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***FOOD SECURITY RESEARCH PROJECT***

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**Cotton in Zambia: 2007 Assessment  
of its Organization, Performance,  
Current Policy Initiatives, and  
Challenges for the Future**

**By**

**David Tschirley and Stephen Kabwe**

**(This paper will also be published as a World Bank  
Discussion Paper)**

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**September 30, 2007**

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## ACRONYMS

ACF	Agricultural Consultative Forum
AMO	Agricultural Marketing Officers
APEP	Agricultural Productivity Enhancement Program
CAZ	Cotton Association of Zambia
CCC	Chipata-China Cotton Ginnery
CDT	Cotton Development Trust
CFA F	French <i>Franc</i>
CFS	Crop Forecast Survey
COCF	Cotton Outgrower Credit Fund
CSO	Statistical Office
ECZ	Environmental Council of Zambia
FRA	Food Reserve Agency
FSAF	Foundation for Sustainable Agriculture and Forestry
FSRP	Food Security Research Project
GOR	Ginning Outturn Ratio
GTZ	German Technical Cooperation/German Development Agency
ICAC	International Cotton Advisory Council
IFPRI	International Food Policy Research Institute
LINTCO	Lint Company of Zambia
MACO	Ministry of Agriculture and Cooperatives
OLS	Ordinary Least Squares
PHS	Post-Harvest Survey
PRA	Participatory Rural Appraisal CDC
PU	Phytosanitary Unit of the MACO,
RATES	Regional Agriculture Trade Expansion Support Program
REER	Real Effective Exchange Rate
SCCI	Seed Control and Certification Institute
ULV	Ultra-low Volume
YIELD	Yield Improvement through Empowerment, Learning, and Discipline
ZABS	Zambia Bureau of Standards
ZKW	Zambian Kwacha
ZNFU	Zambia National Farmers' Union

## 1. INTRODUCTION

Cotton is one unquestioned success of Zambia's turn towards a market economy. After liberalization in late 1994, production rose from 20,000 mt to over 100,000 mt in the 1998 harvest year. After collapsing to less than 50,000 mt in 2000, it has risen steadily, nearing 200,000 mt in 2005. Over 2002-2005, exports of cotton lint were first among all agricultural exports in value, 30% higher than any other agricultural export (Export Board of Zambia 2006). The closest competitor to cotton during this time –raw cane sugar –is primarily produced on large operations, while cotton is almost entirely a smallholder crop. Its potential role in poverty alleviation and food security is, thus, very large. The success of this sector has been achieved despite persistent declines in international cotton prices since 1995, serious problems of credit default during the late 1990s, the departure in 1999 of the sector's biggest company, Lonrho, and a very recent crisis brought on by the appreciation of the Zambian Kwacha during 2006.

The Zambian cotton story is of interest for policy makers for four reasons. First, the sector's boom since 2000 has been driven entirely by private sector innovation; understanding the details of that innovation and how it was able to flourish might provide insights for other countries. Second, as one of the only remaining sectors that is both fully private and has a high degree of concentration<sup>1</sup>, Zambia faces special challenges in maintaining a balance between the coordination needed to ensure rising quality and productivity, and the effective competition typically needed to protect the interests of smallholder farmers; assessing the ways in which both government and existing firms have gone about this may also yield useful insights. Third, these challenges have been thrown into high relief during 2006 and 2007, as the entry of several new and potentially strong companies combined with the appreciation of the kwacha to substantially alter the competitive dynamic in the sector; over the next several years, Zambia may thus be a second case study (following Zimbabwe) in how a concentrated sector responds to the challenges of new entry. Finally, government policy initiatives since 2002 have had a decidedly mixed effect on the sector, have evolved since their last review (Tschirley and Zulu 2004), and merit a further examination.

This paper is part of a continent-wide review of cotton sector reform experiences in Africa. It grows out of earlier work on cotton in Zambia by the Food Security Research Project (Govere et al. 2000; Tschirley and Zulu 2003; Tschirley and Zulu 2004), and on collaborative work by Michigan State University in southern and eastern Africa with Imperial College and colleagues in Tanzania, Zimbabwe, and Mozambique (Poulton et al. 2004; Tschirley et al. forthcoming). The paper has six main purposes:

- To capture the key elements and sequencing of the sector's reform process since 1994, and suggest how these might be functionally linked to previous structural and performance characteristics of the sector;
- To provide an updated, detailed descriptive overview of the current organization of the sector and of the behavior of key public and private participants;

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<sup>1</sup> A "concentrated, market-based" system in the classification scheme of Poulton et al. (2004) Zimbabwe was classified in this way in the early 2000s, but has since seen the entrance of numerous smaller companies.



- To assess the sector's current performance in multiple dimensions, including the institutional approaches used to pursue desired performance, and to evaluate to what extent the chosen approaches can be linked to structural characteristics of the sector;
- To provide an updated critical evaluation of recent policy initiatives in the sector and suggest key modifications that might be needed;
- To assess the cost competitiveness of the sector at farm and ginning levels; and
- To identify very recent structural changes in the sector and highlight the key steps the sector needs to take to ensure its future competitiveness in regional and international markets.

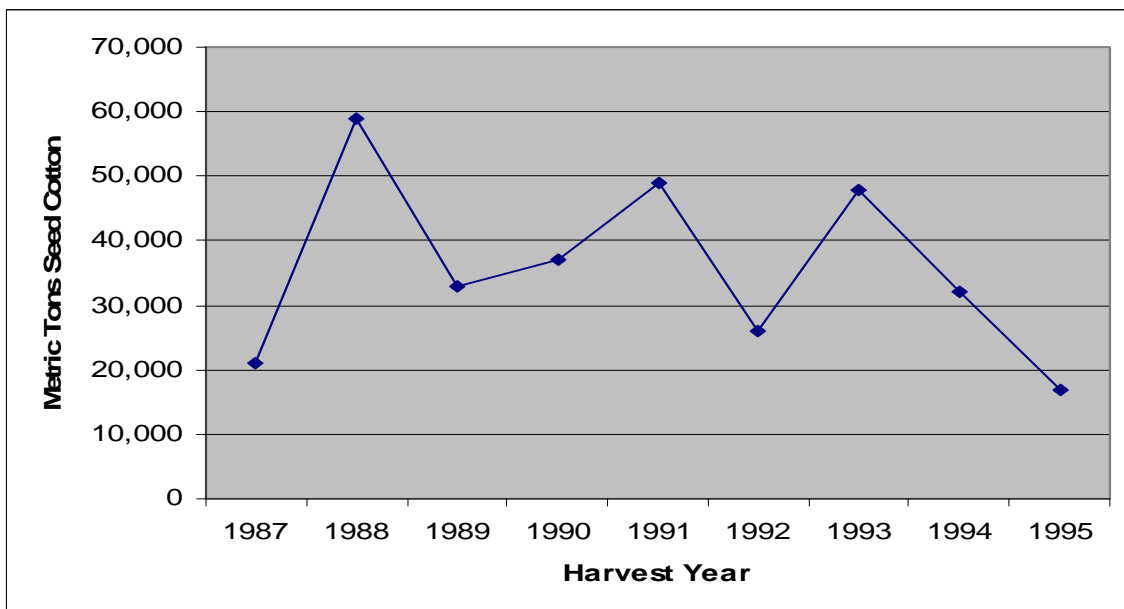
The next five chapters deal with each of these objectives: Chapter 2 presents historical background and reviews the reform process of the mid-1990s, while Chapter 3 provides a current overview of the sector. Chapter 4 then describes in more detail current institutional arrangements in the sector and related performance. Chapter 5 presents farm and ginnery budgets, uses them to assess returns to farmers and competitiveness at farm and ginning levels, and discusses sector sustainability. Chapter 6 closes by identifying lessons learned.

## 2. HISTORICAL BACKGROUND

### 2.1. Pre-Reform Institutional Set-up and Performance

From 1977 to 1994 the state-owned cotton company LINTCO (Lint Company of Zambia), on behalf of government, purchased seed cotton from farmers at a fixed price, provided certified seed, pesticides, sprayers, and bags and provided extension advice to farmers. LINTCO had a near monopsony in buying seed cotton and a monopoly in distributing cotton inputs on credit. Very little empirical information is available for this period, though some insight into the performance of the cotton sector during LINTCO's tenure can be inferred from the only available data from part of that period: the annual crop forecast surveys conducted by the government's Central Statistical Unit (Figure 1). The data suggest that, from 1987 to the year immediately following liberalization (1995), production was low, fluctuating, and in secular decline, falling below 20,000 mt of seed cotton in the 1995 harvest year. According to Zambia Privatization Agency (ZPA), LINTCO was also in serious financial crisis before its sale, having accumulated substantial unpaid debts. In 1994, as part of a concerted and broad-based effort by the new government of Frederick Chiluba to restructure Zambia's economy, LINTCO was sold to Lonrho Cotton and Clark Cotton, two private companies with regional cotton interests. The sale appears to have been designed explicitly to limit competition between the companies, as Lintco's gins in the center of the country were sold to Lonrho, and those in Eastern province were sold to Clark.

**Figure 1. Seed Cotton Production in Zambia Prior to Reform (1987 – 1995)**



Source: Central Statistical Office Post Harvest Surveys

## **2.2. From Reform through 2003: Phases One to Three**

Since reform Zambia's cotton sector has passed through five overlapping phases: in phase one (1994 - 1997), LINTCO was sold and the sector expanded rapidly on an entirely private and unregulated basis; phase two (1998 - 2000) was marked by a severe credit default crisis, which was resolved in phase three (2000 - 2003) entirely through private sector innovation; in phase four (2002 - present), government has become increasingly involved in the sector, with mixed results. Phase five (2006 - present) has seen the entry of three or more significant new players at the ginning level and a recurrence of the credit default crisis of the late 1990s. Table 1 presents a summary chronology of key events in the sector. We discuss phases one to three here, leaving the more recent events of phase four and five to Chapter 4.

From the sale of Lintco in 1994 through 1996, competition between Lonrho and Clark was minimal, as they operated in different areas of the country. Each company initiated outgrower programs and had very little problem with credit repayment. From 1994 through 1998, cotton production increased by a factor of three to four, depending on data source, facilitated by high international prices and aggressive promotion of the crop by Lonrho and Clark.

However, from 1997 the expansion of the cotton production base attracted many new entrants, both in ginning and assembly. At least four new ginning companies emerged and began to compete aggressively in the purchase of cotton. Some ginners contracted agents to recruit farmers on their behalf in addition to the farmers directly recruited by them. There also emerged a group of independent cotton traders who obtained their own inputs, distributed them to farmers, purchased seed cotton and sold to any ginner wishing to purchase.

Government at the time was committed to a liberalized economic policy and made no attempt to limit this competition. As the number of ginners and assemblers expanded, several key problems came to the fore. First, ginning capacity expanded to over 150,000 mt per annum, while production peaked at about 105,000 mt in 1998 and then declined for two years. This overcapacity created a competitive scramble for cotton among ginners to increase their throughput and minimize unit ginning costs. The emergence of agents and independent traders contributed substantially to this scramble for cotton. Firms operating outgrower schemes experienced increased loan default rates as competing firms, some of which did not provide input credit and hence could offer higher prices, purchased cotton from farmers participating in other firms' outgrower programs. These problems were exacerbated by a continual decline in world market prices from their peak in 1995, which was passed on to farmers.

Farmers had grown accustomed over several years to increasing prices, and with limited information on world market conditions, they found it difficult to understand the reasons for the price declines. This, together with a lack of transparency in how each buyer determined its prices and deducted input costs, lead many farmers and their representatives to conclude that they were being exploited. Lonrho estimated that loan repayment rates dropped from almost 86% in 1996 to about 65% in 1999.

**Table 1. Summary Chronology of Key Events in Zambia's Cotton Sector, 1977 to 2007**

Year	Action Taken	Comments
<b>Pre-Reform</b>		
1977-94	State-owned LINTCO runs single channel cotton system	Production trends downward from mid-1980s in spite of rising international prices. Public debt accumulates.
<b>Phase One</b>		
1994	Lintco sold to two private companies: Lonrho and Clark Cotton	Two companies operate for two years in separate areas of country. Production booms, aided by high international prices.
<b>Phase Two</b>		
1997-99	Four new ginning companies enter market, group of independent traders also emerges. Government does not intervene	Combined Dunavant and Clark market shares fall to 80%. Competition for seed cotton increases. Charges that new entrants provide few if any inputs to farmers. Credit recovery falls below 60% during 1997/98 season.
1999	Lonrho, citing input credit losses of US\$2m, leaves Zambia. Assets purchased by private company Dunavant.	Lonrho had begun to launch Distributor Scheme, Dunavant (under same management) continues to develop it. Credit recovery over 60%.
<b>Phase Three</b>		
2000-01	Dunavant fully develops its private Distributor Scheme	Credit recovery improves to 85%. At least one of the recent entrants falters but does not leave market.
2001/02	Drought in southern areas of country	Indications that credit recovery rate decreased
<b>Phase Four</b>		
2002	New government enters late 2001, launches Cotton Outgrower Credit Fund (COCF)	Publicly funded credit line for input provision being developed in close collaboration with ginners. First direct government involvement in the sector since liberalization in 1994.
2003/04	Cotton Act proposes new Cotton Board	Regulatory functions only. Heavy policing role.
2005	Cotton Association of Zambia formed	Represents about 300,000 cotton farmers, nearly all smallholders, under aegis of Zambia National Farmers' Union
2003/04, 2004/05	Cotton Outgrower Credit Fund expands, becomes revolving fund	Funds increased to \$390,000 from \$250,000 first year. Disbursements favor smaller players in relative sense. Recoveries suggest effective management.
December 2005	President signs Cotton Act	Stakeholders were surprised by the signing, as they had raised concerns and understood that the President would delay signature
<b>Phase Five</b>		
Late 2005	Kwacha begins rapid appreciation	Appreciates 33% through start of cotton marketing season, then begins to decline
Late 2005 – late 2006	Broad group of stakeholders – ginners, farmers, Minag, and the Cotton Development Trust (CDT) – collaborate to develop proposed revisions to Cotton Act	Run-up to elections prevents submission to Parliament in June 2006; Act to be presented to new government November 2006.
May 2006	Cargill Cotton buys Clark Cotton	Former parent company AFGRI cites low profit margins and insufficient global reach in marketing
Harvest season 2006	Key beneficiaries of Cotton Outgrower Credit Scheme continue to be suspected of promoting credit default by farmers	Credit default returns to levels not seen since 1999. Dunavant operations outside Eastern Province most affected. Cargill claims repayment rates in Eastern of more than 90%.
March 2007	Three multi-national affiliates (Dunavant, Cargill, Great Lakes) open discussions on "Zambia Cotton Pre-Financiers' Association"	Meant to encourage cooperation among these companies to reduce credit default during marketing season; group invites CCC also to participate.

Source: Authors

At the same time, increased default rates created incentives for outgrower firms to capitalize their bad loans into the cost of inputs for those farmers who did repay<sup>2</sup>, resulting in lower net prices for cotton after deducting the cost of inputs. Farmers who remained loyal and repaid their loans were thus penalized, potentially fueling a vicious cycle of further loan defaults or exit from participation in outgrower programs.

The sector reached a crisis point in 1999. Lonrho, the largest buyer, was sold to Dunavant, a privately held U.S. cotton company. Among its reasons for departing, the company cited \$2 million per year in unpaid loans. Other outgrower firms cut back on the number of farmers they supported from the 1999/2000 season, driving production to a post-reform low of less than 50,000 mt.

From this nadir, the sector underwent important structural change and recovered dramatically through the 2005 harvest season. The agents and independent buyers that contributed so much to the credit repayment problems in the late 1990s largely disappeared. At least one of the new ginners went out of business in late 2002. These developments were associated with two parallel strategies adopted by Dunavant. First, it launched in 1999, and over the next several years it refined, its Distributor System, which dramatically improved credit repayment rates among farmers. Second, Dunavant used this system to aggressively expand its production network. Clark also improved its more traditional system and was able to dramatically expand its production in Eastern province while maintaining high repayment rates. Partly as a result, national production more than quadrupled between 2000 and 2005, driven by yield growth in addition to area expansion, and credit repayment for Dunavant improved from about 65% to over 90%. Both companies largely resolved, through very different approaches, a problem of polypropylene contamination which had threatened the country's export market, and the country began to receive a premium on world markets<sup>3</sup>. Finally, despite operating in a much more concentrated sector, companies in Zambia paid prices nearly as high as in Tanzania.

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<sup>2</sup> One outgrower company stated that in 1999 it attempted to offset its loan defaults by adding a 50% mark up to the price of inputs.

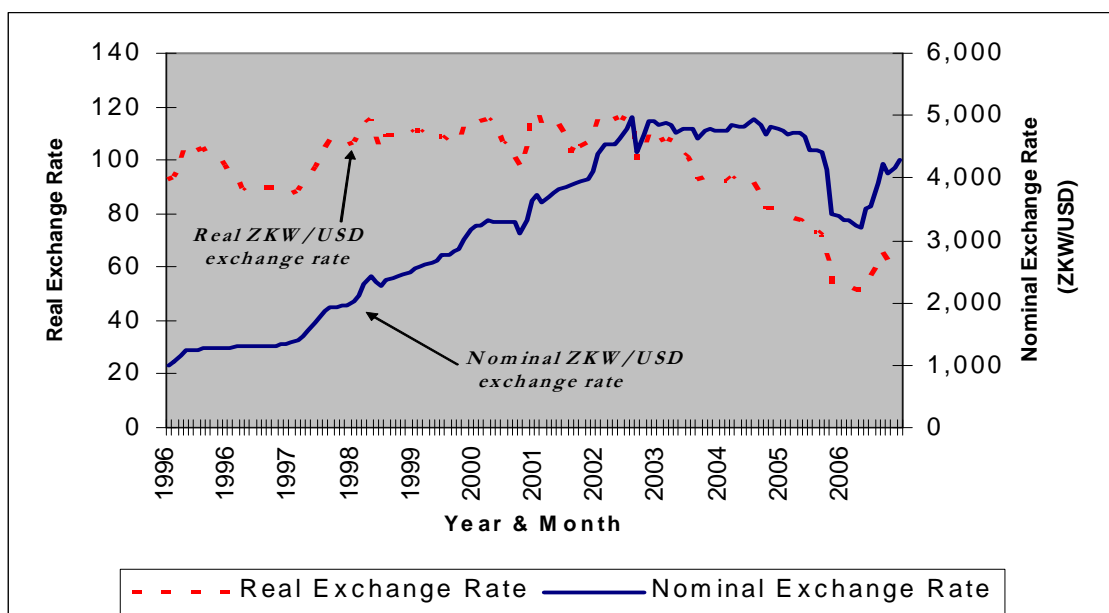
<sup>3</sup> We discuss the two companies' different approaches in Chapter 4.

