33% fall presumably improved production incentives. Although the producer price of seed cotton was increasing at a faster rate than input prices, the nominal increases in input prices that farmers observed in their higher credit repayments had a profound effect on production strategies.

3.3.1 A First Response to Devaluation - Extensification

Higher farm-level prices spurred large increases in the production of seed cotton and in the quantity of cotton ginned. Between 1994 and 1998, production grew annually by 21%. In the first four years after the devaluation, seed cotton and lint production increased 118%, tracking a similar trend witnessed throughout the region. The consequential increase in cotton lint exports quickly pushed the francophone CFA countries' world market share from 8.8% in 1991/92 to 15% in 1997/98.

This expansion arose primarily through increases in area cultivated. Over the entire cotton sector, acreage planted to cotton grew annually by 7.6% between 1994 and 1998. Within cotton farms, the CMDT observed that farmers had expanded area planted to cotton by 85% and to coarse grains by 29%, resulting in a 45% average increase in total area cultivated among cotton farm households. On a per farm basis, the higher growth in area planted to cotton relative to cereals increased the cotton's share of total farm landholdings from 23 to 30%, while reducing the area planted to cereals from 61 to 55% (Table 2).[xiii] By 1998, the average cotton farm in the CMDT zone planted 2.4 to seed cotton and 4.4 hectares to cereals with a total area of 8 hectares (CMDT 1998).

Most farmers increased acreage cultivated by reducing fallow periods and clearing new lands, the latter behavior predominant in the relatively newer production zones (Giraudy, 1996; Diakité et al., 1996; CMDT, 1999). The CMDT monitoring division observed that farmers were replacing the traditional five to seven year fallow period on 50% of their holdings with almost continuous cropping; the other one-half of their acreage was left in a 10-13 year fallow system (Giraudy, 1999). Kébé and Brons point out that in Mali's traditional cotton basin where there is human and animal demographic pressure on the land, many farmers have begun putting fallow land into production out of fear of losing their customary rights to a given parcel (1994).

Change in area planted			
	93/94	97/98	% Change
Ave. cotton Area planted (ha)	1.3	2.4	85%
Ave. cereal area Planted (ha)	3.4	4.4	29%
Total farm size (ha)	5.5	8	45%
% Cotton area of total hectares	23%	30%	30%
% Cereal area of total hectares	61%	55%	-10%
Ave. # members in farm household Size	12.7	15.1	19%

Table 4

The growing availability and use of animal traction equipment was a major factor facilitating the rapid increase in total area planted.[xiv] After the devaluation, the number of equipped and semi-equipped farms (Types B and C) increased respectively by 6% and 11% while the manual or non-equipped farms declined by 23% percent (CMDT 1998).

The CMDT's decision to open production in the Kita district in western Mali was another factor contributing to the large increases in area cultivated. With the addition of approximately 15,000 farm households beginning cotton production and an increased number of households migrating to the cotton zone, there was a large increase in the total number of cotton households. Despite this massive influx, the CMDT was successful in integrating them into their production support system. In 1998, 93% of the farm households in the CMDT zone grew cotton and benefited from their services, up from 84% in 1993. And by 2000, there were over 200,000 farm households growing cotton in Mali, a 50% increase since 1993.

It is important to underline that the supply response after the devaluation was made possible by the improved economic environment and industry profitability that convinced the CMDT to invest in increased ginning capacity. The construction of four new cotton gins and upgrading of others (a total of 17 gins with a capacity of approximately 600,000 tons) subsequently allowed the CMDT to lift strict production quotas and unleash farmers' pent up demand for expanding production.

The large supply response was not limited to cotton. Average per capita cereal production of CMDT farm households increased cumulatively by 14% in the four years following the devaluation, reaching 367 kilograms per capita in 1998 (CMDT 1998). Per capita maize and sorghum production in equipped farms was 45% higher than those without equipment (Kebe et al. 1998).

3.3.2 Yield growth, Input levels and Environmental Sustainability

While area planted increased substantially, average seed cotton yields continued their downward slide between 1994 and 1998, dropping 10% during the period. Average maize yields, in contrast, increased annually by 5% over these four years. With a slightly improved incentive environment after the devaluation, the percentage of cotton acreage receiving inputs increased from 32 to 43% between 1994/95 and 1997/98 while the CMDT reported an increase in the percentage of maize fields receiving fertilizer from 50 to 67% (Doucouré and Healy 1999). Farm level surveys show relatively little change in the quantity of NPK fertilizer applied to cotton fields between 1993 and 1998 and current levels remain at 75% of the CMDT-recommended quantity (CMDT 1998; Kebe et al. 1998). Urea fertilizer use increased cumulatively by 15% after the devaluation and average use is slightly greater than the 50-kilogram recommendation.

Cotton farmers also increased the quantity of manure applied to their cotton fields (20% to 100% depending on the zone and farm type) but levels still remain half of the recommended quantity (5000 kg). Partially equipped farms (i.e., those missing a plow or a draft oxen) doubled the quantity of manure applied and their application rates are 22 to 44% higher than the better-equipped farms. Greater use of manure was made possible partly by an increase in the total number of carts owned by cotton farmers (an 11% increase between 1993/94 and 1997/98) as well as increased manure production spurred

by cotton farmers' increased investment in cattle. Farms without carts or draft animals were understandably handicapped in the production and application of manure.

In addition to the lower than recommended levels of fertilizer and manure, environmental concerns were amplified by farmers' minimal use of anti-erosion techniques. Despite many successful projects implemented in the 1980s and 90s to address environmental problems, the CMDT estimates that only 28% of cotton farm households have used anti-erosion techniques (CMDT, 1998). Surveys have shown that the majority of farmers undertake little conservation work in the off-season - spreading organic matter and anti-erosion work. Household members prefer to spend their time in commerce, horticulture and non-farm seasonal work to diversify income sources (Kébé and Brons, 1994). The intra-household distribution of cotton revenues may be one factor influencing the relative incentives of individual household members to perform this work.

Overall, the continued trend of extensification, in which farmers use insufficient quantities of mineral and organic fertilizers, increase area planted by reducing fallow periods and cultivating marginal land and do not follow recommended cropping practices (the large number of new cotton farmers do not necessarily have the same knowledge and skills), has contributed to low soil fertility and increased erosion. In their efforts to assure food and income security in the least risky way possible, farmers tend to focus on the potential short-term benefit of using the recommended technologies while discounting the long-term financial returns to soil recapitalization stemming from current investments in fertilizer and conservation work (Tefft 2000).

With well-tested technical solutions available, there is little argument of the need to improve farmers' incentive environment (i.e., lower input and higher output prices) in order to stimulate greater use of intensification practices and investment in long-term soil conservation measures.[xv] Sustainable solutions to environmental problems will inevitably need to go beyond the cotton sector to consider livestock/crop interactions, land tenure systems, wood collection and deforestation, crop diversification and the establishment of viable credit and input markets for all crops.

The effects of fertilizer runoff and pesticides on water supplies and more generally on the environment are unknown. There is also little empirical information on the effects of cotton production on human and animal health.

Mali's recently elected rural communes are well positioned to play a central role in working with communities and farmer organizations to address problems of land management and environmental degradation. After establishing the foundation of decentralized governance throughout the 1990s culminating with the election of mayors and communal councils for 703 communes in 1999, local governments have fiscal authority and a mandate to oversee the execution of decentralized actions in their jurisdictions including governance, health, education and infrastructure (Primature, Sécrétaire Général du Gouvernement, République du Mali 2002).

