# ECONOMIC ANALYSIS OF FACTORS AFFECTING COTTON PRODUCTION IN ZIMBABWE

**BY**

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Submitted by **GODFREY MAHOFA** In Partial Fulfilment of the Requirements of the Degree of **MASTERS OF SCIENCE IN AGRICULTURAL AND APPLIED ECONOMICS**

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## Abstract

Improving cotton production is undoubtedly one of the greatest challenges facing the Zimbabwean government today. Since cotton is an important cash crop for the country and for individual households, it has important implications for livelihoods of rural people. In order to achieve this, several interventions in the sector were done since independence in an attempt to improve production.

The main objective of this thesis was to identify factors affecting cotton production in the country during the period 1965-2005.Nerlovian supply response function was used to conduct the study. Empirical findings reveal that the major factors were government expenditure on research and extension and short-term credit extended to farmers by commercial banks and Agribank.The elasticity of supply response with respect to research and extension was 0.17 and 0.4 in the short-run and long-run respectively. The elasticity of supply response with respect to agricultural credit was found to be 0.32 in the short-run and 0.74 in the long-run. Simulation experiments reveal that a 10 per cent increase in the provision of short-term credit will result in a 3.2 per cent increase and 7.4 per cent increase in area planted to cotton. And also it was found that a 10 per cent increase in government expenditure on research and extension will result in a 1.7 per cent increase in area planted to cotton in the short run and 4 per cent in the long run. The study also documented low elasticities of supply response with respect to own price and that of competing products (maize in this case).

A comparative analysis of domestic and international cotton marketing reveal that there is some relationship between the two markets. A Spearman correlation coefficient of 0.72 was found between world price (Cotton-A Index) and the domestic lint price expressed in US dollars and was significant at 1 percent. Nominal protection coefficients were also computed for the period and it was found that the degree of protection in the domestic sector was declining over the years, but generally farmers have been taxed.

Important policy messages from the empirical findings were that there is need for the government, private sector and NGOs to increase extension and training programmes to farmers and also they should continue to lobby for scrapping of policies in the developed world that depress lint prices in the world market. It was recommended that measures should be put in place that enables financial institutions to increase their provision of credit to cotton farmers. Empirical findings also reveal that in the presence of some institutional mechanisms, policies that have negative effect( producer price fall) on production, cotton production will not fall as much than in the absence of such institutional mechanisms.

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# Abbreviations

| | |
|---|---|
| **AFC** | **Agricultural Finance Corporation** |
| **Agribank** | **Agricultural Development Bank** |
| **AREX** | **Agricultural Research and Extension Services** |
| **CFA** | **Communaute Financiere Africaine** |
| **CIE** | **Centre for International Economics** |
| **CMB** | **Cotton Marketing Board** |
| **Cottco** | **Cotton Company of Zimbabwe** |
| **CRI** | **Cotton Research Institute** |
| **CSO** | **Central Statistics Office** |
| **ESAP** | **Economic Structural Adjustment Programmes** |
| **f.o.b** | **Free on board** |
| **FAO** | **Food and Agricultural Organisation of the United Nations** |
| **GDP** | **Gross Domestic Product** |
| **ICAC** | **International Cotton Advisory Committee** |
| **LDC** | **Less Developed Countries** |
| **LSCF** | **Large Scale Commercial Farmers** |
| **NACGMB** | **National Association of Cotton Ginners, Merchants and Buyers.** |
| **NCC** | **National Cotton Council** |
| **NGO** | **Non Governmental Organisations** |
| **OECD** | **Organisation for Economic Co-operation and Development** |
| **R&D** | **Research and Development** |
| **SSA** | **Sub-Saharan Africa** |
| **US$** | **United States Dollar** |
| **Z$** | **Zimbabwe Dollar** |