### 3. OVERVIEW OF THE COTTON SECTOR

#### 3.1. The Macro-economic Environment

Movements in the real exchange rate have had an important influence on the cotton sector in Zambia over the past decade. Figure 2 shows movements in the real exchange rate between the kwacha and the U.S. dollar from January 1996 through December 2006<sup>4</sup>. From 1996 through 2001, the kwacha slowly depreciated in real terms against the dollar. As a result, export sectors with a significant share of costs in local currency would, all else equal, have been able to earn slightly higher profits. Since 2002, however, the kwacha has steadily appreciated against the dollar. Until late 2005, this pattern may have been broadly consistent with the general decline of the U.S. dollar in international currency markets. Since that time, however, the appreciation of the kwacha has proceeded much more rapidly and has been related to factors internal to the country. In either case, export sectors have been placed under increasing pressure by the kwacha since 2002, and since late 2005, the currency's rapid appreciation has caused a serious crisis in all export sectors. The slight recovery in the real rate in late 2006 left it still well below typical levels from 1996 through 2002.

**Figure 2. Nominal and Real Exchange Rates between Zambian Kwacha and US\$, January 1996 through December 2006**



Source: Central Statistical Office

<sup>4</sup> The graph takes a purchasing power parity approach. With calendar year 1996 as the base, we calculate movements in the ZKW/US\$ exchange rate that would have maintained the purchasing power of the kwacha relative to the US\$. Purchasing power is based on relative movements in the Consumer Price Index in each country. A value above 100 indicates that the kwacha had depreciated in real terms compared to 1996, while a value below 100 indicates real appreciation. Note that this approach traces out a pattern of appreciation nearly identical to that calculated by a Real Effective Exchange Rate (REER) approach incorporating prices of tradables and non-tradables, and weighting by the structure of trade (Calí and te Velde 2007).

Fynn and Haggblade (2006) estimate that, if ginning companies were earning an 8% gross margin (revenue minus variable costs) at an exchange rate of ZKW4500/US\$ (the rate prior to the dramatic appreciation), that margin nears zero at an exchange rate of 3,500, while net profit (gross margin minus capital costs) is clearly negative at this level.

The timing of the 2005/06 appreciation of the kwacha was especially bad for agricultural export sectors. Outgrower companies had to purchase most inputs for the 2005/06 growing season no later than June or July of 2005, when the exchange rate was around ZKW4,700/US\$. They based their input prices to farmers on their costs at that exchange rate. The kwacha then began to appreciate in August, and by May 2006 was down to ZKW3,200/US\$, and some in government were indicating that they were committed to continued appreciation. In this environment, Dunavant indicated that it mobilized the local currency it needed for the 2006 harvest at the low exchange rates prevailing in May, and announced that it would pay only ZKW860/kg, down from ZKW1,200/kg the previous year, and from the ZKW1,220/kg that it had indicated it would pay prior to planting in late 2005; though it indicated that this offer was contingent on the exchange rate remaining above ZKW4,200/\$, this condition received little focus when the company did drop its price.

Interviews with ginning companies and farmers indicate that smallholder cotton plantings for the 2006/07 growing season fell by 40% to as much as 50%. Dunavant announced that it would pay no less than ZKW1,050/kg of seed cotton, regardless of prevailing exchange rates, but farmer confidence in this price had been shaken by events the previous year. Other companies declined to announce pre-planting prices. By early 2007, the exchange rate had stabilized around ZKW4,200-4,300/\$, a level which should allow Dunavant to pay at least its guaranteed minimum prices, with comparable prices paid by competitors. In Dunavant's own words, a key challenge it now faces is to "rebuild confidence in (the) pre-planting price".

### **3.2. Cotton Production: Trends, Geographical Distribution, and Farm Structure**

Production data in Zambia are available from several sources, including the Central Statistical Office's (CSO) Crop Forecast Survey (CFS), CSO's Post-Harvest Survey (PHS), and derived estimates from ginnery outturn. These estimates do not all agree with each other, but, with the exception of CFS data for 1999, paint a relatively consistent picture of production trends since liberalization (Table 2). Since reform began in 1994 with the break-up of LINTCO, the monopoly cotton parastatal, production has gone through four phases (Figure 3)<sup>5</sup>: 1) rapid expansion through 1998, with production increasing from less than 20,000 mt in 1995 to over 100,000 mt in 1998, 2) rapid decline in 1999 and 2000, spurred in large measure by a serious credit default crisis; production in 2000 fell to less than 50,000 mt, 3) sustained and rapid recovery from 2000 to 2006, and 4) a sharp forecasted decline in 2007, driven by the kwacha appreciation crisis of the previous year.

Household survey data show that cotton production is heavily concentrated in Eastern province, with over one-third of all households in that province producing the crop and accounting for about a two-thirds share of national production during the 2003 harvest

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<sup>5</sup> Data in Figure 3 are based on CFS estimates for 1993 through 1995, and on derived ginnery or CDT estimates since that time. All production figures are in terms of seed cotton.

**Table 2. Seed Cotton Production Estimates in Zambia from Various Sources, 1993-2007**

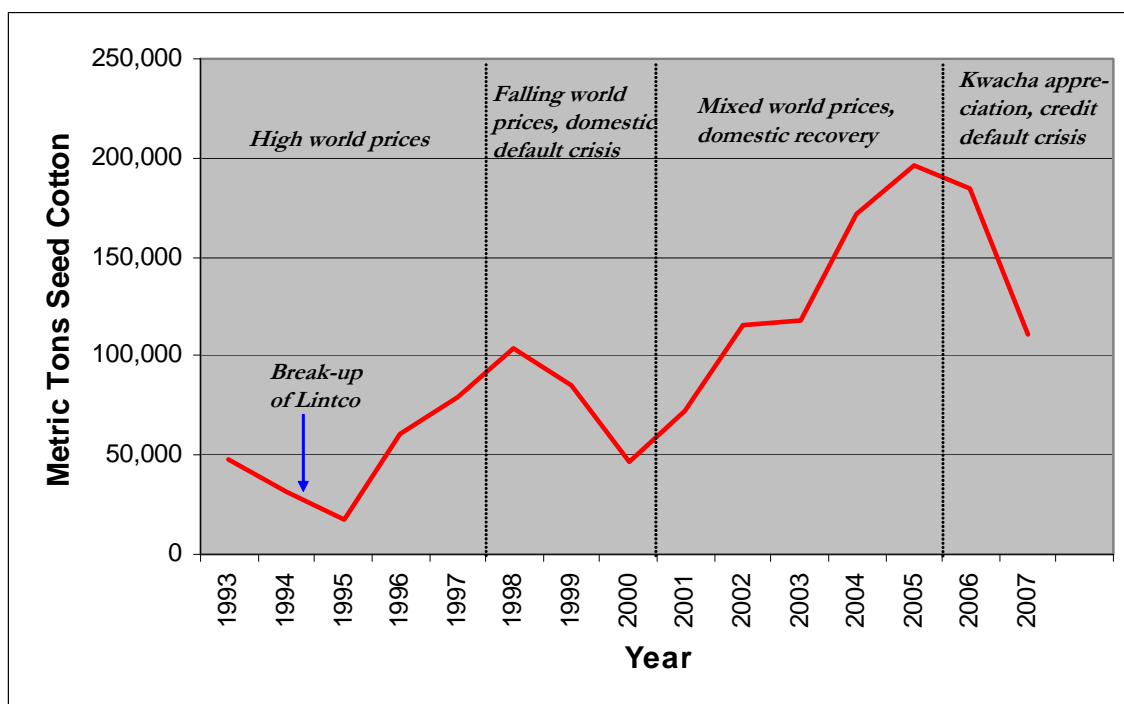
Harvest Year <sup>1</sup>	PHS Estimates <sup>2</sup>		CFS <sup>2</sup> Estimates	Derived Ginnery Estimates <sup>3</sup>			
	# of households	Area (ha)		Production (MT)	# of households		Production
					Min	Max	
1993	32,944	32,343	23,103			47,851	
1994	30,764	28,669	18,384			33,093	
1995	32,824	28,450	27,991			16,578	
1996	50,981	64,084	63,859	40,824	113,333	170,000	61,200
1997	85,514	74,279	58,051	70,000	142,217	213,325	79,900
1998	85,735	79,272	72,561	110,000	179,050	268,575	104,500
1999	70,159	63,000	50,858	140,024	139,895	209,842	84,700
2000	44,196	36,681	27,500	49,498	74,449	111,674	46,700
2001	87,422	87,026	65,979	57,083	110,924	166,387	72,000
2002				47,326	172,900	259,350	116,000
2003					170,341	255,512	118,000
2004					240,712	361,069	172,000
2005					266,173	399,259	196,000
2006					244,005	366,007	185,000
2007 (Est.)					142,308	213,462	111,000

<sup>1</sup> Harvest year refers to cotton planted late in the previous year. <sup>2</sup> PHS and CFS estimates are from Central Statistical Office. <sup>3</sup> Seed cotton production estimates through 2000 derived from lint production figures of Lonrho, Clark, and Amaka, and based on ginning outturn ration (GOR) of 0.38. Production since that time based on CDT estimates, which use data from all companies. Estimate of minimum (maximum) number of households assumes average of 0.8 ha (1.2 ha) cotton per farmer, with yields increasing from 450 kg/ha in 1996 to 650 kg/ha in 2007.

season. Central and Southern provinces follow, with 16% of farmers growing the crop in Central and accounting for 19% of national production, and 12% growing in Southern and accounting for 13% of national production (see Table 3 and Figure 4). Data from a similar survey for the 2000 harvest season show a comparable dominance of Eastern province, followed again by Central and Southern, but suggest that Southern Province's national share, at 5%, was much lower that year than in 2003. Nationally, nearly 11% of all farmers grew the crop in 2003; by 2006, that figure had likely risen near 15%.



**Figure 3. Seed Cotton Production in Zambia, 1993 - 2007**



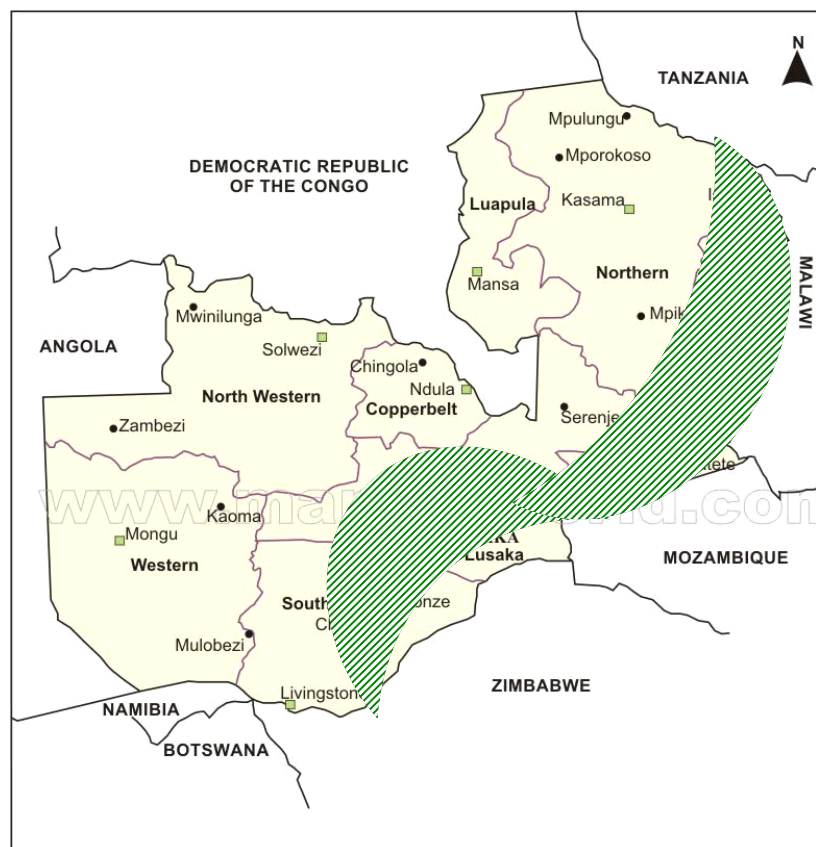
Source: Central Statistical Office Post Harvest Surveys and ginner estimates

**Table 3. Cotton Production Data in Zambia by Province, 2003 Harvest Seasons**

Province	Share of HHs in province producing cotton	# of cotton farming HHs	Share of all cotton farming HHs nationally	Total cotton production (mt)	Share of national cotton production
Central	0.16	22,155	0.17	23,754	0.19
Copperbelt	0.00	127	0.00	254	0.00
Eastern	0.36	89,773	0.68	79,702	0.65
Luapula	0.00	0	0.00	0	0.00
Lusaka	0.07	2,522	0.02	2,082	0.02
Northern	0.00	0	0.00	0	0.00
Nwestern	0.00	0	0.00	0	0.00
Southern	0.12	17,778	0.13	16,484	0.13
Western	0.00	0	0.00	0	0.00
<b>Total</b>	<b>0.11</b>	<b>132,355</b>	<b>1.00</b>	<b>122,276</b>	<b>1.00</b>

Source: PHS/FSRP Supplemental Survey

**Figure 4. Map of Zambia Showing Provincial Boundaries and Main Cotton Production Zones**



Source: Developed by authors

Cotton is produced almost entirely by small-scale farmers in Zambia. Among the 11% of such farmers that grew the crop in 2003, over half of production and sales were accounted for by the largest 20% of farmers (Table 4 and Figure 5). These concentration levels are not high compared to a crop like maize, where the top 20% of producers account for nearly two-thirds of all production and a much larger share of sales. Of course, because nearly 90% of farmers do not produce cotton, the top 20% of cotton farmers represent only 2%-3% of all farmers. These large cotton farmers cultivate more total land, dedicate more of it to cotton, achieve higher cotton yields<sup>6</sup>, and also produce more maize than smaller cotton farmers. We will compare these same groups of cotton farmers to non-cotton farmers in Chapter 4 when we examine the effects of cotton farming on household incomes.

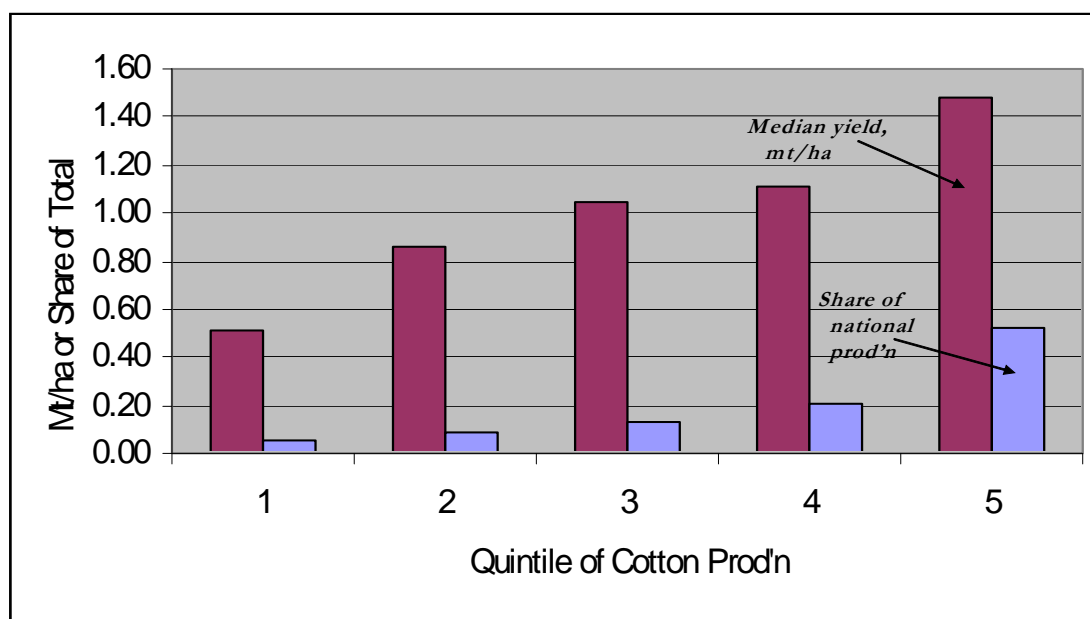
<sup>6</sup> Note that yield figures based on household surveys consistently generate higher mean and median yield estimates than those indicated by cotton outgrower companies. We estimate that the yields in Table 4 overstate actual yields by 20% to 30%, but we have no reason to believe that the relative patterns in the table are biased.

**Table 4. Cotton and other Indicators by Quintile of Total Cotton Production among Smallholder Farmers**

Quintile of Cotton Production	Cotton Indicators					Other Indicators	
	Median Ha in Cotton	Median Cotton Yield (mt/ha)	Median Cotton Production (mt)	Share of all Cotton Area	Share of all Cotton Production	Median Total Land Cultivated	Median Maize Production (mt)
1	0.41	0.51	0.249	0.11	0.05	1.25	0.70
2	0.41	0.86	0.420	0.14	0.09	1.62	0.86
3	0.61	1.05	0.600	0.17	0.13	1.75	1.15
4	0.81	1.11	0.900	0.22	0.21	2.28	1.38
5	1.22	1.48	1.700	0.37	0.52	3.09	2.07
Total	0.81	0.96	0.600	1.00	1.00	1.92	1.15

Source: PHS/FSRP Supplemental Survey 2004

**Figure 5. Median Cotton Yield and Share of National Production, by Quintile of Total Cotton Production among Smallholder Farmers**



Source: PHS/FSRP Supplemental Survey 2004

Yield calculations in Zambia are based primarily on the areas financed and seed cotton purchased by Dunavant and Cargill. These figures are thus affected by side-selling; since Dunavant and Cargill most likely lose more cotton from side-selling than they gain, the figures should be interpreted as a lower bound for the yields obtained by farmers financed by these two companies. With these caveats in mind, yields appear to have risen since reform, due to the persistent efforts of these two companies to ensure steady input supply and some level of extension training for farmers. Dunavant has suggested that their mean yields have

risen from about 450 kg/ha in 1996 to nearly 700 kg/ha by 2005. With support from the German Development Agency (GTZ), the company is now attempting to increase yields further through its YIELD program (Yield Improvement through Empowerment, Learning, and Discipline)

Data from Cargill may be relatively reliable in the sense that the company reports high repayment rates, so that yields calculated as total purchases divided by total hectares financed may be more accurate than for Dunavant, which gets lower repayment rates. These data show mean yields of 974 kg/ha in 2004, 695 kg/ha in 2005 (a drought year), and 795 kg/ha in 2006. These yields are consistent with previous understandings that yields in Eastern province (the only province in which Cargill operates) averaged about 900 kg/ha. Such yields are substantially better than those in neighbouring Mozambique or Tanzania (each with mean yields closer to 500 kg/ha), and comparable to Zimbabwe when Cottco was still operating its outgrower scheme.