3.3.3 Pesticide use and resistance

Effective pest management has played a predominant role in the CFDT/CMDT's strategy to produce cotton and increase productivity over the last forty years. The CMDT/CFDT has followed a conscientious approach to pest management through the uniform use of lower cost pesticide "cocktails" in the cotton zone. These efforts have been effective in slowing the onset of pest resistance in a crop that is generally considered to be sensitive to pests and diseases. Numerous studies in Mali over the last thirty years have estimated potential crop losses due to pests between 20 and 35%, far lower than the 60 to 65% average loss rates documented in Africa (Delattre and Gall, 1982; Michel 1999; Oerke et al. 1999).

There is, however, growing concern that resistance is developing in certain areas and that current pesticides are becoming ineffective, particularly with respect to the increasing resistance to pyrethroid pesticides in the population of the American boll worm (*Helicoverpa armigera*) (PR-PRAO, 2000). There has also been a resurgence of secondary pests such as the white fly (Bemisia tabaci) that has developed after widespread insecticide use against other insects. Growing resistance is often cited as main determinant of decreasing seed cotton yields.

This situation has developed despite a doubling in the quantity of pesticide used on cotton over the 1990s. In fact, farmers increased the quantities used from 3.6 liters per hectare in 1994/95 to 7.5 liters/ha in 1998.[xvi] The impact on production costs was however tempered by the relative stability of pesticide prices after the devaluation. In addition to the doubling of insecticide use intensity, the concentration of pyrethroids in the cotton insecticide formulations has increased by 20% (Ajayi et al. 2002).

The problem of pest management and increasing resistance presents a formidable challenge to Mali's cotton sector with large implications for productivity and production costs. If pesticide resistance persists and Mali continues on the pesticide "treadmill", it will be necessary to use increasingly more powerful and expensive pesticides whose cost can only be supported by a commensurate increase in productivity (Van der Walk, 1999).

3.3.4 Future pest management technologies

The challenges confronting the cotton sector in Mali and throughout West Africa are substantial as research centers and cotton companies' work to assess the feasibility, effectiveness and limitations of new and different approaches to address the pest problem. Potential solutions include greater extension of the "targeted staggered application" method of pesticides, integrated pest management, the use of genetically modified organisms (GMO), the production of organic cotton without synthetic pesticides or combinations of all.

3.3.4.1 Integrated Pest Management

Since 1994, the CMDT has promoted a scheme of reduced insecticide use (targeted staggered applications or "*lutte etagée ciblée -LEC*) that has proven to be an effective alternative to current methods. Pesticide applications follow the usual calendar method but at reduced dosage with additional complementary sprayings dependent on the type and magnitude of insect infestation (when pest damage surpasses an economic threshold. Even though method has produced similar yield results but with 40% less pesticide, it has only been used on 2% of the total cotton area in Mali. Adoption has been limited by the need for extensive farmer training, considerable amount of farmer time needed to monitor cotton fields as well as a lack of publicity (Michel 2000 ; CIRAD 2004; Grain 2004).

In a similar fashion, initial experiences with integrated pest management techniques (IPM) in other countries have shown promising results. A Recent FAO farmer field school project in Mali to strengthen integrated pest management practices reported a 70% reduction in pesticide applications, a 25% jump in yields and 49% increase in farm revenues (Grain 2004; FAO ??). Recent experiences with ecology-based pest management in several Asian countries have recorded similar findings: reduced expenditure on pesticides, higher seed cotton yields and increased farmer incomes. By reducing use of the most harmful products, IPM also improved biodiversity in cotton fields by increasing the number and diversity of natural enemies (average predator-pest ratio was increased). Reduced exposure to pesticides (during mixing, spraying and cotton harvesting) in both the targeted staggered application method and integrated pest management also helps to limit pesticide poisoning and subsequently farmers' medical expenditures and the number of lost workdays (IPM Programme 2004).

3.3.4.2 Genetically Modified Organisms

Future productivity improvements may depend, however, on access to a variety of performance-enhancing genetics recently developed by multinational agro-chemical pharmaceutical firms. Both CIRAD/Dagris and a group of two international biotechnology companies (Dow Agrosciences, Monsanto and Syngenta) have recently signed agreement to conduct biotechnology research with IER in Mali (Dagris 2004). This work will including test and evaluate two types of genetically modified cotton:

- Herbicide resistant varieties that have been genetically modified to tolerate applications of broad-spectrum herbicides that would otherwise kill both weeds and the cotton plant;
- Bt cotton that has been genetically engineered to contain a gene that allows the plant to express the naturally-occurring protein, bacillus thuringiensis, or bt, which kills the heliothis caterpillar when it feeds on the plant.

Biotechnology research presents a daunting scientific challenge to Mali's research system and regulatory agencies in terms of gaining a fuller understanding of the impacts of GMO technology. While Mali can carefully study the results from other countries and monitor the research experiences in Burkina Faso, given the diversity of ecosystems and circumstances in which the technologies may be deployed, these research agreements will hopefully produce scientifically validated results on which to base future decisions.

Although Bt has been used as a biological pesticide for many years, it has been the genetic engineering of this gene that has generated both excitement and fear in the research community and general public. Bt technology amounts to continuous spraying of an entire plant with the toxin, except the delivery of the lethal doses of the natural toxin is from the inside out (Benbrook 2003; Lewis 1997). This continuous exposure to Bt through plant tissues will lead to many of the same problems as chemical sprays in terms of the developing resistance. In other words, the question is when insects will become resistant to bt and what can be done to delay the process (Lewis 1997; Benbrook 2003). Rather than consider bt as a single technology solution, research in other countries suggests that the effectiveness "the longevity of Bt cotton efficacy will be determined by the commitment and investment in insect resistance management that can reduce selection pressure and delay resistance" (Benbrook 2003; Carriere et al., 2003; Jenkins 2000).

Initial results from studies of bt cotton in China, South Africa and India show increases in yields, reduced pesticide levels, labor savings, lower production costs and higher net income (Grain 2004; Russell 2004; Pschorn-Strauss 2004; Sahai and Rahman 2003; Thirtle et al. 2003; Baffes 2004; Carl et al. 2001; AC Nielsen 2004). There exists, however, numerous critiques of the validity of these studies, claiming that a lack of methodological rigor, selective reporting of results and limited duration of the studies. While these results appear to confirm the interest and need to test this new technology in Mali, they also suggest the need to establish a long term, independent, multi-disciplinary and methodologically valid research, and monitoring and evaluation effort. This capacity will be critical in assessing the new technology with respect to its effectiveness in crop protection, the productivity benefits and profitability as well as an analysis of the risks and benefits (including environmental, health and biodiversity concerns) before it is used commercially.

Research will also need to determine the type of farmers who may be most apt to grow bt cotton, particularly since the higher cash expenditures on seed and the need to set aside 20% of land for suitable insect buffer refuges of non-bt plants (i.e. a resistant prevention tactics) would appear to run counter to the risk management strategies and current extensification practices used by a large percentage of Malian cotton farmers. Further, developing the most appropriate organizational structure and institutional relationships – international partnerships or contractual mechanisms - may prove to be an important prerequisite to gain access to this technology. While an integrated sector may possess advantages in developing close relations with these companies and obtaining access to the results of ongoing varietal and biological research, the interest of the giant multinationals in investing in Mali will depend in part on the protection of their intellectual property rights over these seed varieties. Establishing mechanisms to assure enforceable contracts thus becomes very important (Tefft et al., 1998).

Chinese efforts to independently develop 11 bt varieties underline the importance of developing the capacity to conduct independent research and to establish a regulatory framework that encourages investment in research, testing and independent monitoring mechanisms.[xvii]

3.3.4.3 Organic Cotton

This research and regulatory capacity is equally important to biotechnology as it is to integrated pest management and organic cotton such as monitoring the Swiss-supported trials growing organic cotton in the Kolondieba region. Despite poor rainfall conditions and under-equipped farmers, these efforts to develop organic cotton have been promising as much for the innovative marketing opportunities and price premiums (i.e. contracts with German organic regulatory agency, an international broker and European buyers to purchase cotton at a 20% markup on international prices) as the agronomic results (Valenghi 2003). Economic analysis will need to carefully assess profitability as costs of certifying and monitoring organic cotton may outweigh the benefit of higher sale prices and market analysis must carefully assess market opportunities that may not be as great as other organic products (Baffes 2004).