**Dedication**

*To my wife and son Charles*

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# CHAPTER 1

# INTRODUCTION

## 1.1 Background

Agriculture is the mainstay of the Zimbabwean economy contributing about 18.5 percent of the GDP and 22.8 percent of the foreign exchange earnings and about 23 per cent of formal employment (RBZ, 2006). This indicates that Zimbabwe like most low-income countries has a high proportion of their population dependant on agriculture for their means of livelihood. Therefore what happens in the sector is critically important in determining economic development of the country. If the farmers who are also the major consumers are doing well, this has a positive impact on the development of agro-processors and the demand for goods produced in the non-agric sector. Although economic theory suggests that the relative importance of agriculture declines as economies grow, agriculture is usually critical for such structural transformation to occur. Historically the sector in Zimbabwe was dualistic, consisting of densely populated smallholder sector (mostly communal) and a modern, large scale commercial sector. Since independence resources have been concentrated on improving the performance of agriculture in the communal lands. The commercial area has shrunk significantly as a result of land purchases for resettlement and the Fast Track Land Reform. The above reasoning clearly shows the importance of farmer response to agricultural policies, and is the focus of this thesis.

Agricultural policies in Zimbabwe have taxed the sector since independence, a practice which might affect production as well as resources allocated to agriculture. Producers in the agricultural sector have been strongly influenced by the indirect effects of economy wide policies. Krueger et al (1995) noted that the principal indirect effects in many developing countries have been;a) exchange rate misalignment because of macroeconomic policies which reduces the real purchasing power of income received from sales of export and import competing products;b) protection for domestic industry,

which forces farmers to pay more for agricultural inputs than they would have to pay for the same goods imported at world prices and also reduces the purchasing power of households as consumers of manufactured goods; and c) appreciation of real exchange rate because of industrial protections policies, which results in additional taxation of farm producers. Evidence has accumulated that strongly suggest that agriculture is a dynamic sector that responds positively to price incentives and that "policies which tax agriculture reduce the investment in the sector, increase out migration, and reduce the implementation of new techniques" (Mundlak, 1985).One issue that has attracted the attention of policy analysts is the response of the export sector to macroeconomic and agricultural price policies. Since cotton earnings constitute more than half of Zimbabwe's export earnings and recently cotton has overtaken tobacco as the country's major foreign currency earner, some studies have documented the response of the cotton sector to policies. Cotton is currently one of the country's important agricultural exports and it earned the country US$150 million in 2004(Rusare et al, 2006).Cotton is also considered an important cash crop in rural areas, as it provides income for most households.

Zimbabwe produces approximately about 123 000 tonnes of lint cotton annually and exports to the international market amount to 70 percent while 30 percent is used domestically (Rusare et al, 2006) .It contributed about 12.5 percent of the total agricultural contribution to GDP in 2004 (RBZ, 2005). Cotton production in the country is done mainly by smallholder farmers. 99 percent of total production in the 2002/3 season came from these farmers (Mlambo and Poulton, 2003). The semi-arid climate in the country makes it favourable for peasant farmers to grow cotton. Cotton is mainly grown on communal farms that are geographically dispersed in rural areas and are operated as family units, but these are areas of concentrated poverty.

The main objective of this thesis is to try and identify factors which affect for cotton production differences across the years. It will also find out the responsiveness of farmers to policy and institutional incentives. Since cotton is internationally tradable the analysis will also look at agricultural policies in the developed world. Due to increased globalization, economies of different countries have integrated through trade liberalization and markets tend to be correlated. Thus policies in other countries will have

an effect on the livelihoods of cotton farmers via the exchange rate and price transmission. It has been asserted that liberalization of markets (globally or domestically) is a double-edged sword, for many farming systems, as some preferential access to markets will be lost, and some domestic production will be threatened (IFPRI, 2005). It can be seen that smallholder farmers may be affected, as they are producers and consumers of goods. Thus government need to put proper policies that support these farmers, to ensure their overall welfare is not compromised.

### 1.2 Problem Statement

Low levels of agricultural production have been the major problem facing the Zimbabwean economy since Independence. Given the importance of agriculture and particularly the cotton sub sector in Zimbabwe on rural livelihoods and general well being of the macro-economy there is need to identify the determinants of production in the sector for policy advise. Cotton production is conducted in regions were there is low rainfall and so most farmers grow cotton in order to boost their incomes for them to be able to purchase food. After independence in 1980 the government has introduced various policy instruments in order to boost production of cotton farmers. The instruments include, price incentives, input subsidies and credit provisions. Thus the thesis will establish whether low levels of production are a result of lower producer prices being offered to farmers or poor macroeconomic policies and a weak institutional environment.

### 1.3 Research Objectives

Main objective of the thesis is to determine factors affecting cotton production in Zimbabwe during the period 1965-2005.