Regression results (Table 5) provide some insights on yield drivers. As found in similar research on cotton in Mozambique (Benfica, Tschirley, and Boughton forthcoming), and more generally on agriculture throughout Africa (Huffman 1980; Yang 1997), there appear to be no returns to education in cotton cultivation. Households with more family labor achieve higher yields, as shown by the pattern of coefficients on household size and number of children. Use of basins/zero tillage and inorganic fertilizer have significant positive effects on yield, as does the use of manure; yet none of these practices are applied by more than 5% of farmers. Having your own animal traction teams and rotating cotton with maize are common practices that have important and significant positive effects on yield. The importance of animal traction in this regression is consistent with both participatory rural appraisal (PRA) results and simpler regression analysis using a different data set (see Appendix B). Given the widespread use of inorganic fertilizer on maize – but not on cotton<sup>7</sup> – the positive effect of rotation with maize probably reflects continuing positive impacts from previous fertilizer applications; this dynamic between the two crops was frequently referred to by Cargill field personnel during the PRA.

### **3.3. Cotton Ginning**

The structure of cotton ginning in Zambia changed substantially from 2004 through 2006. Eight ginning companies operated in Zambia during the 2005/06 growing season (Table 6)<sup>8</sup>. Of these, three began operations during that season (Great Lakes, Alliance, and Birchand) and a third began in 2004/05 (Chipata-China Cotton). Between them, these four companies purchased more than 30,000 tons of seed cotton in 2005/06. Great Lakes entered Southern Province in mid-2005 and competed directly with Dunavant, even hiring a number of Dunavant distributors for its input distribution program. Alliance also competed directly with Dunavant in Central Province, while CCC operated in areas of Eastern Province where both Cargill and Dunavant have strong field operations. Continental ginneries, which had operated in the country for several years, opened a new gin in Eastern Province (the main producing province) during 2005/06 while continuing to operate its gin in Southern Province.

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<sup>7</sup> Only 3% of cotton fields received inorganic fertilizer in our sample.

<sup>8</sup> We drop Mukuba from the count due to their tiny purchases.

**Table 5. Linear Regression Results on Cotton Yield in Zambia**

	Coefficient	Std. Error	P value	
Constant	6.08	0.190	0.000	*
<b>Demographics</b>				
HH is headed by a female (0,1)	0.12	0.083	0.156	
Years of education of hh head	0.00	0.008	0.876	
# of children in hh	-0.03	0.019	0.117	
Total size of hh	0.02	0.012	0.103	*
<b>Field level practices</b>				
Farmer plowed cotton field (0,1)	0.03	0.081	0.746	
Farmer used basins/zero tillage (0,1)	0.40	0.154	0.009	***
Farmer used ridging (0,1)	0.03	0.086	0.714	
Farmer used tractor to prepare field (0,1)	0.13	0.180	0.467	
Farmer has own animal traction teams (0,1)	0.15	0.072	0.036	**
Farmer planted before the rains (0,1)	0.01	0.060	0.909	
Weeks from planting to first weeding	0.01	0.024	0.710	
Total number of weedings	0.02	0.028	0.540	
Farmer used manure on field	0.27	0.149	0.076	*
Kg of basal fertilizer applied to field	0.01	0.002	0.016	**
Previous crop was maize (0,1)	0.18	0.077	0.022	**
Previous crop was groundnut (0,1)	0.00	0.103	0.992	
Previous crop was cotton (0,1)	0.13	0.105	0.229	
Field was previously in fallow (0,1)	-0.28	0.350	0.431	
Farmer left residue on field (0,1)	0.02	0.056	0.759	
Animals fed in field (0,1)	-0.06	0.109	0.582	
<b>Other Agricultural/Agro-ecological Factors</b>				
Log total maize production	0.05	0.015	0.000	***
Log value of productive assets	0.02	0.004	0.000	***
Log total cultivated ha	-0.25	0.048	0.000	***
Zone 2 (Lower Rainfall) (0,1)	-0.03	0.086	0.707	
Zone 3 (Higher Rainfall) (0,1)	0.19	0.129	0.134	
Zone 4 (Highest Rainfall) (0,1)	0.19	0.649	0.765	
Central Province (0,1)	0.00	0.123	0.973	
Eastern Province (0,1)	0.11	0.111	0.309	
Lusaka Province (0,1)	0.16	0.169	0.345	
R-Squared		0.139		
Adj. R-squared		0.096		
N		611		

Dependent variable = log cotton yield (kg/ha)

\* sig at 0.10; \*\* sig at 0.05; \*\*\* sig at 0.01

Source: Author's calculations from CSO/FSRP 2004 Supplemental Survey

**Table 6. Ginning Companies Operating in Zambia as of 2005/06**

Company	Ownership	Gin Location	Capacity (MT/season)	Seed Cotton Throughput		
				03/04	04/05	05/06
Dunavant	Multi-national	Lusaka, Lusaka Province	10,000			
		Kabwe, Central Province	22,000			
		Mumbwa, Central Province	25,000			
		Gwembe, Southern Province	19,000			
		Petauke, Eastern Province	17,000			
		Lundazi, Eastern Province	?			
		Katete, Eastern Province	22,000			
Sub-total			> 115,000	112,500 <sup>1</sup>	131,300 <sup>1</sup>	112,000 <sup>1</sup>
Cargill	Multi-national	Three gins in Chipata, Eastern Prov.	60,000	48,976 <sup>1</sup>	44,196 <sup>1</sup>	42,023 <sup>1</sup>
Great Lakes	Multi-national (Plexus)	One gin in Sinazongwe, Southern Prov.	10,000 <sup>2</sup>	0	0	10,000 <sup>2</sup>
Alliance Cotton	Multi-national (Alliance Cotton)	Lusaka Province (planned)	?	0	0	8,000 <sup>2</sup>
Continental	Local	Sinda, Eastern Prov.	15,000 <sup>2</sup>	5,000 <sup>1</sup>	7,000 <sup>1</sup>	8,000 <sup>1</sup>
		Kalomo, Southern Prov.	10,000 <sup>2</sup>			
Mulungushi	Zambian/Chinese	Kabwe, Central Province	10,000	5,820 <sup>1</sup>	8,314 <sup>1</sup>	5,140 <sup>1</sup>
Chipata-China Cotton Ginnery (CCC)	Chinese	Chipata, Eastern Province	15,000	0	?	12,000 <sup>2</sup>
Mukuba	Local	Ndola, Copperbelt Province	500	43	113	24
Birchand Oil Mills	Tanzanian	Tanzania	0	0	0	?
Total			> 215,500			

Source: Zambian Cotton Sector Review, Ministry of Agriculture, Food and Fisheries 2000; FSRP Ginners Survey 2003; additional FSRP interviews 2006

Notes: ?=data not available. <sup>1</sup> Self-reported; <sup>2</sup> Rough estimates from discussions with stakeholders

An array of information suggests that these second-tier competitors to Dunavant and Cargill are poised to increase their purchases over the coming years. First, CCC is currently installing a second gin with at least 15,000 mt capacity in Petauke District of Eastern Province. Second, following the Zambian visit of President Hu of China, an accord was signed for the construction of 3-5 new ginneries in the country with Chinese financing. Indications are that most of these gins will be installed in Eastern Province. Third, Great Lakes and Alliance are both local affiliates of multi-national cotton companies that have been expanding operations in southern and eastern Africa in recent years. Finally, Continental more than doubled its ginning capacity in 2005/06, but used barely one-third of this higher capacity. The entrance of so many new and aggressive buyers in the Zambian cotton market has major implications for sector governance, which we will address in Chapter 6.

Dunavant and Cargill are both very large multinational cotton trading companies. Dunavant Enterprises trades over 800,000 mt of cotton lint per year worldwide, and claims to be the largest privately owned cotton merchandiser in the world. In addition to Zambia, it owns cotton gins in Mozambique (in Tete province, directly across the border from Eastern Province in Zambia) and Uganda. Cargill Cotton purchased Clark's Cotton's operations throughout southern Africa in May 2006: three gins in Zambia, three in South Africa, and a majority interest (with ADMARC) of two in Malawi. According to AFGRI management (the parent company of Clark Cotton), key reasons for the sale were that the cotton enterprise did not deliver sufficient return on capital, and Clark Cotton did not have the expertise or the critical mass to effectively market its cotton lint in the international market, whereas Cargill did (Business Day 2006). Cargill also operates in Zimbabwe and Tanzania.

Great Lakes is a joint venture between Plexus Cotton Limited and Africa Resources Holdings Limited, with cotton gins in Uganda, Malawi, and Zimbabwe. Plexus, itself, owns a gin in Mozambique and in recent years has emerged as one of the largest ginneries in that country.

Mulungushi Textiles is a joint venture between the Government of Zambia and the Government of China. This unusual arrangement in an otherwise entirely privatized industry has caused unease among competing private companies, some of whom suggest that the arrangement might confer competitive advantages to Mulungushi, especially in the area of working and investment capital, that these other firms do not have. There is, however, currently no concrete evidence of these and other possible advantages conferred on Mulungushi. Continental Ginneries and Mukuba Textiles are both locally owned firms, while Chipata Cotton Ginneries appears primarily to be financed with Chinese capital.

The operating practices of these firms, especially regarding input supply on credit, will be discussed in more detail in Chapter 4. Here we note that Dunavant and Cargill both run input distribution, extension, and seed multiplication programs that are recognized as serious efforts to build capacity and productivity among their farmers. Both companies also made major successful efforts to eliminate polypropylene contamination in cotton. Great Lakes emphasizes productivity and quality in its promotional materials, and appears likely to expand its pre-financing activities during the 2007/08 season. Many more questions exist regarding the design, coverage, and consistency of the input credit and extension programs of the other companies in the sector.

### **3.4. Independent Cotton Traders**

Independent cotton traders – individuals trading cotton who do not own and are not employed by a ginning company – played a major role in the credit default crisis of the late 1990s. After 2000 such traders largely disappeared, for three possible reasons. First, after launching its distributor system for input delivery and credit recovery in 1999, Dunavant (Lonrho at the time the system was launched) substantially improved it over the next several years, creating strong incentives for distributors to remain loyal to the company. Second, Clark Cotton (which has since been taken over by Cargill Cotton) began paying stronger attention to its relations with farmers, providing an input package that resulted in steady rises in productivity, and also maintaining detailed credit repayment data for each farmer; farmers who failed to repay debts were summarily removed from the list of those eligible for input credit. Finally, the very high international cotton prices that prevailed for several years after reform of the sector, and which made cotton trading a potentially attractive business, had fallen to historically low levels by late 1999 and, after a brief recovery, reached even lower levels by late 2001. For a company to remain a major player in the cotton business at these prices required a long-term commitment and, increasingly, global reach in marketing. The largely locally owned firms that supported independent cotton traders (Amaka, which left the sector in 2002, and Continental and Mulungushi, which have remained) found it very difficult to compete under these circumstances.

Nonetheless, Zambia clearly has a set of actors with extensive experience in the cotton trade and no investment in cotton ginning. Dunavant's distributors, which at one point may have numbered 2,000, are independent entrepreneurs experienced in recruiting farmers, delivering inputs, and mobilizing the crop from them. Whether these actors are called agents (Mulungushi and Chipata Cotton Ginners) or contact farmers (Continental), other companies run similar programs. In all cases, the cotton ginner relates to farmers primarily or even exclusively through its distributors or agents, who make the final determination as to the credit worthiness of farmers.

During the 2006 harvest season, events surrounding the macroeconomic environment (discussed in section 2.1.) led to credit default becoming a major issue in the sector for the first time since 2000. It appears that Dunavant suffered much more heavily from default than did Cargill; the latter claims repayment rates of 92% during 2006 (low by their standards), while Dunavant claims only 60% to 70% and openly acknowledges that Cargill achieves higher repayment rates even during normal years.

### **3.5. Cotton Spinning/Weaving/Apparel Industries**

Zambia's spinning industry appears to absorb a small and declining share of the country's lint production. The last available data indicate that, in 2002, the country's four operating spinning mills processed less than 10,000 MT of lint, or less than one quarter of lint production in the country (Table 7). Export value of yarn fell from about US\$40m in 1997/98 to US\$21m in 2001/2002, and remained at about that level through 2005. As cotton production has increased by about 70% since 2002, the spinning industry's share seems likely to have declined. During the 2001/02 season, Dunavant indicates that it sold nearly 20% of its lint in the local market, exporting the rest. The cotton ginners and Swarp (a spinner)



**Table 7. Spinning Mill Capacity and Throughput in Zambia, 2002**

Textile Mill	Location	Capacity (MT)	Throughput, 2002 (MT) <sup>1</sup>
Swarp	Ndola, Copperbelt Province	14,000	6,400
Mukuba	Ndola, Copperbelt Province	1,900	1,200
Starflex	Ndola, Copperbelt Province	1,200	Not operational
Excel	Ndola, Copperbelt Province	1,650	500
Mulungushi	Kabwe, Central Province	3,000	1,500
Kafue	Kafue	3,000	Not operational
Others	Mostly Copperbelt Province	1,000	N/A
Total		25,750	

<sup>1</sup> Sources: Data on Swarp from phone interview with that company and the Regional Agriculture Trade Expansion Support Program (RATES 2003). Other data based on estimates by Swarp, Ministry of Agriculture, Food and Fisheries 2000, and RATES (2003).

estimated in 2002 that 90% of Swarp's lint needs are met by purchases from Dunavant and Clark (now Cargill); the balance appears to come from smaller ginners. Mukuba Textiles and Mulungushi Textiles both have gins within their premises and purchase seed cotton for processing. Starflex, Excel, Mulungushi, and Kafue all experienced serious financial problems in the early 2000s which led to temporary and sometimes prolonged shut downs (RATES 2003). The other smaller spinners indicate that they periodically import to meet their lint needs when they are unable to reach agreement on price with local ginners.

Despite the problems that these value-added sectors have faced, their combined size is not trivial when compared to cotton lint: total exports of yarn, woven fabric, and apparel totalled US\$23.5m in 2002 (over US\$21m from yarn), compared to US\$30m in lint exports. More updated information on the spinning, weaving, and apparel manufacture industries in the country would thus appear to be warranted.

### 3.6. Oil and Cake

Ginners provide very little information regarding their sales of oil and cake. Key informants indicate that most seed is sold to South Africa, with some remaining in the country and the rest frequently going to Botswana, due to that country's large livestock sector. CCC processes about one-third of its seeds in its own oil processing plant and exports the rest. Estur estimates a net average price of US\$90/kg, based on prices in South Africa and assumed sales of 75% of seed. Local ginners claim prices of US\$60-90.

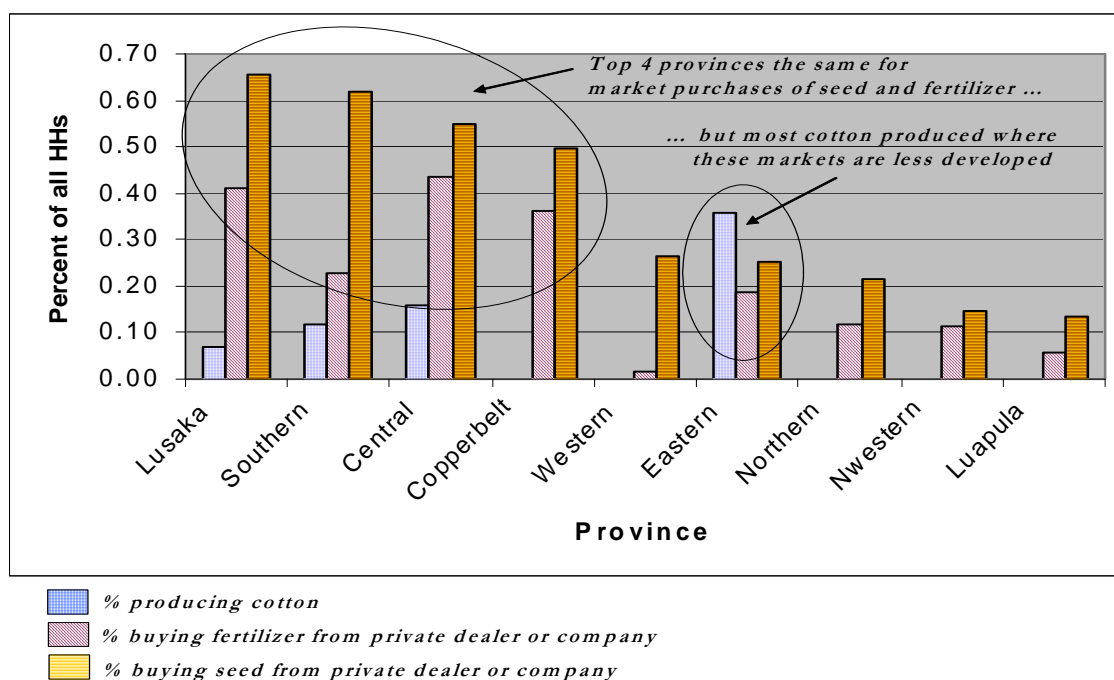
### 3.7. Independent Input Dealers

Private input dealers in Zambia have grown up primarily serving maize farmers, selling fertilizer and maize seed. For example, during the 2003/04 cropping season, 35% of farmers used fertilizer, over half of these (18% of all farming households) purchased the fertilizer

from a private input dealer, and over 80% of all fertilizer transactions (through private dealers or other programs) were for maize. Similarly, 35% of all households purchased seed from a private input dealer or seed company, and 59% of all these market transactions were for maize seed.<sup>9</sup>

The spatial pattern of market purchases of seed and fertilizer compared to that of growing cotton shows that private input markets are relatively less developed where cotton is most commonly grown – in Eastern Province (Figure 6). Partly as a result, private input dealers play very little direct role in providing cotton inputs to farmers. Nearly all cotton inputs in Zambia are delivered to farmers through the cotton ginning companies or through ginners’ agents who receive the inputs from the cotton companies. The cotton companies negotiate for inputs in bulk from local and international companies. With regard to seed, all companies interviewed reported that they grow their own seed through contract farmers and the seed is certified by the Seed Control and Certification Institute (SCCI), the government’s certification unit under MACO.