3.3.5 Effect on farmer incomes

The profitability of cotton farming in Mali has been strongly correlated with farmer cropping practices, input use and the degree of mechanization. An extensification strategy, while not as profitable on a per hectare basis as intensive production, is a lower risk, less costly production strategy well adapted for low-income farmers in an environment characterized by insufficient and unequally spaced rainfall, high cost inputs, variable cereal prices and uncertain markets (Giraudy, 1999; Tefft et al., 1998; Deveze 1994).

Table 5: Selected Illustrations of Costs and Returns per Hectare for Cotton Cultivation from 1991 through 2003

	Non-equipped farm (CMDT Type D)			**Equipped farm (CMDT Type B)**			
Item	**1992/93**	**1997/98**	**2003/04**	**1991/92**	**1997/98**	**2002/03**	**2003/04**
Yield minus est. losses (kg/ha)	932	906	950	1,083	1,030	824	1,080
Cotton price (CFAF/kg)	85	170	180	85	170	180	180
Variable costs (CFAF/ha)	33,545	42,836	80,036	36,165	48,524	63,660	90,950
Hired Labor	5,000	6,500	0	5,000	6,500	17,000	0
Fixed costs (CFAF/ha)	0	0	0	20,595	10,331	39,802	31,938
Net returns (CFAF/ha)	45,243	111,235	91,036	40,495	109,677	27,768	71,512
Total production costs/kg (excl. family labor)	37	49	76	51	57	132	102
Incorporating labor in the analysis:							

High estimate of family labor (days/ha)	203	203	203	162	162	106	134
Returns to high family labor (FCFA/day)	223	548	448	250	677	262	534
Opportunity cost of family labor (CFAF/day)	500	750	1,000	500	750	825	1,000
Total production costs/kg (incl. high family labor)	135	200	268	119	163	227	214

The profitability of cotton farming nevertheless increased after the devaluation of the CFA franc. Real returns to family labor increased 60% and 76% respectively for non-equipped and equipped farmers between 1992/93 and 1996/97 (Table 5). These results are logically sensitive to the methods used to estimate production costs and farm income, particular the number of days of family labor. Using the higher end estimates of 203 and 162 days of family labor per hectare respectively for non-equipped and equipped farms, it is important to note that 1997/98 returns of 548 and 677 CFA francs are less than the 750 CFAF opportunity cost of family labor.[xviii] At the lower estimate of 79 days of family labor for both manual and equipped farms, estimated returns to family labor of 1,408 and1,388 CFAF/ha exceed the 750 CFAF opportunity costs.

Two post-devaluation surveys indicate that maize and lowland rice are more profitable than cotton. Returns to labor of cotton are more profitable than maize only for the most mechanized farmers with at least two complete animal traction teams (Kébé et al., 1998; Doucouré et al, 1999). For semi- and non-equipped farms, returns to maize are equal to or superior to those for cotton. Similar research in the cotton zone in 1995/96 found that lowland valley ("*bas-fonds*") rice production had significantly higher returns per day of family labor than maize, sorghum/millet and especially cotton (Dimithe 2000).

The total costs of production for manual and equipped farmers (including an estimated cost of family labor) increased respectively by 48% and 37% after the devaluation to 200 and 163 CFAF per kilogram of seed cotton ($450 and $363 per hectare). Under the lower estimate of family labor days (i.e. 79 days per hectare) the total costs were 108 CFAF/kg both farm types ($243 and $214 per hectare).

3.3.6 Farmer expenditures and Farmer organization indebtedness

Expenditure surveys conducted after the devaluation showed that the farms reporting higher incomes generally spent cotton revenues on consumer goods (such as radios, televisions, cement and roofing for houses, bicycles, motorcycles, sewing machines, generators) (Kebe et al 1998). Between 1996 and 1998, many farmers also took advantage of a less than rigorous banking practices and internal management procedures within village associations to gain access to bank loans to finance consumer purchases. These practices lead to over-leveraged farmer associations that, under the principle of

joint liability or "*caution solidaire*", had to assume the unpaid debt of their members (Kébé et al., 1997; de la Croix 2002).

Malian banks have generally used the farmer organizations' bank accounts and future stream of communally earned cotton revenues ("*caution solidaire*") as the collateral to grant consumers loans (Lapenu et al., 2002). Banks have, however, focused on the creditworthiness of the AV as a whole with little consideration for the individual members' solvency. In many AV, the total value of the groups' loans soon reached 60% of the value of cotton revenues (double the 33% threshold traditionally used by banks and AV). (de la Croix 2001). The high level of AV indebtedness and tension created by these practices within AV lead to reimbursement problems and internal social divisions within farmer associations that often lead to their break up into smaller units.

Despite this more recent problem of AV indebtedness, this problem should not detract from the positive role and impact that village associations (farmer organizations) have played in the zone. The investment of the revenues earned from marketing and seed cotton assembly fees has had a large impact both in the cotton sector but perhaps more importantly in social infrastructure in the zone, most notably new schools and community health centers. These cotton funds have enabled villages in the cotton zone to successfully participate in the government's push to increase schooling rates and improve access to medical care.

3.4 1999-2004: Growing pains

The cotton sector has been many things to many actors: an important source of fiscal revenues, export earnings and development platform for the Malian government; as the largest employer, it has provided highly sought after and well-paid jobs; it is the source of raw material for the small but influential textile and cottonseed industries; as a minority shareholder in the CMDT and most important bilateral development partner, the French government has had diverse financial and political interests in the sector; for farmers and farmer organizations, the income and access to resources have contributed to the capitalization of rural economy and improved livelihoods. While these actors' interests have occasionally conflicted over the past four decades, it is important to note that they have more or less shared a common goal of maintaining the status quo, that is, the CMDT-controlled, integrated sector.

The last five years, however, has been witness to a divergence in this consensus view as the sector has been faced with two major shocks:

- The rapid cost inflation, corporate mismanagement and resulting farmer boycott in 1999/2000;
- The huge downturn in international prices in 2001/02 and government actions to reduce the deleterious effects international subsidies on African producers.

This section looks at the context and events and the conditions affecting the response of different actors.

3.4.1 Cost inflation and mismanagement

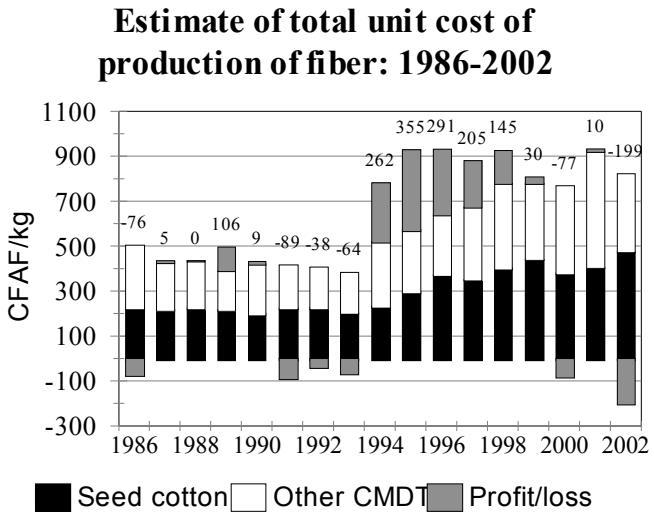
Comparative cost of production surveys have shown that Malian cotton (along with other producing countries in West Africa) is among the lowest cost cotton producers in the world (ICAC 2001). As stated earlier, there has been a large gap between the domestic and export price of cotton absorbed by high cost of CMDT operations and various taxes.