Specific objectives are;

1. To characterize cotton production performance in Zimbabwe.
2. To examine domestic marketing trends in relation to international markets.
3. To examine the factors affecting smallholder cotton production in Zimbabwe and the role of policy and institutional incentives.

**Research Questions**

2. What are the main characteristics of cotton production trends in Zimbabwe ?
3. Does international marketing of cotton have an effect on the domestic market?
4. What are the factors affecting cotton production in Zimbabwe?

## 1.5 Research Hypothesis

The thesis will be guided by the following hypothesis;

1. Smallholder farmers have become the major producers of cotton as compared to large-scale commercial farmers.
2. International markets have a significant effect on the marketing of cotton in Zimbabwe.
3. Price and macroeconomic policies have a significant effect on the production of cotton in Zimbabwe.

## 1.6 Justification and Expected Contribution of the Study

Knowing and understanding the key variables, which affect production of farmers, is of great importance for designing economic policies and their ultimate implementation in Zimbabwe. Explanations of production differences between years may include weather variability, input quantities decline and loss of production efficiency. Identifying the reasons for differences in cotton production in Zimbabwe is not only important from a historical perspective, but also useful to evaluate the effects of existing and new policies. There have been changes in agricultural policies in Zimbabwe since Independence. Policies were mainly put in place to improve productivity of smallholder farmers and therefore improve livelihoods. Liberalisation policies were put in place to improve the functioning of the market system and remove state intervention in agricultural markets. But results of the policies were not fruitful as nothing changed and poverty increased mainly in rural areas. Government then realizing the failure of the policies revert back to

controlling the market, thus policies were going in cycles and without any success in promoting market efficiency. Therefore a reappraisal of the current policy environment especially in the cotton sector is urgently needed. There are critical problems facing smallholder cotton producers in poor rural areas such as those in the semi-arid regions of the country. There is need to assess the causes of success and failure of policy interventions to support such farmers. Empirical studies in these areas are rare and they have not been sufficiently recognized and articulated by researchers. There is therefore need to conduct a study exploring these issues. A deeper understanding of various policy instruments which enhance production is crucial for economic policy making in Zimbabwe. Not much is known about the importance of farmer responses to policy incentives on community incomes and livelihoods. The study is expected to document policy relevant supply elasticities in the cotton sector and their implications on livelihoods. The study is also expected to contribute to the current issues concerning trade policy.

### 1.7 Thesis Organisation

This thesis is organised into seven chapters. The first chapter covers the introduction and background about the issue to be studied. This chapter covers the research problem, questions and hypothesis to be tested and also the justification for conducting the study.

The second chapter will provide a literature review on issues about cotton production. The chapter provides an overview of global and regional cotton production and marketing. Production and marketing of cotton in the country is also reviewed, bringing into attention some of the factors that have contributed to improved cotton production. Review on the importance of cotton production to developing countries and Zimbabwe is also done. Empirical tools commonly used in assessing production performance are finally reviewed.

The third chapter will provide an outline of the methodology used in the study. A conceptual framework was first developed in order to identify possible variables for the study. Tools of analysis are also discussed in the chapter.

Chapter four is the first analytical chapter. The objective of the chapter is to test hypothesis one. Production performance was characterised in this chapter. Second analytical chapter compared international and domestic cotton marketing.

Chapter 6 analysed the determinants of cotton production over the years and the response to policy incentives by farmers. Econometric techniques were used in the chapter.

Chapter 7 provides conclusion and possible policy recommendations for the empirical findings of the study. A summary of results is presented first before policy recommendations.

# CHAPTER 2: LITERATURE REVIEW

## 2.0 Introduction

The main objective of this thesis is to analyse factors affecting cotton production in Zimbabwe, paying particular attention to farmers' response to various government policy instruments during the period under study. This chapter will review literature which guides the research project. The first section of the chapter will provide an overview of global cotton production .Current topical issues relating to international trade of cotton will be reviewed. The section will review issues about regional cotton production and marketing. The second section will review cotton production and marketing trends in Zimbabwe. The third section will review literature on the importance of cotton production to developing countries, especially those in SSA.The last section will review factors affecting production and the empirical models commonly used to study production behavior and farmer's response to policy incentives. The chapter will end with a conclusion.