**Figure 6. Spatial Pattern of Market Purchases of Seed and Fertilizer, and Growing of Cotton**



Source: 2004 CSO/FSRP Supplemental Survey

<sup>9</sup> All data from the 2004 MACO/FSRP Supplemental Survey. Differences in data collection for the two inputs prevent us from presenting identically structured analyses.

## **4. CURRENT INSTITUTIONAL ARRANGEMENTS AND PERFORMANCE**

For eight years after reform in 1994, Zambia's cotton sector operated as a concentrated, market-based system with almost no government involvement, even on a regulatory basis. Extra-market coordination, whether across ginning firms or between ginners, organized farmers, and other stakeholders, was minimal. Since that time, government has developed a more noticeable presence in the sector, and efforts at sector-wide coordination have increased markedly. Most recently, the dominance of the top two ginning companies has become less pronounced, and the new competitors may have a greater ability to remain in the market than did those who affected the sector so strongly in the late 1990s. In this chapter we review the current organization and performance of the sector across a number of tasks: extra-market coordination, input credit, research and extension, quality control, pricing of seed cotton, and competition among companies.

### **4.1. Sector Coordination**

Through the 2005 marketing season, extra-market coordination within Zambia's cotton sector focused most intensively on vertical coordination between ginners and smallholder farmers, and to a lesser extent between ginners and spinners. Efforts at horizontal coordination among, for example, ginning companies, were intermittent, as were sector-wide initiatives involving multiple players from all levels in the system. Starting in 2005, two developments increased the level of effort put into sector-wide coordination. First, the Zambia National Farmers' Union (ZNFU) finalized the creation of the Cotton Association of Zambia (CAZ) to represent farmer interests in the sector, providing the Ginners' Association with an organized private sector body with whom to dialogue on key issues. Second, efforts at revision of the Cotton Act became a focus of intense collaboration across stakeholders, with CAZ and the ginners playing the predominant roles. If the proposed revisions to the Act are accepted and the Act is put into practice, then sector-wide coordination efforts will take a major step forward through the Cotton Board. By early 2007, however, the Act had not yet been passed, and a new horizontal coordination effort was beginning: attempts to form a Zambian Cotton Pre-Financiers' Association. Likely members are Dunavant, Cargill, and Great Lakes; these three have invited CCC also to participate, though it is not yet clear whether this company will do so. It is also not clear whether these companies see the new Association as a complement to, or a substitute for, the Cotton Board and the Zambia Cotton Ginners' Association.

The Cotton Act proposes the formation of a Cotton Board as a statutory body with public and private membership and no mandate to participate as a buyer or seller in the cotton market. The genesis of the Board dates to at least 2000, when the CDT and private stakeholders started developing a regulatory framework for the sector, driven in large measure by a desire to avoid a repeat of the credit default crisis that nearly destroyed the sector from 1997 through 1999. Perhaps as a result of this starting point, the original version of the Cotton Act (which would create the Cotton Board) granted very broad policing powers to the Board, essentially creating a parallel police force. It used vague language in specifying the conditions under which these powers could be exercised, and attempted to insulate decisions of the Board from judicial review. It also transferred powers and responsibilities reasonably within the mandate of the Ministry of Agriculture to an agency another step away from political accountability. A 2004 assessment of the Act (Tschirley and Zulu 2004) suggested

that such an approach was at odds with the fact that the sector survived the crisis of the 1990s due in large measure to the institutional innovations and improved management that emerged from competition between the two major players. The assessment further suggested that the Act focus instead on developing legal bases and operational approaches to improve information on borrowers' credit history, on promoting collective action to improve cotton quality and productivity, and on improving the monitoring of sector performance beyond credit repayment.

Partly in response to this assessment, revisions to the proposed Act during 2005 allowed judicial review of Board decisions while not substantially altering the Board's policing powers, and provided a starting point for creation of a credit bureau for the sector. However, the revisions also altered the balance between the public and private sectors in the Board, to the extent that its new composition threatened to make the Board a largely public sector body rather than a balanced multi-stakeholder body.

Stakeholders and research groups raised strong concerns about these and other provisions of the Act, and were taken off-guard when the President signed the Act in December 2005. When these concerns were again expressed, the President directed that the Act not be put into effect until further consultations could take place. This directive was followed by a highly participatory stakeholder process involving CAZ representing farmers, MACO, and other interested stakeholders. In a series of three working meetings the Act was fully reviewed and specific revisions were agreed to, including a rebalancing of the membership of the Board to avoid public sector domination. Following elections in late 2006, stakeholders are now awaiting the opportunity to present these proposed revisions to the new government.

A final indicator of government's engagement with the cotton sector was the role of the Minister of Agriculture during the 2006 marketing season. The rapid appreciation of the kwacha (see section 2.1.) put tremendous pressure on the prices that ginning companies could pay to farmers. When Dunavant and others announced a price of Zkw850/kg, down from 1,220/kg the previous year, the Minister of Agriculture announced in June a suspension of cotton marketing, apparently to allow farmers and ginners to negotiate a higher price. Because the Minister had no legal authority to suspend private marketing of a crop, and judging that the announced price was the best that they could pay, ginners proceeded with the purchase of the crop. However, the Minister's announcement increased what had already been a very tense situation, and stressed what had been a strong relationship between the Ginners' Association and the Cotton Association of Zambia, representing farmers. Though government in Zambia has long influenced maize marketing both directly through purchases and indirectly through public statements, 2006 was the first time since at least the late 1990s that it had attempted to do the same in cotton.

## 4.2. Input Credit and Extension

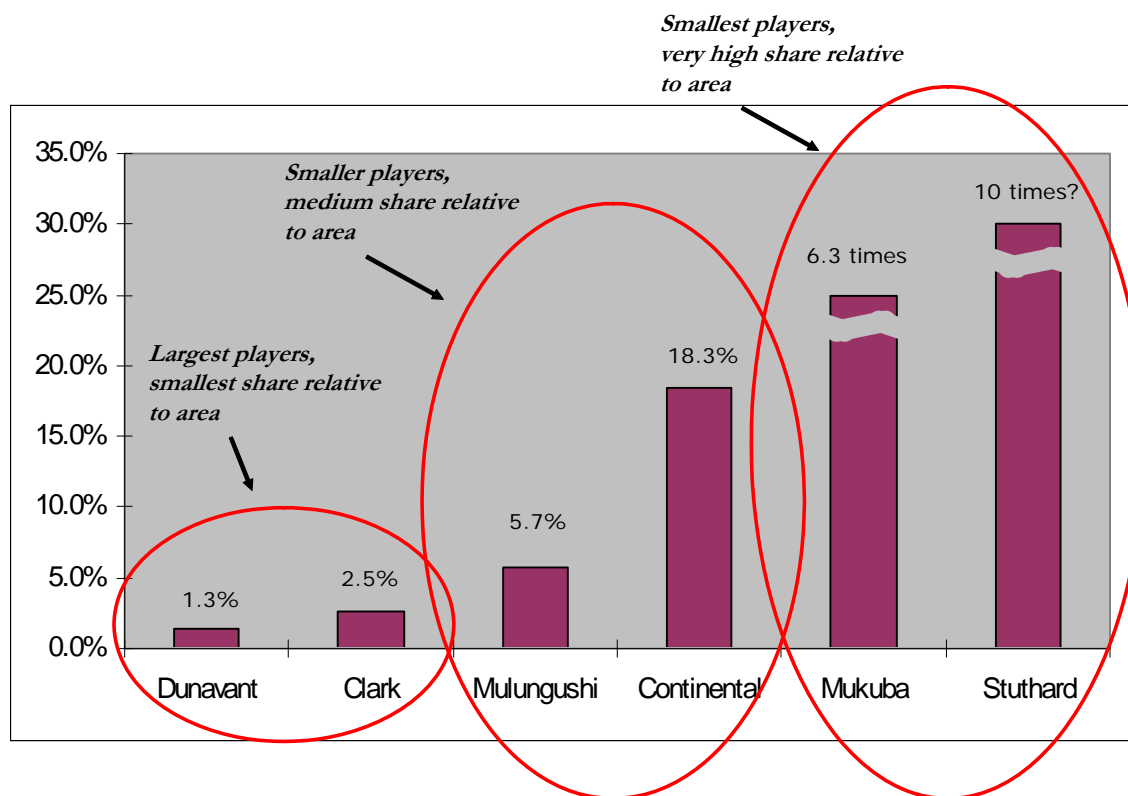
The activities of input distribution, credit recovery, and farmer extension have typically been combined within the same field operation units among outgrower companies. We therefore review them together here. The section focuses first on a government initiative to complement existing private outgrower schemes – the Cotton Outgrower Credit Fund (COCF) – then briefly discusses the input credit and extension systems run by Dunavant and Cargill.

The **Cotton Outgrower Credit Fund** is part of a broader government effort, launched in 2002, to support export crop production. Stated objectives are to increase production by increasing the availability of inputs on credit, and to reduce pirate buying in which firms purposely buy cotton from farmers who have been supported by other companies. The fund started with an allocation of about US\$250,000 from government during the 2002/03 growing season. Two years of credit recovery and an additional allocation from government for the 2003/04 season increased the fund to US\$340,000 for the 2004/05 growing season, and turned it effectively into a revolving fund. No additional government funds were received for the 2004/05 or 2005/06 seasons. Distribution of resources from the fund favors smaller players in a relative sense: while the 2004/05 allocations to the two largest companies (Dunavant and Clark) could finance only 1-2% of their previous year's area, allocations to smaller companies were substantially larger relative to area (Figure 7). Disbursements to two winners who had almost no production during the previous year seem clearly intended to allow them to become at least recognizable players in financing of farmers. The total area financed by the program remains small, at about 3% of the previous year's harvested area. For the smaller players, however, the financing has a substantial impact on their ability to work with farmers. Table 8 shows allocations and recoveries by company for the three years through 2005/06.

To date the scheme has avoided the error of centralizing input procurement and distribution to farmers within itself – a key factor in the demise of post-reform input distribution efforts in Uganda and Tanzania. By channeling credit to private cotton companies already working with farmers and allowing the companies full freedom in using it, the fund essentially becomes a means to increase resources in the system and reduce borrowing costs for the companies.

Yet the fund suffers from at least one major problem, anticipated from the beginning and now apparent after four years of operation. One expressed objective of the fund was to reduce the amount of pirate buying – promotion by cotton buyers of credit default among farmers – in the sector. To accomplish this objective, one eligibility criterion for the fund needed to be that a participating firm maintain open records of credit disbursements to and recoveries from farmers; if such records were not made available to fund management, or if questions regarding the information were not adequately addressed, the company's allocation would need to be eliminated or substantially reduced the following year (Tschirley and Zulu 2004). This has not been done, and serious questions about the activities of some fund beneficiaries have to date not been addressed. With default during 2006 back to levels not seen since 1999 or 2000, this issue deserves priority attention from fund management.

**Figure 7. Credit Allocations to Cotton Companies from Cotton Outgrower Credit Scheme Relative to Previous Year's Cotton Area (Allocations for 2004/05)**



Source: Cotton Development Trust and Authors' Calculations

**Table 8. Credit Allocations and Repayment Rates under Cotton Outgrower Credit Fund, 2003/04 to 2005/06**

Companies	Cropping Year		
	2003/04	2004/05	2005/06
	000,000 ZMK		
Cargill	295	282	220
Continental	300	298	285
Dunavant	605	503	0
Mukuba	40	90	0
Mulungushi	100	208	395
Stuhardt	20	78	71
Retained by CDT	80	110	279
Total Funds Allocated	1,440	1,569	1,251
Interest	108	118	94
To be recovered	1,548	1,687	1,344
Actual Recoveries	1,532	1,589	878
Recovery rate	0.99	0.94	0.65

Source: Cotton Development Trust

**Dunavant:** Immediately following the credit default crisis of the late 1990s, a period of significant private institutional innovation began in 1999 at the initiative of Lonrho, which at the time was being sold to Dunavant. Starting with the 1999/2000 growing season, the company began to create its Distributor System to replace its original system for delivering inputs on credit to farmers and recovering the credit. Tschirley and Zulu (2004) provide a detailed review of the system; Poulton et al. (2004) and Tschirley et al. (forthcoming) also touch on it. Key elements of the system include:

- The system eliminates extension agents as company employees, instead relying on formal written contracts with independent distributors. These distributors are responsible for identifying farmers to whom they wished to provide cotton inputs<sup>10</sup>, receiving the inputs on credit from Dunavant, delivering these inputs to their selected farmers along with technical advice, and ensuring the sale of the farmers' crop to Dunavant to recover the input credit.
- The Distributor's remuneration is directly tied to the amount of credit recovered, on an increasing scale.
- Distributors have had a good deal of flexibility regarding how many and which farmers to support; this observation is consistent with Dunavant's view of distributors as small businessmen rather than company employees.
- Dunavant has dropped any distributor who did not reach minimum credit repayment rates; these cut-offs now stand at 80%.
- The company invested heavily in training of distributors in credit management and cotton production and harvesting. The credit management course has been conducted once a year, focusing on improving the distributor's ability to pick good farmers and keep them. The production training has been conducted in three phases: before planting, focusing on production techniques; just after planting, aimed at the best use of chemicals and other products to control weeds and pests; and just before harvest, focusing on harvesting and storage, with a strong emphasis on how avoid contamination and properly grade the cotton.

Tschirley and Zulu (2003) suggest that, from the company's perspective, the Distributor system greatly diminishes the amount of information that the company needs to manage to ensure adequate credit recovery. The company develops strong relationships with a limited number of distributors and creates incentives for them to recover as much credit for the company as possible. Thus, the company attempts to substitute the distributors' local knowledge, social capital, and financial incentives (specified in the written contract) for its own data bases and enforcement mechanisms.

Dunavant reports that credit recovery rose from 67% in 1998/99 (the year prior to the system) to 80% in 1999/00, 88% in 2000/01, and 93% in 2001/02. Rates likely remained around these levels until 2006, when Dunavant reports they may have fallen again below 70%, due to the exchange rate appreciation crisis discussed above.

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<sup>10</sup> The company refers to farmers under a distributor as farmer groups. In fact, the farmers are groups in only the loosest sense, being organized explicitly for cotton production and without a structure to allow them to be active as a group in other commercial activities.

As part of its continuing effort to improve productivity at the farm level, Dunavant in 2005/06 launched its YIELD Program with funding from GTZ. The effort is also part of the *Cotton Made in Africa* (CMiA) project, a German retailer-sponsored effort to mainstream sustainable cotton production practices in Africa<sup>11</sup>. The program is based on experience in Uganda's Agricultural Productivity Enhancement Program (APEP), funded by USAID. The program is based on demonstration plots run by lead farmers who apply the 5-finger approach to field management:

- Early and proper land preparation;
- Planting with first rains;
- Correct plant population (seeding rates, gap filling, thinning);
- Timely weeding; and
- Effective pest management.

A key decision by Dunavant was to base the demonstration plots on its standard input package featuring treated seed, foliar spray for micro-nutrients only, and pesticides for six sprays per season; herbicide and macro fertilizers were used on some plots during the 2004/05 pilot phase, but eliminated for the launch year in 2005/06. Dunavant classifies farmers based entirely on their management practices, with little or no variation in external input use across the groups. In this classification, traditional farmers achieve mean yields of 600 kg/ha, better farmers average 1,200 kg/ha, and committed farmers average 1,800 kg/ha. Monitoring data suggest that lead farmers, who in principle properly applied the 5-finger approach, achieved mean yields of 1,413 kg/ha, with about 20% meeting or exceeding Dunavant's level of 1,800 kg/ha for committed farmers. Cooperating farmers averaged 788 kg/ha, compared to 538 kg/ha for other farmers. The latter group was comprised of randomly selected farmers who may have attended farmer field days but were not recruited by lead farmers. We will return to these figures when we review our own crop budget results in Chapter 5.

Dunavant advocates spraying on a calendar basis, complemented by scouting. In practice, the recommendation amounts to six calendar sprays plus additional sprays as indicated by scouting results. Farmers are educated about harmful and beneficial insects, and are trained to use a simple pegboard to assess scouting results and decide whether they merit an additional spray. Dunavant's own monitoring suggests that the number and timing of sprays by lead farmers did not differ significantly from that of cooperating farmers, suggesting that scouting techniques during 2005/06 had little, if any, effect on spraying practice.

**Cargill:** Cargill Cotton, and Clark before it, has relied on a more traditional system for input distribution, recovery, and extension, featuring heavy monitoring throughout the chain. Figure 8 compares the structure of Dunavant's distributor system, its YIELD program model, and Cargill's approach. The figure shows that Dunavant's distributor system relied much less on salaried employees than did Cargill; even the new YIELD program uses less salaried

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<sup>11</sup> The project was organized by Foundation for Sustainable Agriculture and Forestry (FSAF), created by Otto, a large German retailer with a long history of attention to environmental and social sustainability. Current countries of action are Benin, Burkina Faso, and Zambia. See <http://www.fsaf.de/index.php?en-projects>, <http://www.otto.com/Sustainability.nachhaltigkeit0.0.html?&L=1>, and <http://www.cottonmadeinafrica.com/index.php?en-home>. Dunavant is the only ginner that is an official Project Partner in CMiA, and recently joined the FSAF Board of Trustees.