Inflationary pressures created by the devaluation of the CFA franc naturally increased the total cost of producing cotton lint. The total average delivered unit cost of production of cotton, i.e., all the costs to produce, gin and transport one kilogram of cotton to a European port (Cost, Insurance, Freight (CIF) - Rotterdam), increased from 384 CFAF/kg in 1992/93 to 670 CFAF/kg in 1996/97, a 17% increase in real terms. While the seed cotton purchase cost (i.e., producer price) dropped 1% in real terms, the "non seed cotton costs to gin" (comprising assembly, marketing, extension, roads and overhead) rose 57% in real terms. Within this line item, overhead and "public" development activity costs grew respectively 30 and 94% (Waddell, 1997). Between 1994/95 and 1996/97, another audit revealed that overhead costs had jumped 112% in two years, a large increase compared to 17% rise in total unit cost (SEC-Diarra/BAC+, 1999; Waddell, 1997). Amongst the many expenditures that contribute to higher overhead costs, SEC-Diarra/BAC+ audit pointed out that the average CMDT employee salary increased over 82% in real terms between 1993/94 and 1997/98 (1999) compared to a 3% real fall in government civil servants wages (Tefft et al., 1997). Budget audits revealed numerous instances in which CMDT-operated functions (as opposed to privately sector operations) had a large inflationary effect on the CMDT's cost structure (e.g., only 20% of the sector's transport operations are undertaken by the private sector, even though private transport rates are 50% less than the cost of the CMDT's truck fleet; CMDT gins powered by CMDT generators are two times as costly as those powered by the Malian energy company).

Audits showed that sector profits were also negatively affected by other CMDT standard operating procedures. Since the CMDT used a negotiated cost structure (*bareme*) that set their cost threshold, any economies could be recuperated directly by the CMDT rather than increasing profit margins that would be shared with farmers and the Malian government (Waddell, 1997; Waddell, 1998; SEC-Diarra/BAC+, 1999). CMDT profits were also negatively affected by the subsidized sale of cotton lint to Mali's textile companies and seed cotton to its subsidiary processing company. And the audits showed that COPACO, a CFDT subsidiary in which the CMDT was minority shareholder, had sold its share of Mali's lint (90%) at a lower price than that received by the private brokers marketing the remaining small share of Malian lint.

The audits also discovered gross mismanagement, fraud and embezzlement in the CMDT ((Waddell, 1997; Waddell, 1998; SEC-Diarra/BAC+, 1999). Coming at a period when the Malian government was making a concerted effort to reduce public sector corruption, the audit and subsequent investigation eventually led to the arrest and legal proceedings against numerous senior CMDT officials. Interviews with private sector partners of the

CMDT undertaken in the context of an anti-corruption campaign exposed a widespread belief that the CMDT was one of the most corrupt organizations in Mali. The minimal use of subcontracting, tenders and auctions for the majority of its procurement contracts provided vast opportunity for rent-seeking, generally to the disadvantage of farmers, and resulting in higher operating costs (Banque Mondiale 2002). Finally, in addition to the negative impact of escalating cost inflation arising from mismanagement and the inefficient operation of critical industry functions (e.g., transport), the CMDT was under tremendous internal financial pressure created by the decision to invest in the construction of four new cotton gins.



3.4.2 Crisis and the farmer boycott

In the four years following the devaluation, the total cost of producing, ginning and exporting one kilo of cotton lint had risen 94% to reach 743 CFA francs in 1998/99. In the late 1990s, world prices were not sympathetic as the Asian economies entered a recession. After reaching a peak of 1264 CFAF/kg in May 1995 and remaining above 900 CFAF/kg in the following three years, the average annual marketing year price of cotton lint fell 25% between 1997/98 and 1998/99 to 766 CFA francs[xix]. This decline was a result of excess world production, weak Asian demand during the 1997 financial crisis, low synthetic fiber prices and a stronger US dollar (Baffes 2004). The combined effect of high cost inflation and lower world prices was squeezing CMDT profits.

Despite these severe financial constraints, at the start of the 1999/2000 marketing year, the CMDT and SYCOV (farmer union) agreed that farmers would be paid a base price of 150 CFAF/kg plus a 35 CFAF/kg profit rebate, essentially the same terms as the 1998/99 season. At harvest, the CMDT reneged on this agreement and paid farmers only 155 CFAF/kg (145 base price + 10 profit-sharing CFAF/kg). With a smaller share of sector profits, this change created major financial problems for many village associations in paying farmers and reimbursing the cost of inputs. Relations between farmers and the

CMDT were further soured by the long delays in collecting and paying farmers for seed cotton. If that was not enough, the problem was further compounded by the "disappearance" of the 18 billion CFA francs ($36 million) that had been built up with a share of sector profits in the years following the devaluation (Grain de sel, 2000; Ministere du Developpement Rural et de l'Environnement 2002).

In previous crisis periods, Malian cotton producers, as the least powerful of the sector actors, often had little choice but to accept the conditions and share of the pie offered to them. In 1999, the tables were turned. After almost a decade of increasing involvement in sector management and growing awareness of both the strategic interests and prevalence of rent seeking activity, the farmers' was prepared to act.

When the CMDT announced a price of 160 CFA/kg for the 2000/01 growing season, the farmers' union called a boycott (Grain de sel, 2000; Ministere du Developpement Rural et de l'Environnement 2002).[xx] When a large number of cotton farmers refused to plant cotton, the total area planted dropped 53% from 482,000 hectares in 1999/00 to 228,000 hectares in 2000/01, resulting in a 47% fall in seed cotton production from 460,000 to 245,000 tons. The loss was enormous. During a period of high international prices and an appreciating dollar, Mali's cotton sector lost at least 20 billion CFA francs ($29 million) in potential revenues.

At the end of 1999, only five years after the devaluation, Mali's cotton sector was confronted again with a major financial crisis. In five years, gross sales revenues had increased 365% from 43 billion in 1992/93 to over 200 billion CFA francs in 1997/98 and 1998/99. By the end of the 1999/2000 period, the CMDT had cumulative losses totaling 58 billion CFA francs (over $100 million) (Banque Mondiale 2002).

3.4.3 Sector performance and Farmer profitability

Between 1999 and 2004, area planted, yields and seed cotton production grew respectively by 4%, 1.3% and 5.2% per year. These figures cloud the large fluctuations in area planted and seed cotton production occurring over this period: falling by approximately 50% during the boycott; increasing 133% in the following year; dropping 17% in 2002; and jumping 30% in 2003/04.

The 2003/04 budget for non-equipped farms and the 2002/03 and 2003/04 budgets for equipped farmers underscore the relative low profitability of cotton farming. Between 1996/97 and 2002/03, real returns to family labor for equipped farms declined by 77%.[xxi] When a 2003/04 producer-estimated budget is used, real returns to family labor declined by 24% and 50% respectively for non-equipped and equipped farms relative to the post-devaluation period (1996/97). A 17% increase in input prices in 2002/03 following the removal of the fertilizer subsidies contributed to the large increase in variable costs during this period (Horus 2003). For both the 2002/03 and 2003/04 periods, the returns to labor for manual and equipped farms are at least 50% lower than the estimated opportunity cost of family labor. For equipped farmers, the higher returns to labor in 2003/04 relative to 2002/03 hinge on the 30% difference between 2003/04 anticipated

yields and the actual ones for 2002/03, underlining the importance of productivity growth to per unit costs of production and farm-level profitability.[xxii]

Sensitivity analysis using a lower estimate of family labor (79 days per hectare rather than 260 days for manual farms and 106 and 134 labor days for equipped farms) increased the nominal returns to family labor by 157% and 34% respectively for the non-equipped and equipped farms. Even with this very low estimate of labor time, returns to family labor remain low. The method in which labor requirements are estimated and family labor is valued has become a highly politicized decision since production cost estimates affect price negotiations between farmers and the CMDT over a "fair return" or "fair price" for seed cotton (Ministere de l'Agriculture de l'Elevage et de la Peche 2003).
Depending on how family labor is valued and the total number of person work-days is estimated, total cost of production in 2003/04 ranges from 151 to 268 CFAF/kg for non equipped farmers and 183 to 214 CFAF/kg for equipped farms. These results would confirm that profitability is just one of the many factors influencing farmers' decision to grow cotton.