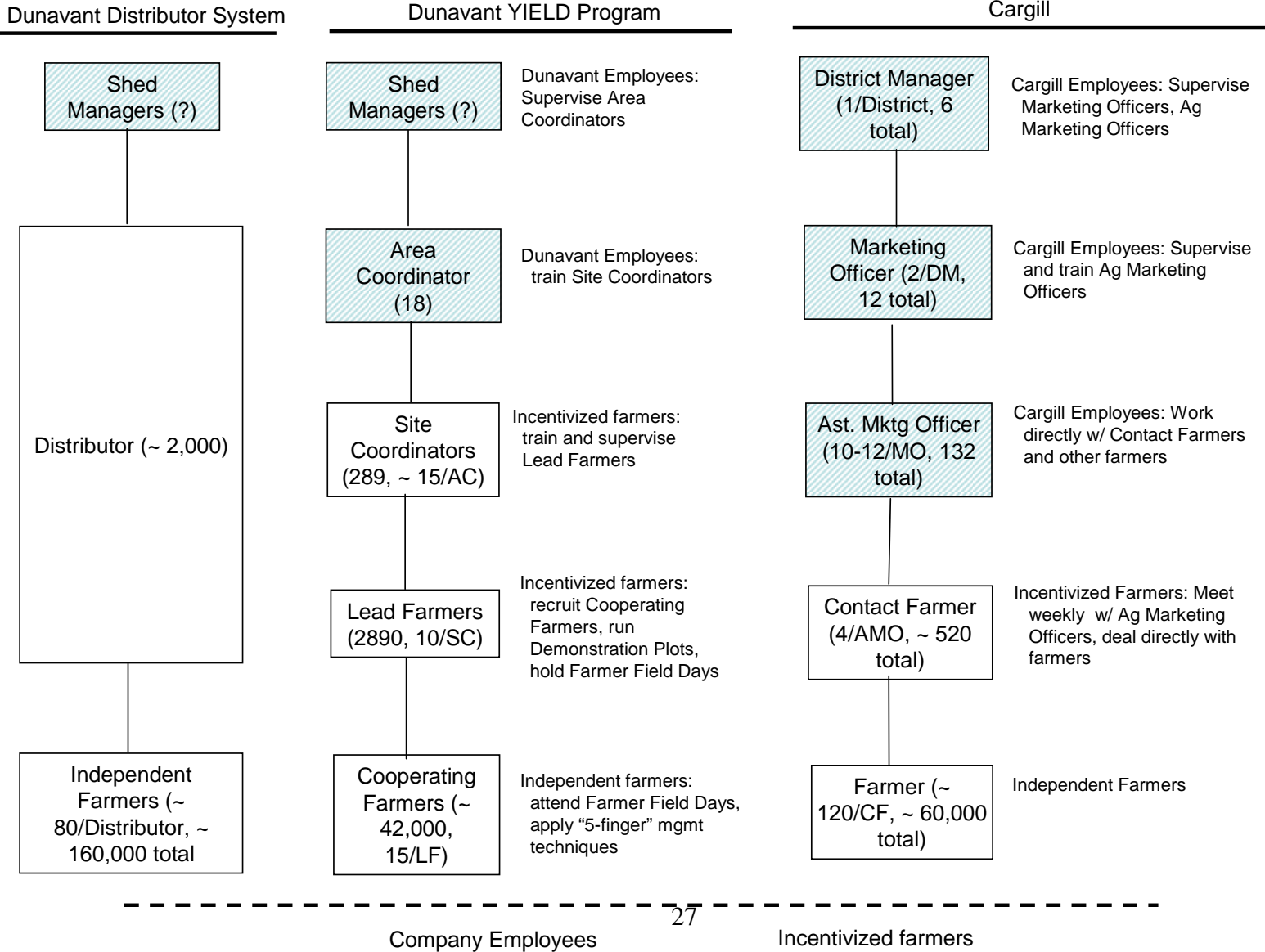
personnel than Cargill. Cargill also signs written contracts and maintains input delivery and cotton sale data for every farmer they support, unlike Dunavant.

Data on input receipts, sales, and credit repayment on every farmer are maintained in the company's data centre. Each year, every farmer applying for input credit is screened for loan default during previous years and is rejected if any default record is shown. Because Clark Cotton seldom participated in sector wide meetings in the past, it has been difficult to evaluate their performance. With the change of ownership to Cargill, there are indications that the company may now become more engaged in such activities. Current management claims credit recovery rates consistently above 90%, including in 2005/06, when Dunavant indicate that recovery fell below 70%. Differential credit repayment performance by Cargill and Dunavant this year deserves close examination to assess the relative effectiveness of the two companies' approaches.

For ten years Cargill has provided farmers with folifert, which provides NPK in addition to micronutrients. They consider this instrumental, along tighter organization of its extension system, for the mean yield above 900 kg/ha that they achieve in Eastern Province.

The basic input package provided by most outgrower firms until 2006/07 included a micronutrient fertilizer, an optional aphicide, an insecticide for bollworm control, and seed. Additionally, each firm sells ultra-low volume (ULV) or knapsack sprayers. Assessing the technical quality of input packages provided by outgrower firms is beyond the scope of this paper; price differences in input packages can reflect differences in type, quality, and quantity of inputs and differences in the price charged for the same input, so these comparisons should be considered only a starting point for possible further analysis. Mulungushi's basic package includes the chemicals mentioned above along with F135 seed, and cost ZKW103,000 per ha for farmers in 2005/06. Continental provides a choice of F135 and Chureza seed in its package, at a total package cost per hectare of ZKW239,000. Cargill is the only company in the country that encourages herbicide use; it indicates substantial uptake in lowland areas where weed growth can overwhelm cotton. It also appears to allow farmer some flexibility in choosing among specific inputs, reflecting a range of prices and quality. The package without herbicide and with fuzzy seed ranged in 2005 in price from ZKW226,000 to ZKW256,000, while the package that adds herbicide and replaces fuzzy seed with delinted seed ranges from ZKW296,000 to ZKW384,000.

**Figure 8. Structure of Dunavant and Cargill Field Operations**



In response to the profitability crisis of 2005/06, Dunavant and Cargill both introduced less expensive input packages that included treated seed, a single type of pesticide, and Soluba for Dunavant, Folifert for Cargill. Cost per ha was reduced to 151,000 ZKW/ha for Dunavant and 110,000 ZKW/ha for Cargill.

Table 9 provides information on the specific inputs that Continental, Mulungushi, and Cargill make available to farmers, the prices they charged for the 2005/06 season, and retail prices charged during September 2006 for the same chemicals by input companies. Given the differing time period, the prices are not strictly comparable. In general, however, the data suggest that prices charged for some inputs by outgrower companies may be well above the retail prices charged by input companies. Given the concentrated structure of the cotton sector and the very limited choice that most farmers have among companies, this issue deserves further attention.

### **4.3. Varietal Development and Agricultural Research**

Prior to the formation of CDT in 1999, all cotton research was done by the MACO Research Branch. The ministry's researchers conducted trials with government funding and were responsible for releasing varieties. All these responsibilities along with Ministry researchers were transferred to CDT after its inception. Chureza, released in 1988, and F135, released 1992, were both developed under MACO and remain the primary seed stock used in the country. Chureza is best adapted to dry areas and predominates in Southern and Eastern provinces, while F135 is mostly used in Central and Western provinces.

CDT released one variety in 2005/06 called CDT 2. Farmer field trials have given yields between 1.5 and 2 tons/ha. The staple is of medium length and strong; Cargill indicates that it has better micronaire and longer staple length than Chureza, along with a slightly higher ginning outturn ratio (42%). Cargill introduced it into two districts of Eastern Province during 2006/07. Dunavant got it as pre-basic seed which it is now multiplying.

Varieties in the pipeline include ALbar9314 which CDT has pre-released. CDT indicates that varieties called CA336, CA347, and MF-20kr are at an advanced stage in testing: CA336 and CA347 are in the third year of multi-location testing while MF-20kr is in the second year.

Cargill and Dunavant both indicate that they are very happy both with the existing Chureza and F-135 varieties, and with the new CDT2 variety. Both commonly indicate that the yield potential of all these varieties is 2-3 mt/ha, providing great scope for yield improvement in the country without continual generation of new varieties. Cargill explicitly warns against having too many varieties in use, given the difficulty of enforcing zoning agreements to maintain seed purity.

**Table 9. Cotton Production Inputs Provided by Outgrower Companies in 2005/06 Growing Season, Prices Charged, and Prices at Retail Charged by Input Companies**

Input Type	Input Name	Cotton Companies						Input Companies					
		Continental		Mulungushi		Cargill		CropChem		Omnia		Cropserve	
		Price Charged		Price Charged		Price Charged		Price Charged		Price Charged		Price Charged	
		Zkw	Unit	Zkw	Unit	Zkw	Unit	Zkw	Unit	Zkw	Unit	Zkw	Unit
Fertilizers	Wuxal					44,000	2 l						
	Foliar mix	40,000	1 l	15,000	1 l	44,000	1 l			18,500	1 l		
	Soluba	17,000	1 kg	13,000	1 kg	-	-	10,000	1 kg	11,080	1 kg	8,500	1 kg
	Decistab					116,000	60 tblts						
	Delta-x					116,000	400 ml						
	Marshal					116,000	400 ml						
Pesticides			750										
	Aphicides	60,000	ml										
	Cypermethrine	90,000	1 l					50,000	1 l			28,000	1 l
	Karate	90,000	1 l					50,000	1 l			55,000	1 l
	Diamethroate							45,000	1 l			28,000	1 l
	Boll pack			40,000	1 l								
	Fenvelarate							50,000	1 l			40,000	1 l
	Monocrotophos							40,000	1 l			60,000	1 l
	Novacetam					16,000	100 ml						
	Agro-prid					16,000	100 ml						
Herbicides	Acetemiprid			10,000	200 ml			120,000	1 l			60,000	1 l
	Weed mix					50,000	10 l					5,500	1 l
	Cotto gard					108,000	2 l					52,400	1 l
	CA223 (Fuzzy)					50,000	30 kg						
	CA223 (Delinted)					70,000	15 kg						
Seed	Chureza (Fuzzy)	40,000	20 kg			50,000	30 kg						
	Chureza (Delinted)					70,000	15 kg						
	F135 (Fuzzy)	40,000	20 kg	35,000	20 kg								
	F135 (Delinted)												
	Sprayer	300,000		250,000		230,000							

Source: Company interviews and market observation, compiled by authors.

#### **4.4. Seed Multiplication and Importation**

Dunavant and Cargill both rely on commercial seed producers for their seed supply, ginning the production in separate batches to maintain purity. Seed is then certified by officials from the Seed Control and Certification Institute, and most is treated prior to distribution farmers; all farmers in the PRA indicated that they use treated seed. All other ginners (with the possible exception of Great Lakes) distribute their seed untreated. Cargill imports CA223 variety from CIRAD in South Africa, using it on 22% of its area (Chureza covers the other 78%), but began replacing this in 2006/07 with CDT 2 and intends to continue that process.

Three public sector bodies have some dealing with testing of products manufactured or imported into the country: the Phytosanitary Unit (PU) of the MACO, the Environmental Council of Zambia (ECZ), and the Zambia Bureau of Standards (ZABS). The PU is mostly engaged with assessing the suitability of agricultural products, the ECZ is mostly visible when there is an environmental concern, and ZABS has the mandate to monitor and set up standards of an almost unlimited range of products.

The lack of a clear law as to who should test inputs such as fertilizer, herbicides or insecticides has created a situation where firms import these inputs and sell them with no central review and approval. At times firms conduct their own tests usually for commercial effect.

#### **4.5. Quality Control**

Dunavant and Cargill both use the official grading system of A, B, and C for seed cotton, though Dunavant added A+. This company estimates that 60% of the seed cotton arriving during the 2001 harvest was graded either A or A+. Cargill re-grades every bag at the gin, and both companies maintain strict separation of grades for ginning. Prices paid by Cargill in 2006 were ZKW850/kg for grade A, 830 for Grade B, and 810 for Grade C. They indicate that most cotton was purchased as Grade A, though the grade can change at the gin.

Dunavant and Cargill used very different approaches in achieving what is probably the major success in the cotton sector in recent years: control of polypropylene contamination. Until 1999, most cotton in Zambia was bagged at the farm level using woven polypropylene bags. Fibers from these bags then entered the seed cotton and remained in the cotton lint. Since the polypropylene fibers will not accept dyes, lint contaminated in this way received substantial discounts among buyers. Dunavant addressed this problem primarily by installing cleaning stations in each gin, slow moving conveyor belts at which women are seated, finding and manually removing polypropylene fibers. The company also informed farmers that they would not accept cotton arriving at buying stations in anything other than plastic bags, but have not been able fully to eliminate that practice, despite providing plastic bags in rural areas. As a result, Dunavant continues to employ between 36 and 64 women at each gin, during three shifts per day and six months per year, to clean all cotton entering the gin. At current minimum wages, this practice adds about US\$0.014 to each pound of lint that the

company processes.<sup>12</sup> Compared to a typical premium of US\$0.06/pound over Index A that Zambia now receives, largely due to the control of polypropylene (and which would quickly become a discount if such contamination returned), the cleaning stations appear to be a good investment by Dunavant.

Cargill does not use cleaning stations, relying instead on the strength of its highly organized field operation. The company provides all farmers with plastic bags for cotton picking. Contact farmers and Agricultural Marketing Officers (AMOs) write farmer contract numbers (the farmer's national identity number) on every bag of cotton that the company buys; this allows Cargill to trace polypropylene contamination, or opportunistic behavior such as putting foreign matter in the middle of bags of seed cotton, back to individual farmers. Cargill personnel indicate that, in such cases, they have returned the bag and made an example of the offending farmer.

Cargill and Dunavant both indicate that CCC previously supplied farmers with polypropylene bags for cotton picking, but ended the practice under pressure from both companies.

The virtual elimination of polypropylene contamination from Zambian cotton has increased the premium its top grades receive from international buyers from US\$0.01/lb of lint in the mid-1990s to at least US\$0.06 in 2006/07 (Estur 2006). This is the largest revealed improvement in quality in SSA during this time and places Zambia second only to Zimbabwe in the premium its cotton lint receives<sup>13</sup>.

#### **4.6. Pricing**

There has been no government mandated price, nor any pricing guidance of any kind from government, since liberalization in 1994. Dunavant has typically acted as a price leader, announcing a minimum pre-planting price to farmers, which may be adjusted upwards at the start of the buying season. Cargill typically follows Dunavant's pricing, while smaller ginners frequently pay higher prices than Dunavant.

As competition among private firms began to emerge in 1997, price competition became a key tool in attracting buyers, and also contributed to the serious credit repayment problems which began at that time. A lack of transparency in price setting was stated by some as contributing to misunderstandings between farmers and outgrowers firms, and thus to the repayment crisis (Govereh et al. 2000). There remains a great deal of variability in the level of input credit support offered to smallholders by the various ginners; these differences may allow the companies offering less or no support to use price to attract sellers who may have received input support from another company.

Pricing became the focus of intense conflict in 2006, driven by the appreciation of the kwacha. A key source of the conflict in the sector was that Dunavant announced a pre-

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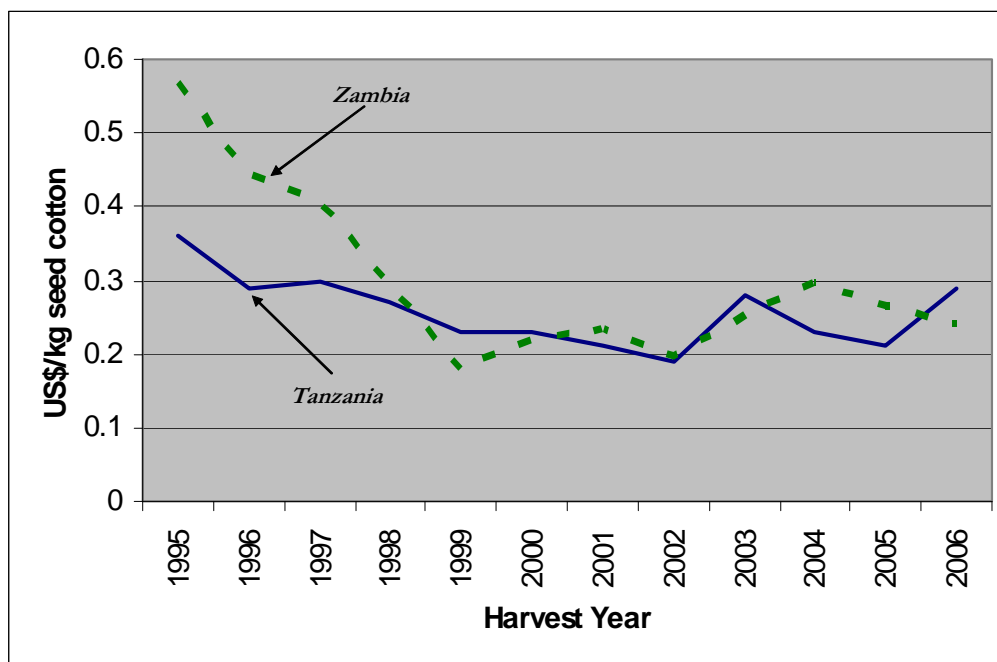
<sup>12</sup> 36 women work at "small" gins, and 64 at "large" gins. Assuming capacity of 15,000 and 25,000 mt of seed cotton, respectively, a GOR of 41%, and the official minimum wage of ZKW560,000/month, costs are US\$14.05/mt lint at small gins and IUS\$14.98 at large gins.

<sup>13</sup> With declining premia in Zimbabwe linked to the changing structure of seed cotton marketing in that country, Zambia may now produce Africa's best quality cotton (see Poulton and Hanyani-Mlambo 2007).

planting price in late 2005 of ZKW1,200/kg, with the stipulation that it depended on an exchange rate not below ZKW4,200/US\$. With the fall of the dollar to ZKW3,200/kg, Dunavant reduced its price to ZKW850/kg, and others followed their lead. To our knowledge, this was the first time that Dunavant had not met its pre-planting price; this decision also led to the first instance of government attempting directly to influence prices, and the first time that farmers attempted in an organized way (through CAZ) to negotiate prices with ginners. The latter have insisted that they will discuss but not negotiate prices. Dunavant does indicate that it “needs to re-build confidence in (its) pre-planting price.” They again announced a pre-planting price for 2006/07, of ZKW1,050/kg, and intend to meet it.

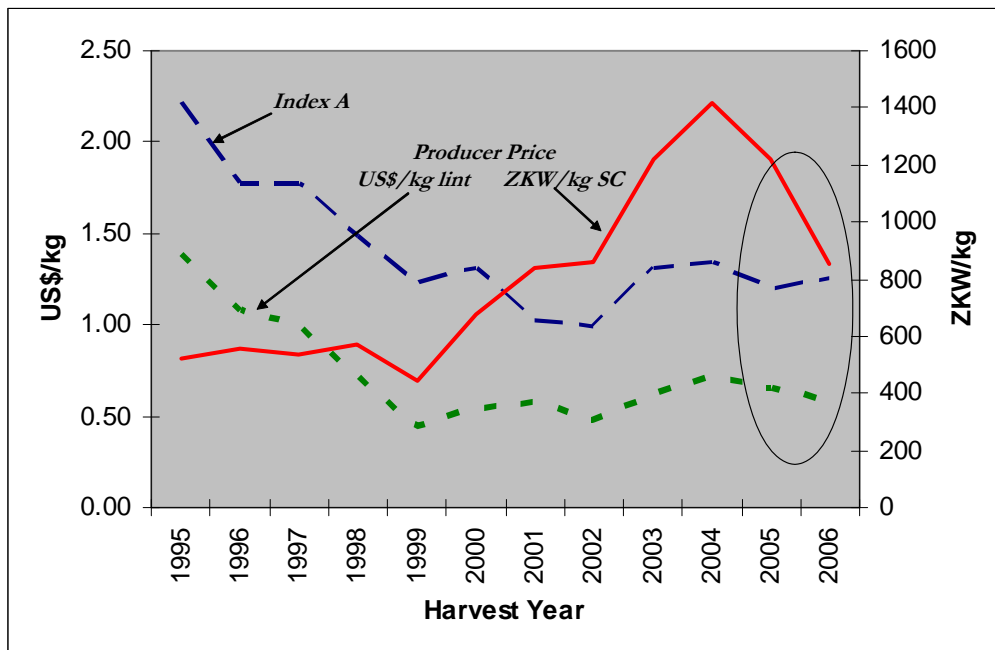
Despite the concentrated structure of the sector, Zambian companies have paid nominal prices comparable to those in Tanzania, where more companies compete more intensely for the cotton crop (Figure 9). A more detailed cross-country analysis, however, shows that Zambia pays a substantially lower share of its realized ex-ginnery price to farmers than in Tanzania; Zambia’s very high price premium on world markets would allow it to pay a higher price than it has been paying (Tschirley et al, 2007). In any case, in Chapter 5 we will examine whether these prices translate into attractive earnings for farmers. Figure 10 shows Zambia producer prices in ZKW/kg of seed cotton and US\$/kg lint, compared to Index A. The gap between lint-equivalent producer prices and Index A widened slightly in 2006, driven by the very sharp reduction in the kwacha price in response to the appreciation crisis.

**Figure 9. Prices Paid to Cotton Farmers in Tanzania and Zambia, 1995 – 2003**  
(US\$/kg)



Source. Cotton Development Trust and Dunavant Zambia, Limited

**Figure 10. Zambian Producer Prices and Index A, 1995 - 2006**



Source: Cotton Development Trust and Dunavant Zambia, Limited for cotton prices, Cotlook for Index A



## 5. COST COMPETITIVENESS, RETURNS TO FARMERS, AND SUSTAINABILITY

### 5.1. Processing and Marketing Cost

As part of the multi-country study of which this report is a part<sup>14</sup>, ginning budgets were developed for each country. The authors were unable to obtain detailed cost data from ginners within Zambia, and so relied on secondary information and expert judgement to develop budgets comparable to those in other countries. Secondary information specific to Zambia includes the typical size and types of gins, approximate purchase and installation cost (for calculating depreciation), electricity rates, and information on approximate staffing levels and wage costs. Expert judgement, based on international norms, was used for estimating energy use and packaging costs. Estimated total costs were also compared to international norms to be sure they were reasonable. Results are presented in Table 10.

**Table 10: Comparative Analysis of Ginning Costs in Nine Countries of East and Southern Africa, and West and Central Africa (US Cents per kg of Lint Cotton)**

Type of system	Burkina <sup>a</sup>	Mali <sup>b</sup>	Cameroon <sup>c</sup>	Mozamb. <sup>d</sup>	Zambia <sup>e</sup>	Zimbab. <sup>f</sup>	Tanzania <sup>g</sup>	Uganda <sup>g</sup>
	Local Monop	National Monop	National Monop	Local monop	Concentrated	Concentrated	Competitive	Hybrid
Exchange rate to US\$ (2006)	505	505	505	23.5	3,600	Variable	1,200	1,800
Type of gins	saw	saw	saw	saw	saw	saw/roller	roller	roller
Average unit ginning capacity	45,000T	40,000T	31,000T	13,500T	20,000T	25,000T	6,300T	5,000 T
% capacity utilized	100%	65%	100%	20%	80%	64%	80%	20%
<b>Fixed costs/kg of lint</b>	<b>5.84</b>	<b>7.99</b>	<b>4.03</b>	<b>17.15</b>	<b>5.86</b>	<b>3.30</b>	<b>1.84</b>	<b>12.29</b>
Depreciation	3.31	4.59	3.06	7.81	3.13	1.9	0.65	6.02
Salaries	1.18	1.08	0.77	9.29	2.60	1.35	1.19	6.27
Other	1.35	2.32	0.2	0.05	0.14	0.05	0	0
<b>Variable costs/kg of lint</b>	<b>9.99</b>	<b>15.39</b>	<b>9.39</b>	<b>6.51</b>	<b>7.61</b>	<b>4.76</b>	<b>6.31</b>	<b>7.66</b>
Energy	2.50	4.40	3.07	2.36	0.50	0.04	0.94	3.04
Packaging	3.49	3.45	3.49	3.91	3.50	2.17	4.17	3.05
Other (including maintenance)	4.00	7.54	2.84	0.24	3.61	2.56	1.20	1.58
<b>Total cost</b>								
... at assumed capacity	15.83	23.38	13.42	23.66	13.47	8.06	8.15	19.95
... at 100% capacity	15.83	20.58	13.42	9.94	12.30	6.87	7.78	10.12
... at assumed capacity and adjusted exchange rates <sup>h</sup>	13.62	20.11	11.55	23.66	10.78	8.06	8.15	19.95

Source: Adapted from Tschirley et al. 2007.

Notes: a. SOFITEX actual accounts for 2003/04; b. CMDT budget for 2006/07; c. SODECOTON actual account for 2004/05; d. Estimate for 2005 calendar year (see country study); e. Estimates by Estur for 2005/06 (ginners contend they are underestimated); f. Estimates for 2005/06 (see country study); g. Estimates based on 2006/07 costs but 2004/05 capacity utilisation (see country study); h. CFA587/US\$ for Burkina, Mali, and Cameroon, equal to the mean 1995-2006 rate; ZKW4,500/US\$ in Zambia, reflecting rates prior to the sharp appreciation in the ZKW in late 2005/early 2006; all other countries unchanged. Note also that both Zambia and Uganda use some second-hand ginning equipment.

<sup>14</sup> Other countries in the broad study are Mozambique, Zimbabwe, Tanzania, Uganda, Mali, Burkina Faso, Cameroon, and Benin.

Note that the assumption of 80% capacity utilization in Zambia was based on the nearly full use of capacity prior to 2006; since that time, new ginning investments combined with lower production have sharply reduced capacity utilization. We compare countries under three scenarios: at assumed capacity utilization rates, with all at 100% utilization, and at assumed capacity utilization rates but with adjusted exchange rates for the West/Central African countries and for Zambia. In the former case, officials and some analysts contend that the current French Franc (CFAF) is over-valued compared to the US\$; in Zambia's case, the adjustment is based on exchange rates prior to the very sharp appreciation of the kwacha that took place starting in late 2005.

Overall, results suggest that ginning costs in Zambia lie near the lower end of costs in East and southern Africa, clearly above those in Tanzania and Zimbabwe, but well below costs in Uganda and Mozambique. In the latter two cases, very low capacity utilization levels sharply increase total costs. Tanzania's low costs are related to their frequent use of roller gins, which have substantially lower investment costs than saw gins; Uganda also uses roller gins and would have very competitive ginning costs if they operated closer to capacity. Mali stands out as an extremely inefficient ginner, even at 100% capacity or adjusted exchange rates.

## **5.2. Cost Competitiveness at the Farm Level**

Table 11 presents summary information from the crop budgets developed through PRA exercises in six villages spread over Chipata and Katete districts of Eastern Province during March, 2007. In each village, 15 to 40 farmers attended the sessions, though typically about ten provided nearly all the information. Detailed budgets are provided in Appendix A.

The shares of each group in the number of cotton farmers, cotton area, and cotton production are based on a complete enumeration of all cotton farmers in each village, and assignment of each to one of the groups. Shares of area and production are then based on data generated during the interviews. Because village selection was not random, and because the number of villages is small, these shares should not be taken as representative of Eastern Province as a whole.

Five points emerge from the table. First, the area-weighted average yield that emerged from the PRA exercise is comparable to that claimed by Cargill and Dunavant in Eastern Province: 836 kg/ha compared to the claimed 900 kg/ha. Notably, yields based on household surveys are substantially higher. Second, about 15% of farmers in these villages are equipped with animal traction and related equipment – all of group 1, and a minority of group 2. These figures are somewhat lower than household survey estimates, which suggest that 20%-25% of cotton farmers in Eastern Province own such equipment. This low level of ownership (even in household surveys) is in part a reflection of serious reductions in animal herds over the past decade due to reduced veterinary service support and disease; farmers indicate now that herd sizes are beginning again to rise. Third, better equipped farmers (group 1) and those able to hire labor whenever needed (primarily groups 1 and 2) are able to achieve higher yields due to greater timeliness in field operations. This pattern is consistent with analysis of household data, which suggests that households with animal traction enjoy yields more than

**Table 11. Summary Crop Budget Indicators by Farmer Type, Mean of Crop Seasons 2004/05 – 2006/07**

	Group								Area weighted mean	
	1		2		3		4			
Share of cotton farmers	9%		15%		42%		34%			
Share of cotton area	27%		20%		42%		11%			
Share of cotton production	36%		26%		32%		6%			
Area in cotton (ha)	4.5		2.0		1.5		0.5		1.51	
Cotton Yield (kg/ha)	1,200		1,050		600		450		836	
Equipment	Animals, plough, ridger, sprayer, ox-cart, handhoes		Sprayer, handhoes		Handhoes		Handhoes			
Labor	All hired		Mostly hired		Mostly family		All family			
Revenue Indicators	ZKW	US\$	ZKW	US\$	ZKW	US\$	ZKW	US\$	ZKW	US\$
Gross revenue	1,248,000	312	1,092,000	273	624,000	156	468,000	117	868,920	217
Input cost/gross revenue	0.15		0.17		0.19		0.21		0.18	
Gross margin (excluding family labor)	426,522	102	349,871	83	466,113	115	328,634	81	417,052	101
Returns/day family labor	11,284	2.69	11,214	2.66	3,917	0.97	3,029	0.75	7,268	1.75
Net margin (after family labor)	237,522	53	193,871	43	-128,887	-37	-213,866	-58	25,247	1
Total cost/kg	842	0.22	855	0.22	1,255	0.32	1,515	0.39	1,092	0.28
Gross margin from all cotton	1,919,350	457	699,742	166	699,169	173	164,317	41	969,899	234

Source: Participatory Rural Appraisal data and Authors' calculations

300 kg/ha higher than those without animal traction (Appendix B). Fourth, yield and area planted are both highest for households with most animal traction equipment; groups 3 and 4, both of whom have only handhoes, are distinguished by group 3 hiring more labor and conducting its field activities in a more timely manner, resulting in somewhat higher yields. Finally, total cost of production (assuming an opportunity cost of family labor of ZKW5,000/day, equal to the typical daily wage rate in rural areas) is lowest for the best equipped farmers, and rises substantially for the least equipped households with lowest yields.

### 5.3. Returns to Farmers and Poverty Alleviation Considerations

Table 10 can also be examined for insights regarding the impacts of cotton cultivation on poverty. We complement this discussion with Figures 11 and 12. Four comments are relevant. First, farmers in all villages indicated overwhelmingly that only the poorest households did not grow cotton. Second, during 2004/05 and 2006/07, Groups 1 and 2 earned 2.5 – 3 times the going daily wage rate in rural areas from their cotton growing activities, while groups 3 and 4 earned below this wage rate during all three years (Figure 11). Third, during all three years, earnings from cotton were typically less than 10% of the extreme poverty line for a family of six for all but Group 1 (Figure 12; average household size in Zambia is six). Finally, returns to cotton were far lower in local currency terms in 2005/06 than during the other two years in our analysis. During that year, none of the groups earned above the going daily wage rate, and only Group 1 (barely) earned enough from its cotton activities to keep a family of six above the poverty line. Because the sudden and large appreciation of the kwacha in 2005/06 makes it a very unusual year, we consider 2004/05 and 2006/07 to be more representative of what farmers typically earn from their cotton crop.

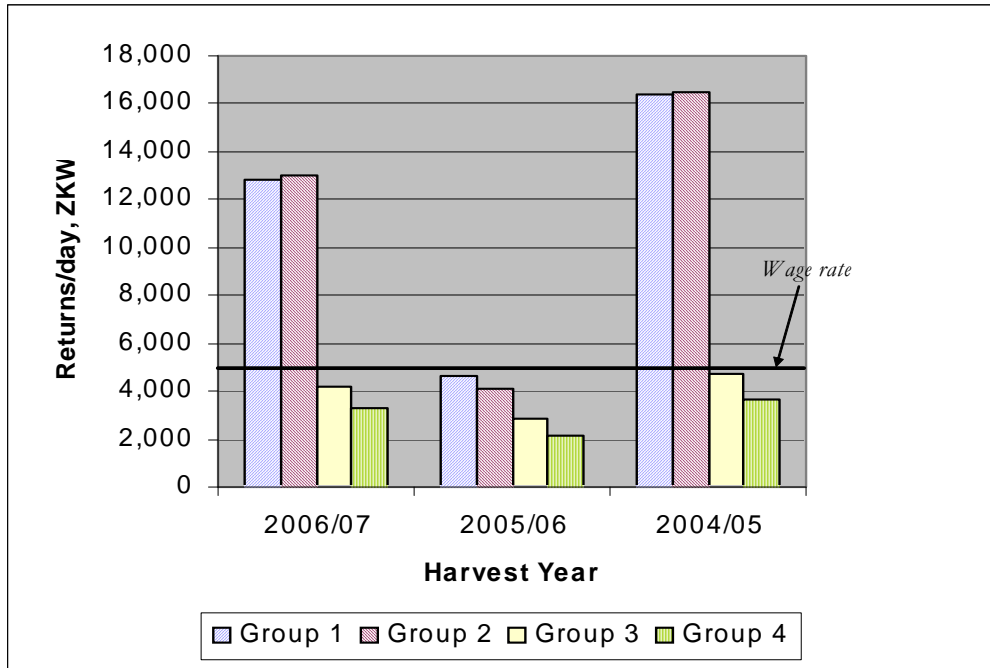
Establishing causation between cotton cultivation and total household income levels is exceptionally difficult. Appendix C and Figure 13 present results from an econometric analysis of the effect of cotton cultivation on net farm incomes, the probability of earning off-farm income, and total household incomes. The results are shown by quintile of cotton area, and depict the estimated association between cotton cultivation at each of these levels and net farm income, and probability of having off-farm income, and net total household income from all sources (including the value of retained food production; see Appendix C for full results)<sup>15</sup>. The regressions control for household education, household assets, total land area, whether the household is headed by a female, and household size and composition (number of children) in an attempt to isolate the effects of cotton. Asterisks above or below each bar indicate whether the result was statistically significant at  $p=0.10$  or better. Three patterns stand out. First, households with small areas in cotton appear to earn the highest net cropping incomes, controlling for all these other factors; the top two quintiles (top 40% in terms of cotton area) appear not to gain any net cropping income from cotton. Second, cotton cultivation appears to be associated with a reduced probability of a household earning off-farm income, except among those devoting the least area to cotton. Third, and consistent with the pattern on net farm income, total household income (again adjusted for the other independent variables) may decline with cotton area, though none of these results are statistically significant. This pattern echoes previous findings in Mozambique (Benfica,

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<sup>15</sup> The regressions are single stage ordinary least squares (OLS) for net farm income and total household income, and a logit analysis for having off-farm income. The single stage OLS approaches do not control for possible selection bias, and will be replaced with two-stage Heckman or double hurdle approaches in the next version of the paper. Households were included in the analysis only if they resided in a district that had at least two cotton farmers. This reduced the number of districts from 70 to 24, and the sample size from 5419 to 2275.

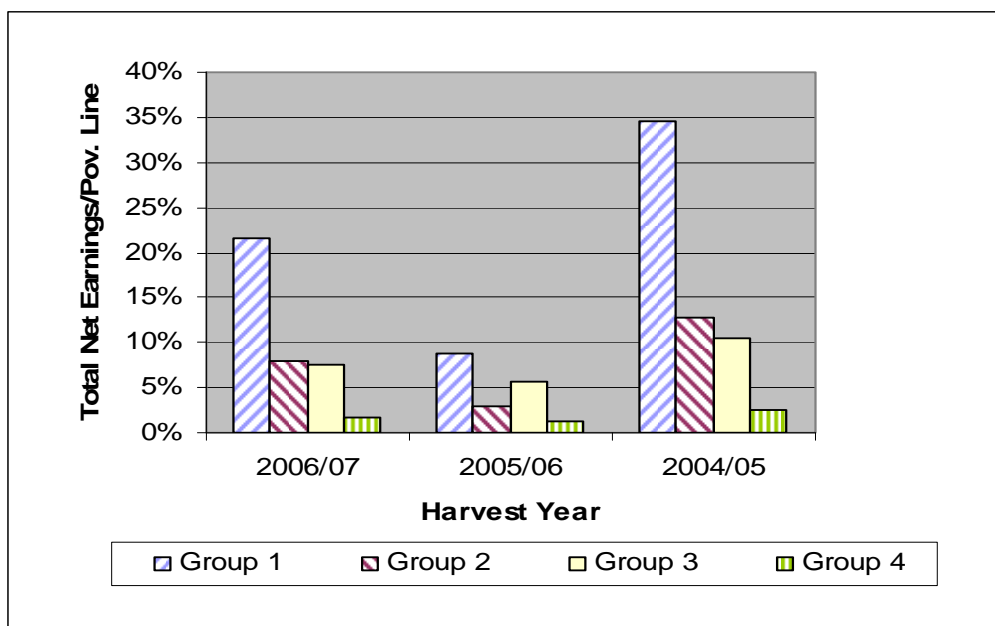
Tschirley, and Boughton forthcoming; Tschirley and Weber 1994) showing that cotton farmers systematically gave-up off-farm income and typically did not enjoy any net gain in overall income. The specific pattern across cotton area quintiles is also remarkably similar to that found more recently in Mozambique (Boughton et al. 2007).