Recent research has found that the concentration of income in cotton households is much more pronounced than in other production systems (e.g., rice) (Tefft and Kelly 2002). The senior male head of a large extended family traditionally manages cotton and coarse grain production in the cotton zone, controlling access to resources and income earned from production. Parents of young children who are part of a large extended family in the cotton zone may not necessarily have access to or control of cotton resources. The unequal control and distribution of household profits among family members has contributed to the break-up of large extended production units into smaller autonomous units, many of whom no longer have sufficient equipment (Kebe 1996). Incomes of both mothers and fathers in the cotton zone (who are not extended family heads) are in fact considerably lower than those in the rice zone. Limited access to income may be one of several factors contributing to the high rate of malnutrition in the cotton zone (48% prevalence of stunting) (Tefft and Kelly 2004).

3.4.4 **Reforms**

The tremendous earnings growth and post-devaluation euphoria appeared to create a certain laxity vis-à-vis corporate governance, rigorous financial management and the need for continued productivity improvements required to compete internationally. The serious management problems, producer boycott and large operating losses, occurring at a downturn in international market, effectively eroded the competitiveness of cotton production in Mali, destroyed farmers' incentive environment and shattered their confidence with the CMDT. In past crises, the CMDT/CFDT's strategy consisted of procuring deficit financing from the Malian and French governments and other donors in order to weather the market downturn as they made small changes to improve finances and a few dysfunctional areas but without considering changes to the CMDT-led system. These events, to a much greater degree than other crises, revealed the structural weaknesses of the system and contributed to the growing realization that more serious

reforms were needed. The cotton sector was no longer serving as a dynamic motor of economic development in rural Mali.

These developments also appeared to establish some common ground in an ongoing debate started in the 1990s between the World Bank, French government and franc zone cotton companies (e.g., CMDT) on the most appropriate model for the future development of the cotton sector. To simplify very complex and multifaceted positions, the French government and the CMDT/CFDT had advocated maintaining the status quo, arguing to keep an integrated sector that has proven successful. The World Bank, on the other, while recognizing the important achievements recorded by the CMDT and CFDT over the last 25 years, argued for privatization of cotton companies and liberalization of the sector on the grounds that greater competition will lead to higher producer prices and farmer incomes, greater cost efficiencies that will foster more rapid growth, increased rural and urban employment and larger tax and foreign exchange earnings (CFDT, 1998).

Faced itself with financial difficulties arising from world market events, the CFDT (or henceforth Dagris) underwent an internal reorganization in 2002 aimed at reducing risks, improving its financial system and information technology (Peltier 2003). Dagris and French development agencies were naturally well aware of the gravity of the situation in Mali and conscious of the need to find more lasting solutions to some of the main factors affecting the sector's ability to compete and remain profitable.

In 2001, sector actors agreed to an emergency plan aimed at reducing deficits, freezing the investment program, changing the CMDT leadership, reestablishing farmers' confidence, freezing cotton gin investment program, creating an independent reform commission and conducting a series of financial audits and diagnostic studies. After a series of technical discussions and a general assembly of cotton sector actors in April 2001, the Malian government signed the *Lettre de Politique de Developpement du Secteur Coton* or the Cotton Sector Development Policy Letter that established an eighteen month action plan (timed with Mali's electoral calendar) that included seed cotton price setting mechanisms, privatizing the cotton seed oil processing subsidiary and a 27% reduction of CMDT's employees. Perhaps most significantly, this letter committed the government to liberalize the sector and privatize the CMDT by 2005. While the immediate measures contributed to a reduction in fixed costs and non-seed cotton variable costs respectively by 40% and 15%, resulting in a 9 billion CFA franc savings in 2001/02, the sector still lost 20 billion in 2002. (Ministere du Developpement Rural 2001)

3.4.4 Falling world prices and price subsidies

Between January and October 2001, world market prices fell 42%, dropping below 40 cents/pound for the first time in over 30 years. Since the CMDT was producing a kilogram of cotton lint for 822 CFA francs, the drop in prices to 667 CFAF/kg (average price 2001/02 marketing year) was ruinous for Mali's cotton sector.

Although there are many structural factors that affected the steep drop in cotton prices (e.g., import/export balance of China, price of polyester, world economy), worldwide attention focused on the role of production and marketing subsidies of major exporting countries. In October 2001, the International Cotton Advisory Council (ICAC) released a study that estimated the effect on world cotton prices of eliminating the production and export subsidies provided by governments of cotton-producing countries (e.g., USA, EU, China). ICAC estimated that the net positive effect of removing US cotton subsidies would be 11 cents on average cotton prices in 2001/02 or 26% higher than actual averages. If subsidies in all producing countries were eliminated, average prices would have been 31 cents per pound higher than actual prices in 2001/02 assuming the same theoretical response as in the US (ICAC 2002).

If one considers the cost to the CMDT for covering certain costs related to the transport and storage of inputs, Malian farmers received 2.5 cents per pound subsidy (Ministère du Développement Rural et del'Environnement. 2002).

An 8.5-cent increase in world prices would have increased Mali's average CFA franc sales price by 136 CFAF/kg. Assuming that farmers would receive 32% of the increase sales price (their actual share of world prices in 2002), this increase would have translated into a 17 CFAF/kg (in seed cotton equivalent) in farmers price, thus rising to 217 CFA/kg. For typical Malian cotton farm family that grows 2.4 hectares of rain fed cotton and producing 1073 kg/ha, this price rise, holding all other factors constant, would have increased gross cotton revenues by $25 per hectare or $60 per farm, a 9 percent increase on $296 gross revenues per hectare. For the whole sector, this would have translated into a 20% increase with an approximate net gain of $50 million.[xxiii]

More recent analyses have used alternative methods and different assumptions regarding the structure of the cotton market and supply elasticities to measure the impact of cotton subsidies on world cotton prices and production. These studies estimate more modest price increases of 10 to 13 percent following the removal of subsidies and subsequent response and readjustments of production and stock levels (Gillson 2004; Quirke 2002; Fapri 2002). When an 11% price increase is assumed, farmer profits would increase by 4% or $12 per hectare. This estimate is probably more accurate particularly when one considers that stickiness in the world cotton market (whereby spinning mills generally prefer in the short run to purchase cotton lint from one or several origins in order to maintain consistency in their product line) prevents easy substitution among suppliers (Gillson 2004). In this context of fragmented world markets and high supply elasticity in Mali and other CFA zone countries, cotton production earnings would increase 7% following the elimination of subsidies (Gillson 2004).

It is important to note that the removal of the subsidies would not have brought Mali's cotton sector out of the red in 2001/02. In 2001/02, the CMDT's total unit cost of producing and delivering one kilogram of fiber (CIF) was 822 CFAF/kg ($0.62/lb or 23 CFAF/kg higher than what the average sales price would have been in a market without US subsidies). The exact effect of higher producer prices on the household and

individual welfare in the cotton zone is also uncertain given the control of cotton revenues by the household head (Gillson 2004; Tefft and Kelly 2003).