**Figure 11. Returns Per Day of Labor by Farmer Group and Year, Compared to Average Rural Wage Rate**



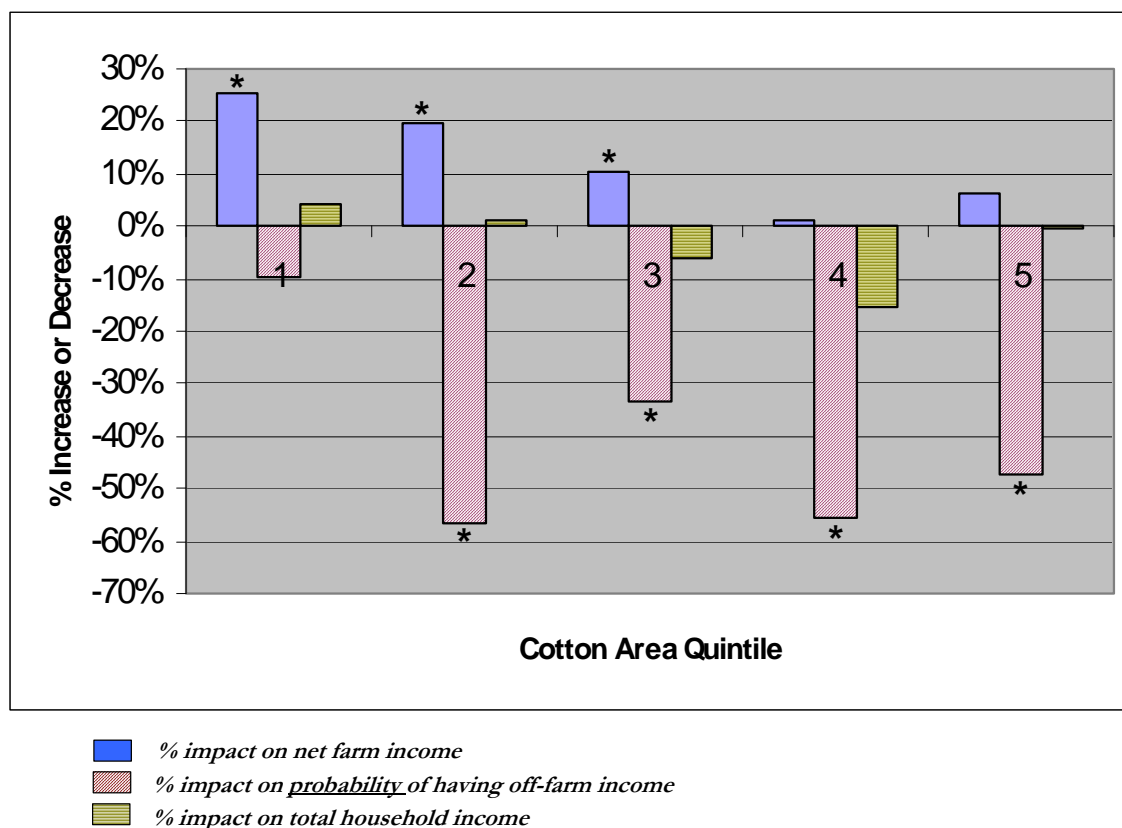
Source: PRA Data and author calculations

**Figure 12. Total Net Earnings from Cotton by Farmer Group and Year as Share of Extreme Poverty Line for Family of Six**



Source: PRA data and author calculations for returns to farmers; Central Statistical Office for Poverty Line.

**Figure 13. Summary Regression Results from Analysis of Association between Area Planted to Cotton and Household Income in Zambia**



Source: Author calculations

Yet this analysis also suffers from serious weaknesses, as follows. Results in this paper, research in Mozambique, and broader research throughout Africa suggest negligible or negative returns to education in agriculture, including cotton. Parallel research suggests that level of education is a key determinant of access to remunerative off-farm income. It may be, then, that relatively uneducated household heads have few remunerative off-farm income opportunities, and that cotton provides the kind of reliable cash income that they otherwise would not be able to earn. Panel data sets in Zambia and Mozambique, which allow more effective control of unobserved variables, may now allow this issue to be explored more rigorously.

In the absence of results from such analysis, the following line of reasoning, based on observations from the field and examination of available data, suggests that cotton has meaningful positive effects in reducing poverty in rural Zambia.

- If cotton cultivation were not available to farmers, most would attempt to produce more maize. This claim is strongly supported by observations in the field during the PRA exercises: many farmers who initially decided not to plant cotton this year, due to very low prices the previous year, attempted instead to plant maize, but when they were unable to obtain fertilizer at subsidized prices, they returned to the cotton companies to obtain planting seed and other inputs. Tobacco and coffee, other important smallholder cash crops in Zambia, are produced in agro-ecological zones not suited to cotton. Other potential cash crops, such as groundnut, have small

markets and no organized system for input provision or output marketing. Cash crops that do provide a more organized output market and which can be produced in the same areas as cotton, such as paprika, have not shown nearly the production growth that cotton has, and do not enjoy as ready a world market as cotton.

- Because Zambia is a land-locked country and a relatively high cost maize producer, market prices for maize would be likely to fall substantially if most cotton area were dedicated to maize.
- Maize is much less drought tolerant than cotton, meaning that in drought years, farmers would be more likely to earn negative cash returns from maize than from cotton.

Table 12 provides an indication of the difficulty smallholders face in relying on maize as their principal cash crop. Yields for both cotton and maize are means from the Central Statistical Office's Post-Harvest Survey (CSO/PHS). Input costs for maize come from previous crop budget work (Haggblade and Tembo 2003), while those for cotton come from our PRA work. For maize, we focus on 2006, when the Food Reserve Agency (FRA) bought a substantial quantity of maize at a very high price: ZKW760/kg (ZKW38,000/50-kg bag), or about US\$181/mt. During the same year, key informants in Eastern province indicated that farmers unable to sell to the FRA received prices of about ZKW500/kg (ZKW25,000/50-kg bag). We examine both of these scenarios, and compare them to cotton in 2005/06, when prices were exceptionally low in kwacha terms, and 2006/07, when they partially recovered. Results show that average cotton returns during both years were below those for maize growers who were able to sell to FRA, but were competitive with returns earned by those selling to the open market. With very high maize plantings in 2006, a large crop expected for 2007, and questions about FRA's ability to buy quantities similar to last year, domestic open market prices might fall below the ZKW500/kg level, making cotton more attractive than maize.

Though previous analysis suggested that maize delivered substantially higher returns than cotton (Haggblade and Tembo 2003, quoted in Tschirley, Zulu and Shaffer 2004), the results reported here are more consistent with the rapid increase in number of cotton farmers and area planted to maize over the past seven years, and with the fact that essentially all of these cotton growers also grew maize.

**Table 12. Indicative Crop Budgets for Maize and Cotton in Zambia**

	Maize, 2006		Cotton	
	Selling to FRA	Selling on market	2006	2007
Yield (kg/ha)	1,348	1,348	874	874
Price (ZKS/kg)	760	500	850	1050
Gross revenue (ZKW)	1,024,100	673,750	742,475	917,175
Input cost (ZKW)	200,000	200,000	200,000	130,000
Gross margin (ZKW)	824,100	473,750	542,475	787,175
Labor days	90	90	110	110
Returns per day (ZKW)	9,157	5,264	4,932	7,156
Exchange rate	3,200	3,200	3,200	4,200
Returns per day (US\$)	2.86	1.64	1.54	1.70

Source: CSO/PHS for yields; FRA, key informants, and cotton companies for prices; Haggblade and Tembo (2003) for maize input costs and maize labor days; PRA for cotton input costs and days of labor; maize labor days adjusted down from Haggblade and Tembo (2003) to reflect cotton's recognized greater labor intensity.

## 5.4. Sector Sustainability

Zambia's cotton sector faces three key challenges to its long-term sustainability: managing and adjusting to the real exchange rate effects of copper exports, sector coordination challenges in light of the recent – and perhaps long-term – changes in sector structure, and increasing productivity across a larger number of cotton farmers. A third possible sustainability challenge – soil fertility depletion due to lack of use of macro fertilizers on cotton – is likely not pressing, due to cotton's rotation with maize and the widespread use of such fertilizers on maize.

The startling appreciation of the kwacha from late 2005 through mid-2006 was simply an accentuated version of the appreciation that had been taking place since mid-2002. In fact, Calí and te Welde (2007) show long-term appreciation of the kwacha since the late 1980s. The recent decline of the kwacha still leaves its real level 35% stronger than the fairly steady rates seen from 1996 through 2002. Fynn and Haggblade (2006) predicted the strongly negative impact of the recent sharp appreciation on cotton and other export sectors, and events during the harvest in 2006 and the later planting bore out their forecasts; Dunavant reduced its support to the sector, it and Cargill both provided less expensive input packages to farmers for 2006/07, and plantings fell by as much as 50%. Calí and te Welde further show that Chile, a country nearly as dependent on copper exports as Zambia, has managed its copper revenues in such a way that its exchange rate shows very few rapid movements and almost no correlation with the copper price; Zambia's real exchange rate, in contrast, is strongly and significantly correlated with the copper price, especially over the past two years, and is also much more volatile. Fynn and Haggblade (2006) summarize the challenge for Zambia:

Governments who have successfully managed similar foreign exchange windfalls to the advantage of their agricultural producers have used the windfall earnings to promote, rather than impede, economic diversification. Their main tools have been active management to avoid excessive exchange rate volatility, sterilization of foreign exchange earnings to avoid currency appreciation, strict controls on government spending in order to combat inflation, and significant public investment in agricultural technology and infrastructure. To date, the Zambian government has adopted none of these measures.

Previous sections in this paper highlighted the substantial structural changes at ginning level in Zambia over the past two years, and suggested that they might represent a long-term shift in the level of direct competition between firms in the sector. Experience in Uganda and Tanzania shows that heavy competition for seed cotton among ginners undermines input credit provision and cotton lint quality. More recently, Zimbabwe has moved from a concentrated sector to one with much more competition, and has also seen input credit provision and quality decline. While Zambia had not reached the productivity levels seen in Zimbabwe, it was moving (perhaps slowly) in that direction, and had already surpassed Zimbabwe in the premium its lint receives in world markets. The rise of CAZ since 2005, its active collaboration with the ginners and MACO in revising the Cotton Act, and its continued constructive engagement with ginners in not allowing disagreements on pricing to divert attention from productivity enhancement, is also a positive sign for the sector. Finally, Zambia joined the International Cotton Advisory Council (ICAC) in 2006, potentially contributing to greater engagement and knowledge within the sector regarding the world market in which it operates.



Yet all these gains can be undone with unrestrained competition among ginning companies. Writing on Zimbabwe, Poulton and Hanyani-Mlambo (2007) suggest that, “If ... policy makers wish the national cotton industry to maintain its historic ‘high yielding and high quality’ profile, then some degree of regulation will be necessary ...”. In Zambia, stakeholders worked together to support revisions to the Cotton Act that would create a stakeholder-led Cotton Board. Dunavant, Cargill, and CAZ have publicly and repeatedly stated that they support the revised Act and wish to see it passed. Most recently, the Minister of MACO has also stated his intention to push the revised Act through. Despite this, little forward movement has occurred since the elections in September, 2006. Presently, the three main multi-nationals in Zambia’s market (Dunavant, Cargill, and Great Lakes), possibly joined by CCC, are discussing creation of a Cotton Pre-Financers’ Association. Precisely what relationship these companies see between such an association and the Cotton Board is not clear at the present time. Recent experience across Africa suggests that, however it occurs, more overt coordination among ginners, and between ginners and farmers, will be required in future years if the sector is to maintain its impressive gains in lint quality and build on the progress it has made to date in farm level productivity.

Such effective regulation will be crucial if Zambia is to provide the inputs and extension needed to continue the slow progress it has made in raising productivity at the farm level. As seen in the section on returns to farmers and poverty alleviation, about three-quarters of farmers (groups 3 and 4) never earned the equivalent of the average rural daily wage rate in their cotton activities during the three years from 2004/05 to 2006/07. Given the sector’s rapid growth, many of these farmers were probably new to cotton, so it could be expected that they will raise their productivity over time if they decide to continue producing the crop. But this will not happen – and the encouraging yields of groups 1 and 2 could fall substantially – if unbridled competition undermines input distribution and extension. A stable environment for private investment in input credit and extension is thus the first requirement for continued productivity growth. Substantially broadening that growth, so that more farmers move into groups 1 and 2, may require more explicit cooperation among ginners, farmers (through CAZ), CDT, and development agencies. Lessons from Dunvant’s YIELD program (financed by GTZ) and Cargill’s privately financed extension approach need to inform any new and expanded initiatives.

Assuming the sector can consolidate a workable approach to horizontal coordination, management of the Cotton Outgrower Credit Fund would be enhanced with more rigorous criteria for eligibility. More generally, government needs to avoid actions and statements that increase uncertainty within the cotton sector. Such behaviour has been a persistent characteristic of government action in the maize sector, and has resulted in more price volatility than would otherwise have prevailed (Tschirley et al. 2006). Events surrounding the kwacha appreciation, especially the Minister’s attempt to suspend cotton marketing in June of 2006, suggest that some of the same governmental patterns seen with regards to maize may begin to emerge in cotton. It is imperative that unilateral government action give way to a more collaborative role; creation of the Cotton Board may help in this regard by investing a recognized multi-stakeholder body, with both public and private representation, with the authority to speak for the sector’s interests.

At the present time, soil fertility and seed quality do not appear to be hindrances to sustainable increases in cotton production. Historically in Zambia, maize has received substantial application of external nutrients in the form of urea and basal compound fertilizers. Cotton in Zambia is rotated with maize and, because it is deep-rooting, is able to benefit from any nutrients that may have leached below the maize root zone. Both Dunavant

and Cargill are pleased with the performance of Chureza and F-135, noting that the country has not yet come close to exhausting their yield potential of 2-3 tons. CDT, while criticized by many sector stakeholders, has developed a variety (CDT 2) that appears to have won acceptance among ginners, and has 2-3 other varieties in the pipeline.

## 6. LESSONS LEARNED

Several lessons emerge from Zambia's post-reform experience. First, a concentrated sector has inherent advantages over more competitive sectors in the areas of input distribution, credit repayment, and quality improvement. Unlike Tanzania and Uganda, whose post-reform structures were highly competitive, Zambia's input distribution system never collapsed, and in fact has consistently improved since reform, at least until the 2005/06 crisis. Furthermore, government played almost no role in this expansion of input credit and improvement in quality, because the two largest private firms were able to ensure sufficient credit recovery to make it financially worthwhile for them to mount the input credit programs. More competitive sectors such as in Tanzania and Uganda have required much more government action to attempt to resolve these problems.

Second, concentrated, market-based systems may be subject to periodic structural instability. Zambia's early duopoly after liberalization was shaken after 3-4 years by substantial credit default instigated by new entrants who provided little if any input credit. Institutional innovation by both Lonrho/Dunavant and Clark/Cargill allowed these companies to re-establish their supply chains, reduce credit default to manageable levels, and substantially grow the overall crop. Over the past two years, more companies have again entered and credit default has returned as a serious problem.

Finally, government can easily get it wrong in these sectors, as shown by the sudden kwacha appreciation, the previous Minister's attempt to suspend cotton marketing, and the failure of CDT to impose more stringent eligibility criteria for the COCF. MACO's participation in the highly collaborative review of the Cotton Act is a much better model for government action. It deals explicitly with some of the crucial regulatory issues raised above, and provides hope that government and private stakeholders together can learn how to collaborate in addressing the sector's key challenges.

One key challenge for concentrated sectors such as Zambia's, therefore, is to develop a flexible and commercially supportive regulatory regime that understands the strengths and weaknesses of the concentrated model. Specifically:

- Concentrated sectors need limited barriers to entry (licensing rules that specify strict capabilities and conduct of firms wishing to participate in the sector) to defend the ability of firms within the sector to coordinate on input supply, extension, quality control, and perhaps other matters.
- Concentrated sectors must retain some contestability to provide incumbents with an incentive to maintain attractive seed cotton prices. As in the case of local monopolies, it is important for those in charge of policy for the sector to form a clear idea of the types of company that they wish to allow into the sector, so as to be able to formulate rules accordingly. Given these sectors' tendency to slide towards unrestrained competition and credit default crises, a strong commitment to raising farmer productivity and improving quality within the chain should be given high priority in the selection criteria
- Given the problems of relying entirely on the threat of entry to discipline incumbent firms within concentrated sectors, it may also be desirable to develop price setting mechanisms that are more formalized than the price leadership that has prevailed in concentrated systems so far. As piloted in many West African cotton sectors, farmer organizations have a potentially very important role to play within such mechanisms.

However, this role needs to be informed by a solid understanding of world markets to avoid the serious problems of sector sustainability that now afflict many West African sectors.

The second key challenge is to mount a sustained and coordinated approach to substantially raising productivity at the farm level. Despite the country's relatively good performance on input credit provision, yield growth has been slow, yields remain well below those in West- and Central Africa, and average returns to farmers appear to be no higher than in Tanzania, where input use and yields are lower. Two findings of the farm productivity analysis in chapter five are especially relevant. First, we found that animal traction is strongly correlated with cotton yields, not just cotton area planted. The more general point of this finding is that timely and adequate cultural practices could generate much higher yields at current levels of input use. However, the second key finding is that a large plurality of farmers (group 4) are unable to prioritize cultural practices on their cotton fields because of limited labor, lack of animal traction, lack of cash to hire labor, and the absolute necessity of ensuring an adequate maize harvest.

Dunavant's focus on the "five non-negotiables" (or five fingers) thus makes a great deal of sense, but under present circumstances, it appears that only a minority of farmers will be able consistently to apply them. Forty percent of farmers in many West- and Central African countries commonly achieve yields of 1,200 kg/ha or more, and animal traction is a key reason they are able to do this (fertilizer use is also high, but soil fertility is lower than in Zambia). The cotton systems in those countries helped farmers build up these assets over a long period of time, and did so in part with outside resources that saw cotton as a vehicle for rural development, not just a single cash crop. Dunavant's YIELD program, financed by donor funds, may be a starting point for an industry-wide approach to attract the resources needed to effect this transformation. Greater attention, however, would need to be paid to building the farm assets of households.

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## Appendix A: Detailed Crop Budgets

**Table A1. Detailed Crop Budgets by Farmer Type and Year**

	Groups			
	1	2	3	4
<b>Technical Itinerary</b>				
Total cotton area (2-limas)	9	4	3	1
Share of area in cotton	0.5	0.33	0.33	0.33
Use of manure	No	No	No	No
	Cleaning, 1 plowing, 1 ridging with own ox plow	Cleaning, followed by single ridging/plowing with hired ox team	Cleaning, plow/ridge by hand hoe with family labor	Cleaning, plow/ridge by hand hoe with family labor
Land Preparation				
Planting method	On ridges	On ridges	On ridges	On ridges
Planting seed (kg; all treated de- linted)	7.5	7.5	7.5	7.5
Thinning	Hired	Family	Family	None
Gap Filling	Hired	Family	Family	None
Number of weeding	3	3	3	2
Type of labor for weeding	Hired	Hired	Family	Family
Number of sprayings (pest + Soluba/foliar)	6	6	3	2
Type of labor for spraying	Hired	Hired	Family	Family
Harvest labor	Hired	Hired	Hired	Family
Transport labor	Hired	Hired	Hired	Family
<b>Input Cost</b>				
Manure	0	0	0	0
Seed	20,500	20,500	20,500	20,500
Pesticides+Soluba or Foliar Mix	44,750	44,750	22,375	14,917
<b>Sub-total</b>	<b>65,250</b>	<b>65,250</b>	<b>42,875</b>	<b>35,417</b>
<b>Ownership of equip., animals</b>				
Animals for AT	Yes	No	No	No
Plough	Yes	No	No	No
Ridger	Yes	No	No	No
Handhoe	5	4	3	2
Knapsack sprayer	Yes	Yes	No	No
ULV sprayer	No	No	No	No
Ox-cart	Yes	No	No	No
<b>Amort'ion of equip, animals</b>				

**Table A1. Detailed Crop Budgets by Farmer Type and Year**

	Groups											
	1			2			3			4		
Two oxen (50% used off-farm)	14,086			0			0			0		
Plough	6,299			0			0			0		
Ridger	11,061			0			0			0		
Handhoe	4,500			5,346			5,346			10,692		
Knapsack sprayer	2,224			3,302			0			0		
ULV sprayer	0			0			0			0		
Ox-cart (50% used off-farm)	11,738			0			0			0		
<b>Sub-total</b>	<b>35,822</b>			<b>8,648</b>			<b>5,346</b>			<b>10,692</b>		
<b>Hired Services</b>												
AT team for plowing/ridging	0			60,000			0			0		
Spraying (rented sprayer only)	0			0			7,500			5,000		
Ox, cart for transp field to home	0			14,000			8,000			6,000		
<b>Sub-total</b>	<b>0</b>			<b>74,000</b>			<b>15,500</b>			<b>11,000</b>		
<b>Labor requirement (man-days)</b>	Family days	Hired days	Hired cost	Family days	Hired days	Hired cost	Family days	Hired days	Hired cost	Family days	Hired days	Hired cost
Cutting	0	7	30,000	0	7	30,000	3.5	3.5	15,000	7	0	
Plowing	6	0	0	0	0	0	0	0	0	0	0	
Ridging	3	0	0	0	0	0	0	0	0	0	0	
Combined Plow/ridge	0	0	0	0.6	3	0	0	0	0			
Handhoe land preparation	0	0	0	0	0	0	10	10	45,000	20	0	
Planting	0.8	4	17,000	4	0	0	4	0	0	4	0	
Thinning	0.4	2	8,500	2	0	0	2	0	0	0	0	
Gap filling	0.2	1	4,000	1	0	0	0	0	0	0	0	
Weeding 1	1.8	9	45,000	1.8	9	45,000	9	0	0	9	0	
Weeding 2	1.8	9	45,000	1.8	9	45,000	9	0	0	9	0	
Weeding 3	1.8	9	45,000	1.8	9	45,000	9	0	0	0	0	
Soluba/Foliar mix (applied with insecticides)												
Spray 1	0.1	0.5	12,000	0.1	0.5	2,500	0.5	0	0	0.5	0	
Spray 2	0.1	0.5	12,000	0.1	0.5	2,500	0.5	0	0	0.5	0	
Spray 3	0.1	0.5	12,000	0.1	0.5	2,500	0.5	0	0	0	0	
Spray 4	0.1	0.5	12,000	0.1	0.5	2,500	0	0	0	0	0	
Spray 5	0.1	0.5	12,000	0.1	0.5	2,500	0	0	0	0	0	
Spray 6	0.1	0.5	12,000	0.1	0.5	2,500	0	0	0	0	0	
Harvest	2	10	50,000	2	10	50,000	15	0	0	11.25	0	



**Table A1. Detailed Crop Budgets by Farmer Type and Year**

	Groups										
	1				2		3		4		
Transport home	0.5	0	0	0	1	0					
<b>Sub-total</b>	<b>18.9</b>	<b>47</b>	<b>286,500</b>	<b>15.6</b>	<b>44</b>	<b>200,000</b>	<b>59.5</b>	<b>10</b>	<b>0</b>	<b>54.25</b>	<b>0</b>
<b>RETURN SCENARIOS</b>											
<b>2006/07</b>											
<b>Price=</b>		<b>1,050</b>			<b>1,050</b>			<b>1,050</b>		<b>1,050</b>	
<b>Input cost =</b>		<b>65,250</b>			<b>65,250</b>			<b>42,875</b>		<b>35,417</b>	
<b>cotton farm budget</b>											
		<b>1a</b>			<b>1b</b>			<b>2</b>		<b>3</b>	
Total production/2-lima		600			525			300		225	
Price seed cotton (ZK/kg)		1,050			1,050			1,050		1,050	
Gross income		630,000			551,250			315,000		236,250	
Input cost		65,250			65,250			42,875		35,417	
Hired services (AT + pump)		0			74,000			15,500		11,000	
Hired labor		286,500			200,000			0		0	
Amortization of equip, animals		35,822			8,648			5,346		10,692	
Total cash cost		387,572			347,898			63,721		57,109	
Net cash income (excluding family labor)		242,428			203,352			251,279		179,141	
<i>Returns per day of family labor (ZKW)</i>		<i>12,827</i>			<i>13,035</i>			<i>4,223</i>		<i>3,302</i>	
Returns per day of family labor (US\$)		3.05			3.10			1.01		0.79	
Implicit value family labor		5,000			5,000			5,000		5,000	
Total value family labor		94,500			78,000			297,500		271,250	
<i>Net income (including value family labor)</i>		<i>147,928</i>			<i>125,352</i>			<i>-46,221</i>		<i>-92,109</i>	
Full cost of seed cotton (ZKW/kg)		803			811			1,204		1,459	
Full cost of seed cotton (US\$)		0.19			0.19			0.29		0.35	
Typical area cultivated in cotton (2-lima)		9			4			3		1	
<i>Total cash earnings (ZKW)</i>		<i>2,181,850</i>			<i>813,408</i>			<i>753,837</i>		<i>179,141</i>	
Exchange rate		4,200			4,200			4,200		4,200	
Total cash earnings (US\$)		519			194			179		43	

**Table A1. Detailed Crop Budgets by Farmer Type and Year**

	Groups			
	1	2	3	4
<b>2005/06</b>				
<b>Price=</b>	<b>850</b>	<b>850</b>	<b>850</b>	<b>850</b>
<b>Input cost =</b>	<b>100,000</b>	<b>100,000</b>	<b>65,709</b>	<b>54,278</b>
<b>cotton farm budget</b>	<b>1a</b>	<b>1b</b>	<b>2</b>	<b>3</b>
Total production/2-lima	600	525	300	225
Price seed cotton (ZK/kg)	850	850	850	850
Gross income	510,000	446,250	255,000	191,250
Input cost	100,000	100,000	65,709	54,278
Hired services (AT + pump)	0	74,000	15,500	11,000
Hired labor	286,500	200,000	0	0
Amortization of equip, animals	35,822	8,648	5,346	10,692
Total cash cost	422,322	382,648	86,555	75,970
Net cash income (excluding family labor)	87,678	63,602	168,445	115,280
<i>Returns per day of family labor (ZKW)</i>	<i>4,639</i>	<i>4,077</i>	<i>2,831</i>	<i>2,125</i>
Returns per day of family labor (US\$)	1.45	1.27	0.88	0.66
Implicit value family labor	5,000	5,000	5,000	5,000
Total value family labor	94,500	78,000	297,500	271,250
<i>Net income (including value family labor)</i>	<i>-6,822</i>	<i>-14,398</i>	<i>-129,055</i>	<i>-155,970</i>
Full cost of seed cotton (ZKW/kg)	861	877	1,280	1,543
Full cost of seed cotton (US\$)	0.27	0.27	0.40	0.48
Typical area cultivated in cotton (2-lima)	9	4	3	1
<i>Total cash earnings (ZKW)</i>	<i>789,100</i>	<i>254,408</i>	<i>505,336</i>	<i>115,280</i>
Exchange rate	3,200	3,200	3,200	3,200
Total cash earnings (US\$)	247	80	158	36
<b>Price=</b>	<b>1,220</b>	<b>1,220</b>	<b>1,220</b>	<b>1,220</b>
<b>Input cost =</b>	<b>100,000</b>	<b>100,000</b>	<b>65,709</b>	<b>54,278</b>
<b>cotton farm budget</b>	<b>1a</b>	<b>1b</b>	<b>2</b>	<b>3</b>
Total production/2-lima	600	525	300	225

**Table A1. Detailed Crop Budgets by Farmer Type and Year**

	Groups			
	1	2	3	4
Price seed cotton (ZK/kg)	1,220	1,220	1,220	1,220
Gross income	732,000	640,500	366,000	274,500
Input cost	100,000	100,000	65,709	54,278
Hired services (AT + pump)	0	74,000	15,500	11,000
Hired labor	286,500	200,000	0	0
Amortization of equip, animals	35,822	8,648	5,346	10,692
Total cash cost	422,322	382,648	86,555	75,970
Net cash income (excluding family labor)	309,678	257,852	279,445	198,530
<i>Returns per day of family labor (ZKW)</i>	<i>16,385</i>	<i>16,529</i>	<i>4,697</i>	<i>3,660</i>
Returns per day of family labor (US\$)	3.56	3.59	1.02	0.80
Implicit value family labor	5,000	5,000	5,000	5,000
Total value family labor	94,500	78,000	297,500	271,250
<i>Net income (including value family labor)</i>	<i>215,178</i>	<i>179,852</i>	<i>-18,055</i>	<i>-72,720</i>
Full cost of seed cotton (ZKW/kg)	861	877	1,280	1,543
Full cost of seed cotton (US\$)	0.19	0.19	0.28	0.34
Typical area cultivated in cotton (2-lima)	9	4	3	1
<i>Total cash earnings (ZKW)</i>	<i>2,787,100</i>	<i>1,031,408</i>	<i>838,336</i>	<i>198,530</i>
Exchange rate	4,600	4,600	4,600	4,600
Total cash earnings (US\$)	606	224	182	43

Source: PRA and Authors' Calculations

Notes:

1. We assume that no hired labor is unsupervised, and that supervision/joint work by family = 20% of the hired labor days
2. The difference between 1a and 1b is that the hhs in group 1b did not own oxen, they only hired a ridger to do ridging as single operation
3. Hired labor for sprays - ZK2000 per 1 knapsack sprayer and there were 6 knapsacks per acre hence having a total charge of ZK12000
4. There was mixed labor for group 1 while the other groups 2 and 3 used only family labor for weedings
5. Groups 2 and 3 do not have sprayers, they just rent

**Table A2. Summary Crop Budgets by Farmer Type and Year**

Source: Participatory Rapid Appraisal data compiled by authors.

	Group								Area weighted mean	
	1	2	3	4						
Share of cotton farmers	9%	15%	42%	34%						
Share of cotton area	27%	20%	42%	11%						
Share of cotton prod'n	36%	26%	32%	6%						
Area in cotton (ha)	4.5	2.0	1.5	0.5						
Cotton Yield (kg/ha)	1,200	1,050	600	450					836	
Equipment	Animals, plough, ridger, sprayer, ox-cart, handhoes		Sprayer, handhoes		Handhoes		Handhoes			
Labor	All hired		Mostly hired		Mostly family		All family			
<b>Revenue Indicators</b>	ZKW	US\$	ZKW	US\$	ZKW	US\$	ZKW	US\$	ZKW	US\$
Gross revenue										
2006/07	630,000	150	551,250	131	315,000	75	236,250	56	438,638	104
2005/06	510,000	159	446,250	139	255,000	80	191,250	60	355,088	111
2004/05	732,000	159	640,500	139	366,000	80	274,500	60	509,655	111
Input cost/gross revenue										
2006/07	0.10		0.12		0.14		0.15		0.13	
2005/06	0.20		0.22		0.26		0.28		0.24	
2004/05	0.14		0.16		0.18		0.20		0.17	
Gross margin (excl. fam. lab)										
2006/07	242,428	58	203,352	48	251,279	60	179,141	43	231,369	55
2005/06	87,678	27	63,602	20	168,445	53	115,280	36	119,821	37
2004/05	309,678	67	257,852	56	279,445	61	198,530	43	274,389	60
Returns/day family labor										
2006/07	12,827	3.05	13,035	3.10	4,223	1.01	3,302	0.79	8,207	1.95
2005/06	4,639	1.45	4,077	1.27	2,831	0.88	2,125	0.66	3,491	1.09
2004/05	16,385	3.56	16,529	3.59	4,697	1.02	3,660	0.80	10,105	2.20
Net margin (after fam. labor)										
2006/07	147,928	35	125,352	30	-46,221	-11	-92,109	-22	35,466	8
2005/06	-6,822	-2	-14,398	-4	-129,055	-40	-155,970	-49	-76,081	-24
2004/05	215,178	47	179,852	39	-18,055	-4	-72,720	-16	78,486	17
Total Cost/kg										
2006/07	803	0.19	811	0.19	1,204	0.29	1,459	0.35	1,045	0.25
2005/06	861	0.27	877	0.27	1,280	0.40	1,543	0.48	1,115	0.35
2004/05	861	0.19	877	0.19	1,280	0.28	1,543	0.34	1,115	0.24
Gross margin from all cotton										
2006/07	2,181,850	519	813,408	194	753,837	179	179,141	43	1,088,098	259
2005/06	789,100	247	254,408	80	505,336	158	115,280	36	488,860	153
2004/05	2,787,100	606	1,031,408	224	838,336	182	198,530	43	1,332,738	290

## Appendix B: Regression to Estimate Area-adjusted Yield Advantage of Households Owing Animal Traction

### Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.285(a)	.081	.081	534.46467

a Predictors: (Constant), prov8ownat, hect, prov3ownat, prov1ownat, prov3, prov8, prov1

### Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta	B	Std. Error
(Constant)	1097.198	19.310		56.821	.000
Hectares of cotton	-126.219	2.244	-.191	-56.255	.000
Central Prov	-18.803	19.949	-.013	-.943	.346
Eastern Prov	-79.954	19.378	-.066	-4.126	.000
Southern Prov	-236.277	20.713	-.130	-11.407	.000
Central Prov* own AT	43.480	8.484	.021	5.125	.000
Eastern Prov* own AT	322.354	5.251	.214	61.389	.000
Southern Prov* own AT	13.266	11.319	.005	1.172	.241

a Dependent Variable: yield

Source: Authors' calculations from CSO 2003/04 Post-Harvest Survey data

## Appendix C. Income Regressions

Variable	Net Farm Income (OLS)				Total Household Income (OLS)				Prob. of off-farm income (logit)				
	Coefficient	Std. Error	P-value		Coefficient	Std. Error	P-value		Coefficient	Std. Error	P-value		
(Constant)	12.91	0.066	0.000	***	13.151	0.082	0.000	***	-1.33	0.13	0.000	***	
loghatotal	0.93	0.022	0.000	***	0.726	0.028	0.000	***	-0.07	0.03	0.007	***	Logit: linear, not log
logasset	0.02	0.002	0.000	***	0.029	0.002	0.000	***	0.00	0.00	0.026	**	Logit: linear, not log
femhead	0.01	0.040	0.859		-0.071	0.050	0.160		0.20	0.12	0.090	*	
logedhhh	0.01	0.005	0.003	***	0.038	0.006	0.000	***	0.11	0.01	0.000	***	Logit: linear, not log
lognchild	-0.02	0.006	0.001	**	-0.015	0.007	0.034	**	0.02	0.03	0.588		Logit: linear, not log
loghsize	0.25	0.037	0.000	***	0.277	0.046	0.000	***	0.04	0.02	0.067	*	Logit: linear, not log
qnt1	0.26	0.089	0.004	***	0.045	0.112	0.688		-0.10	0.26	0.708		
qnt2	0.20	0.061	0.001	***	0.011	0.076	0.885		-0.57	0.20	0.004	***	
qnt3	0.10	0.063	0.099	*	-0.059	0.079	0.452		-0.34	0.20	0.085	*	
qnt4	0.01	0.085	0.903		-0.154	0.106	0.145		-0.55	0.26	0.033	**	
qnt5	0.06	0.064	0.317		-0.002	0.080	0.977		-0.47	0.20	0.016	**	
central	-0.06	0.041	0.164		0.201	0.051	0.000	***	0.80	0.12	0.000	***	
lusaka	-0.08	0.067	0.235		0.783	0.084	0.000	***	1.75	0.23	0.000	***	
southern	-0.10	0.039	0.009	***	0.092	0.049	0.060	*	0.62	0.11	0.000	***	
Adj. R-square		0.638				0.479							
Cox & Snell R-square										0.122			
N		2275				2275				2360			
Dep. Variable		log net farm income				Log net household income				0,1 has off-farm income			

Source: Author's calculations from 2004 CSO/FSRP Supplemental Survey