While there is little argument that the removal of subsidies would generate gains for Malian farmers, the CMDT and the Malian economy, their elimination is not the panacea many make it out to be. One Malian newspaper argues that Malian cotton farmers suffer more from the CMDT's bad management than the effect of American agricultural subsidies (Bolly 2004). Improving productivity and reducing operating costs remain essential to the competitiveness and profitability of Mali's cotton sector.

3.4.5 Mali and the WTO

In 2003, in response to the profound effect of the steep fall in world cotton prices on their economies, and following on Brazil's formal complaint about US subsidies under the World Trade Organization (WTO) dispute mechanism, the Malian government joined with Benin, Burkina Faso and Chad to launch a new initiative for cotton entitled "Poverty Reduction: Sectoral Initiative in Favour of Cotton" that was discussed in the run-up to the World Trade Organization's ministerial meeting in Cancun, Mexico. In this petition, the four countries asked for the removal of all subsidies and requested financial compensation for lost export revenues that are due to (US) subsidies (WTO 2003). While the WTO ruled in Brazil's complaint that the US had violated WTO obligations "by granting excessive subsidies to its growers between 1999 and 2002, depressing prices at the expense of Brazilian growers, the West African proposal failed with the rest of the Cancun agenda. The US and four West African countries subsequently agreed in 2004 to pursue the issue in a cotton sub-committee during future agriculture negotiations (WTO 2004).

While these actions have not yet attained the desired outcome for Mali and other cotton producing countries, the petition sets an important precedent for African countries in international trade negotiations. It is also significant as an example of the type of action and regional collaboration that will increasingly be required by the governments to promote its interests in global markets.

4.0 Challenges

Improving the livelihoods of Malian cotton farmers and stimulating broad-based economic growth in Mali's cotton zone depends largely on sustained productivity growth that increases profitability and generates productive reinvestment of increased revenues. Recent performance has highlighted the declining profitability of cotton production both for the sector as a whole and a large percentage of cotton farmers. This situation is wasting valuable resources, harming livelihoods and has negative implications for the environment in southern and central Mali. This section discusses several key challenges that the sector must face in the future.

4.1 Cost inflation and Improving Incentives

Improving farmers' incentives through lower input prices and higher seed cotton prices are essential prerequisites to changing farmers' practices in favor of intensified production and soil recapitalization. Independent of actions to increase world market prices (i.e., eliminating subsidies – whose impact has been projected to be short lived), however, increasing seed cotton producer prices will be difficult given the high and rising cost of producing cotton lint (particularly the non-seed cotton costs such as ginning, transport and CMDT fixed costs). In other words, the high direct and indirect cost of running the CMDT prevents little opportunity to increase farm prices to levels that are needed to improve profitability and stimulate intensification and soil conservation practices that are needed assure the long-term sustainability of cotton production in Mali. Falling productivity and cost inflation has essentially eroded the profitability of cotton production and the competitiveness of Malian cotton.

Reestablishing the competitiveness and profitability of Malian cotton will depend largely on how Mali restructures the sector to provide the necessary incentives to farmers and other actors to achieve the desired performance. If a liberalized cotton sector offers greater potential to improve internal operating efficiencies and decrease rent seeking that are needed to reduce the unit cost of cotton lint and increase both sector and farm level profits, these reforms also pose considerable challenges for successfully implementing and coordinating many of the critical functions that have been effectively performed in the vertically and regionally integrated system. The challenge consists of developing a more cost-effective system to produce high quality cotton lint at a lower cost while maintaining the benefits derived from a well-coordinated sector.

4.2 **Reforms and Coordination**

Current discussions suggest that future reforms may replace a national ginning monopsony (i.e. CMDT) with several regional ones and rely more on private sector actors throughout the supply chain.[xxiv] Having a few alternative outlets for farmers to sell seed cotton (three or four companies) may not necessarily result in the desired efficiency and performance gains if the new structure does not improve services and increase producer

prices.[xxv] While the CMDT/CFDT's ownership and internalization of the majority of transactions between the vertically adjacent stages of production of cotton lint may have initially contributed to a reduction of transaction costs and risks and greater assurance of consistent supplies of quality lint, the efficiency gains from the vertically integrated sector have been eroded by internal management difficulties and cost inflation. An alternative way of organizing the sector may reduce internal inefficiencies and rent seeking but the sector will need to pay attention to the effect of the new structure on transaction costs arising from exchanges between a larger number of actors in the system. Even if coordination will not be controlled internally through ownership integration (i.e., within the control of the CMDT), alternative mechanisms to coordinate the sequence of sector stages must be established.[xxvi] Effective harmonization of the critical functions in the supply chain can be assured through various types of contracting arrangements and diverse forms of association such as cooperatives, alliances, joint ventures or networks.

The fundamental question comes down to finding the best way of organizing individual and collective action to improve the productivity of the different levels of the sector, and the coordination among those levels, while taking into account economies of scale and trying to avoid rent-seeking behavior? In short, it isn't simply a question of changing the system. It involves determining the appropriate roles of the various actors (CMDT, farmers, private business and government units) and empowering them with the legal, financial, organizational and technical resources needed to effectively carry out those roles (Tefft et al., 1998).

4.2 Key Sector Issues

As Mali advances in reforming its cotton sector, it only has to look back on its success over the past four decades to identify several critical issues that must remain at the forefront of its efforts to regain its competitive edge and profitability:

- Producing a quality product;
- Partnerships
- Research and extension
- Interlocked credit, input and output markets
- Improving actor capacity (farmer organizations and industry}
- Reinventing the public sector

4.2.1 Producing a Quality Product

Consistently producing quality cotton lint is essential to satisfying the demands of international buyers (i.e., spinning mills) and remaining competitive in international markets. While fiber characteristics developed in breeding new varieties are important factors affecting lint quality, producing excellent fiber is affected by the meticulous implementation and coordination of functions throughout the supply chain including crop management, post harvest practices and ginning. Establishing technically accurate and transparent procedures for grading seed cotton and classing cotton lint and linking price

premiums to higher quality are needed to strengthen for actor's confidence in the system and to improve quality. The sector needs to develop mechanisms to monitor the preferences, needs and requirements of the industry's customers and channel that information into sector decision making on research and development. Future involvement of multiple ginners (in different regions) may also require quality coordination if the sector wants to preserve the image and label of Malian cotton.

4.2.2 Partnerships

Strong and effective partnerships have been one of the hallmarks of Mali's cotton sector and a key ingredient of its success. The formation of innovative partnerships which are consistent with the strategic direction and perspective of the industry and the goals of various actors will be particularly important in the following areas: varietal and agronomic research and extension; soil fertility; interlinked credit and input markets; industrial organization and international marketing. Strengthening their capacity and developing mechanisms to share and manage risk, to provide access to timely information and to monitor and enforce contracts will be equally important to the smooth coordination of sector functions.

4.2.3 Research and extension

Strengthening the human and institutional capacity to conduct research and developing the financial mechanisms to fund independent study, testing and evaluation of new technologies will be particularly critical to efforts to increase productivity, particularly at the farm level. The assessment of alternative and competing approaches to address the problems of declining seed cotton productivity and the growing problem of pesticide resistance will be critical input to reverse the trend. Research programs that test and evaluate integrated pest management, organic cotton, genetically modified cotton as well as soil conservation programs (NRM) must be accelerated, procure sustained funding and include careful assessment of the institutional and farmer capacity needed for them to be adopted and sustained. Finding sustainable Adoption of new and more complex technologies will require effective extension services with mechanisms to hold actors accountable for delivering quality services at acceptable cost.

4.2.4 Interlinked credit, input and output markets

The CMDT has invested heavily to establish a viable and solvent system to provide farmers on a timely basis with quality inputs on credit and to assure their reimbursement. The strength of this credit provision system hinges on interlocking input and output markets that have been instrumental in reducing credit defaults. Experiences from other countries have highlighted the negative impact on input use and access to credit when this link is broken. Given the importance of reducing the cost of fertilizer to stimulating correct application of recommended doses, the sector will need to balance the potential benefits of a more competitive system with the potentially higher fertilizer prices resulting from the reduced economies of scale without the CMDT. The performance of an alternative system for credit and inputs and the ability to attract private investment will

depend largely on the particular institutional details of how the system is designed. The effectiveness will also depend on the structure of the new system (cooperation and coordination between buyers of seed cotton for credit recovery), particularly with respect to limiting the incentives for farmers to sell their seed cotton to a buyer other than the one who provided the credit (Govereh et al. 1998).

To smooth the transition from CMDT-managed interlocked markets to a competitive system, farmers associations must improve their management skills and ability to reduce strategic default. More generally, greater involvement of farmer organizations and unions will depend on the progress in improving their capacity for management and governance and thus their ability to assume more responsibility for sector functions. The creation of an appropriate institutional and legal environment that assures the establishment and respect of transparent working rules acceptable to all the actors will also be important.[xxvii]

An expanded role of farmer organizations will need to be preceded by successful resolution of several internal problems including social (generational) conflicts, increased economic differentiation in villages leading to smaller associations grouped around smaller family units, loss of confidence with extension agents and indebtedness due to unreimbursed individual member credit that had been secured by communal collateral (Kébé et al., 1997). To be more effective, farmer organizations will need to secure complete legal status as well as increase the numbers of functionally literate and numerate members and improve financial management, transparency and accountability.

Recent difficulties incurred by the farmers' union first experience in managing the import and distribution of fertilizer for maize grown in the cotton zone underlines the important challenges in training new actors and in having access to market information and a viable credit system. It raises important questions about how a new system to import and distribute inputs will reduce the producer price of inputs particularly with reduced economies of scale.

4.2.5 Increased capacity and new public roles

Capacity is an issue that the sector must address at every stage of the system and consists of empowering actors with the legal, financial, organizational and technical resources needed to carry out their roles (Tefft et al., 1998). Although a great deal of attention during commodity sector reforms is naturally focused on the development of private sector capacity to step in and implement functions formally executed by state agencies like the CMDT, one can not underestimate the importance of developing the capacity of government agencies or an industry stakeholder group to provide key oversight and regulatory functions. There are numerous areas:

- Additional public investment to improve infrastructure (e.g., roads, electricity), to strengthen the legal system and mechanisms for contract enforcement and dispute resolution between industry actors and to provide market information systems are all important public services to encourage private investment and enable industry actors.

- Public or industry organizations will need to play a role in regulation and oversight of the importation and use of pesticides and fertilizer as well as in specifying the conditions in which private ginners will operate and invest in the sector (e.g., research financing, farmer extension).[xxviii]
- The government's initiative to petition the World Trade Organization is a good example of the need for regional cooperation and increased involvement in international negotiations (e.g., harmonizing cotton reforms and promoting trade within the sub-region).
- The government will need to monitor equity implications of reforms, particularly with respect to farmers in distant or fringe areas of the country with bad access that may not served by private sector actors.
- Local governments will also need to have a stronger role in finding sustainable solutions to land use and environmental degradation.
- Government at all levels is responsible for good governance and transparency throughout the system at both the corporate and farmer organization levels in order to minimize corrupt practices and rent seeking behavior.
- Developing appropriate responses to these challenges depend largely on the capability of the Malian government, in partnership with all economic actors, to develop an independent capacity to analyze, monitor and modify the complex and dynamic interactions between policies, institutional reform, technological change, human capital development. As reform experiences in other countries have shown, restructuring commodity sectors is a dynamic, iterative process (rather than a one time event) that often proceeds by trial and error and continuous monitoring and revision.

4.2.6 Diversification and Value added

Although cotton production will continue to be a major source of growth in southern and central Mali, Malians recognize the dangers of its dependence on the sector. Almost all households grow cotton because it is the only game in town using extensification strategies that are detrimental to soil fertility and the environment. Many farmers would undoubtedly grow other crops (i.e., maize, lowland rice) if there were a functional input, credit and output markets that were not linked to the production of cotton. The need for greater diversification in the zone is also justified by the concentration and control by male household heads of the primary source of cash income. The lack of access to and control of productive resources and a source of income for dependent parents (i.e., those who are dependents of the household head) is a contributing factor to the high prevalence of child malnutrition in the cotton zone and the breakup of large extended families into smaller, nuclear units. Crop diversification and promotion and greater opportunities for younger men and women in the zone would be a positive step in improving livelihoods in the zone. While potentially reducing access to family labor, it would also result in greater specialization of cotton production to those who intensify production and use more environmentally sound practices.

Increasing value added is a major challenge to a sector that exports 95% of its lint. Any opportunity to be compete in a very competitive global textile market will require

significant investment in infrastructure that is needed for industrial development, particularly lower cost energy and good transport and communication networks. Aside from creating a favorable investment climate to encourage investment, the end of the Agreement on Textiles and Clothing (ATC) in January 2005 or the African Growth and Opportunity Act (AGOA) may offer opportunities for countries like Mali to develop their textile industries (Baffes 2004).

4.3 Reform Process

Whether or not restructuring disrupts the coordination between various levels of a sector depends on the capacity of new actors to carry out new functions, the efficiency of economic governance systems and the mechanisms for the enforcement of contracts (Tefft et al., 1998). While lessons from the reform experiences in other countries may underline the importance of developing political support and gradually implementing reforms, a long drawn out reform process also has its disadvantages, as delays and uncertainty over the future may have the effect of paralyzing normal sector operation as actors are unable to procure financing or refrain from making necessary investments. Continued management and financial difficulties and operating losses arising from the uncertainty over the sector's future may suggest, however, the need for a more rapid implementation of the reforms.

5.0 Lessons

This review of Mali's experience in growing rain fed cotton highlights several important lessons for future development efforts of the agricultural sector in sub-Saharan Africa.. First, the Malian experience underlines the positive synergies between the production of cash and food crops in an integrated farming system. Cotton has provided a consistent source of income to farmers in southern and central Mali that has been unavailable with other commodities. By growing a product for which there was more or less a guaranteed market and price, cash crop income allows cotton producers to pay taxes and other household expenses (social functions - weddings) without selling cereal immediately after harvest when prices are low. The profits earned by productive cotton farmers have fostered capitalization of rural households and through increased expenditure on locally produced goods and services stimulated growth through linkages with the rest of the economy.

The solvency provided by cotton income is the backbone of an efficiently managed credit and input system that gives farmers access to fertilizer, equipment and other inputs that have not been available to those who do not grow cotton. Inputs and the use of draft oxen and traction equipment financed by cotton revenues benefit cereal production as well as cotton. With over 75% of cotton farms owning animal traction teams and cattle herds financed with cotton income, farmers benefit from manure production used to improve soil fertility as well as the animal feed produced as a by-product from cotton seed oil extraction process.

The widespread creation of farmer organizations improved the operation of the sector and allowed them to play an important role in financing infrastructure development in many communities throughout the cotton, particular for schools and health centers.

The positive synergies between cotton and food crop production in Mali has been made possible by the ability of the CMDT to productively produce a quality, competitive product for which there is effective demand in international markets. More than fifty years ago, the French government identified a market for cotton lint and systematically and conscientiously worked to develop a comprehensive strategy and system to produce for that market. The sustained commitment and investment by Malian and French institutions in the research, development and extension of a constant stream of technologies improved the productivity and subsequently the profitability and competitiveness of the sector. While the market provided the incentives, the CMDT/CFDT created the structure and coordination mechanisms needed for the technological innovations to translate into improved productivity and to enhance the sector's competitive market position. The effective partnerships between national, regional and international actors that were created along the supply chain were the foundation that underlined its success.

But as the events over the last ten years have shown, the success achieved by Mali's cotton sector in terms of higher incomes, increased production of coarse grains and economic growth benefits to Mali's economy is only possible to the extent that the sector continues to productively and profitability produce a quality product that is competitive in international markets. Falling productivity, declining soil fertility and environmental degradation in combination with rampant cost inflation and seed cotton price rigidity have eroded Mali's competitive position to the point where cotton production is increasingly becoming less profitable and less sustainable to both farmers and the CMDT.

These trends and the events of the last five years suggest that Mali's efforts to put the sector on more solid footing and a more resilient competitive position in international markets will need to focus on improving governance and strict management rigor to reduce costs at all levels of the supply chain, providing a better and more consistent incentive environment for cotton farmers (i.e., lower input prices and higher seed cotton prices) and a more sustainable production system.

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Share of Francophone Africa Cotton

	Fiber production		**Cotton exports**	
	World	**SSA**	**World**	**SSA**
1960	1%	11%	2%	13%
1970	1%	17%	3%	20%
1980	1.4%	42%	4%	45%
1990	2.5%	61%	10%	75%
2000	4.4%	69%	13%	75%

Source: (Béroud 1999; ICAC 2003; Goreux et al. 2003)

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[i] There are nine cotton producing countries among the 13 countries comprising CFA franc zone: Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Cote d'Ivoire, Mali, Senegal, Togo.
[ii] The paper draws heavily from a large body of expert analysis conducted by a variety of authors working in different spheres: farmer organizations (Bingen), historical development (CFDT/Dagris, Dione, CFDT/Dagris, Groupe de Travail), farm level (Dione, Giraudy, Kebe and Diakite, Raymond), sector analysis (Badiane, Deveze, McCrae, Goreux, CFDT/Dagris), world market (Baffes, ICAC), research (Bingen, Kebe, Dembele).
[iii] French development agencies included consecutively the Caisse de la France Libre (1941), Caisse centrale de la France d'Outre-Mar (1941), Caisse centrale de cooperation economique (1958) and Caisse francaise de developpement (1992) prior to Agence francaise de developpement (1998).
[iv] The price premium is due in part to the low percentage of knotted and short fiber content and low levels of contamination
[v] Since 1999, the Ministère de la Coopération became the Direction générale de la Coopération internationale et du Développement (DGCID) in the Ministère français des Affaires étrangères.
[vi] Cotlook Index A is an "average of the cheapest five quotations from a selection of the principal upland cottons traded internationally" (Cotlook, 1999).
[vii] Output/nutrient ratios (yield response) obtained from on farm trials in Mali ranged from 2 to 7 (average of 4); ratios greater than 10 are considered to be efficient (Yanggen et al. 1998).
[viii] While most of the credit for France's contributions to the successful development of cotton production in francophone Africa is given to the CFDT, the French Ministry of Cooperation and particularly the French Development Agency (AFD) – previously called Caisse francaise de developpement – played equally important roles. Funding mechanisms managed by these two organizations financed the majority of France's cotton-specific and other development activities, a large percentage of which was concentrated in the cotton zone. AFD, in particular, after financing the French government's initial investment in the CFDT continued to play a major role in directly funding a large share of France's cotton-related operations (e.g., ginning, transport, marketing, financing during crisis periods) (Alliot 1999)
[ix] This section is inspired largely by the vast body of high quality work undertaken by R. James Bingen on farmer organizations in Mali.
[x] Losses could have been much worse if the dollar would not have been at its forty year high relative to the French franc in 1985.
[xi] The CMDT's 1986/87 producer price, 85 CFAF/kg, or 218 CFAF/kg price in fiber equivalent, was the lowest level in the CFA zone where the average fiber equivalent price was 270 CFAF
[xii] The CMDT changed from a parastatal agency to a semi-public, limited liability, industrial corporation (*société anonyme à caractère industriel*).
[xiii] In the more arid, northern San zone, however, farmers increased the area cultivated in cereals at double the rate of other zones, and even faster than cotton.

[xiv] The inability to replace aging equipment has resulted in a growing percentage of older, and lower performance equipment. This reduction is due to a number of factors including a lack of income due to falling profitability for many farms and changes in equipment provisioning programs (Kebe et al. 1998).
[xv] Declining yields are not due to non-performing seed varieties. Yields obtained in on-farm trials and by the most productive farmers are 20-50% higher than average yields (Dembélé, 1996; CMDT/Sikasso, 1998).
[xvi] This takes account of the switch in 1994 from ultra low volume (ULV) formulations to emulsifiable concentrates (EC).
[xvii] The US has three agencies that regulate and monitor biotechnology: USDA, FDA,
[xviii] A comparison of gross returns to labor for cotton and maize is strongly dependent on estimates of labor demands for different cropping activities and the manner in which equipment depreciation is shared between crops for which there is a dearth of accurate data. There is unfortunately a lack of accurate data on the changes in the type and quantity of labor used after the devaluation. Budgets are based on 203 person days of family labor for non-equipped farms and 162 days for equipped farms. These figures are estimates made by IER's Sikasso farming system research unit in 1989 and are similar to 1975 figures from Cote d'Ivoire (Dimithe 1998; Peltre-Wurtz et Steck, 1979, cited in Pieri 1989). Given the large increase in area cultivated to all crops and the relatively smaller increase in farm household size, labor requirements undoubtedly increased. With a higher number of fully equipped farms able to meet many labor requirements more effectively, seed cotton harvest remains the primary task where the availability of labor may present a problem for many households. For the semi-equipped and non-equipped households, an increased demand for labor for weeding may also have been unmet without additional workers.
With cereal and cotton area increasing respectively by 1.06 and 1.12 hectares, this would represent an increase of 286 additional person days of labor.
[xix] This price represents the average price of the Cotlook Index A over the 12-month marketing year of August to July. The reference price of Malian cotton has on average been 12 CFA francs lower. And the actual sales price depends on the timing of the sales and use of forward contracts.
[xx] The price was eventually increased to 170 F/kg.
[xxi] 2002/03 data are based on a CMDT survey of 192 farms.
[xxii] Although the 2003/04 budget includes twenty-five additional person labor days for manure and compost work (an arguably important addition given the problem of soil fertility), the producers' estimate does not include a 17,000 CFA

cost of hired labor. These differential costs roughly balance out with minimal effect on the returns to family labor. The 43% higher variable costs in 2003/04 (which are based on recommended rather than actual input levels) are also balanced out by the lower cost of depreciation in the 2003/04 budget (reflecting different views on the cost of equipment).

[xxiii] It is interesting to note that total direct assistance to 25,000 US cotton producers in 2001/02 totaled $3.7 billion, a figure that, the popular press has informed us, equals Mali's 2002 GDP (ICAC)

[xxiv] See Horus 2003 for a detailed discussion of different options for reforming the sector including privatizing the CMDT, making farmers shareholders in the CMDT (as in the Burkina model).

[xxv] See Goreux and McCrae for detailed discussion of alternative pricing mechanisms that effectively transmit world prices to farmers while minimizing the negative effect of large price fluctuations and price rigidity.

[xxvi] For example, use of private truckers to transport seed cotton, while more cost effective than use of the CMDT transport fleet, may be hindered by low capacity, poor quality trucks that are not outfitted for direct dumping into modern gins.

[xxvii] The recent communal elections and creation of new, decentralized governmental units way will clearly influence these developments and call for additional training of other actors.

[xxviii] Three independent agencies have regulatory and oversight responsibility of biotechnology in the United States: the Department of Agriculture, the Environmental Protection Agency and the Food and Drug Administration.