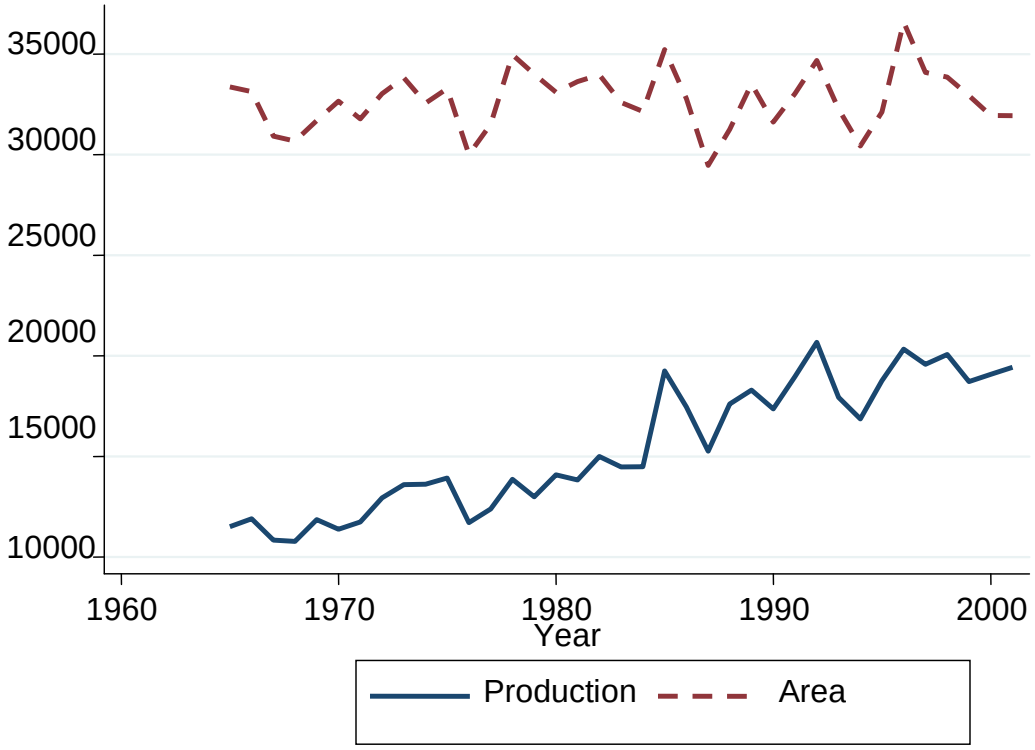
## 2.1 Overview of Global Cotton Production and Marketing

Cotton production is done by many countries in the world, but countries in the Northern Hemisphere accounted for more than 90 per cent of world output. Developing countries account for more than two-thirds of world cotton production(Baffes,2004).The period 1960-2001 saw global cotton output doubling from 10.2 million to 20 million tonnes(Baffes,2004).Notably, the countries that contributed much to this growth are China and India ,which tripled and doubled their production respectively. Other countries that significantly increased their share of world output were Turkey, Greece, and Pakistan. New entrants included Australia, which produced only 2000 tonnes of cotton in 1960 and averaged 650000 tonnes a year during the late 1990s.Another important new entrant in cotton production Francophone Africa, which produced less than 100000 tonnes in the 1960s, now produces almost 1 million tonnes (Baffes, 2004).Figure 2.1

below shows the trends in world cotton production and area planted. The figure shows that cotton production in the world has generally followed an upward trend. The main contributors to this upward trend were the United States and China and also some new producers (Table 2.1). China and the United States are the largest cotton producers in the world, with each accounting for about 20 per cent of world output, followed by India (12 percent),Pakistan(8 percent),and Uzbekistan(5 per cent)(ICAC,2002).

**Figure 2.1: Graph showing world cotton production and area planted**

Production and area under cotton-(000) Hectares and (000) Metric tonnes




**Source: ICAC (2002)**

United States and Central Asian republics of the Soviet Union have maintained their output levels at about 3.5 million tonnes and 1.5 million tonnes, respectively. The share of these two dominant producers in the world declined during the 1960-2002 period. The share of East African cotton producers have also declined during the period. Other significant cotton producers are Francophone Africa, Turkey, Brazil, Australia, and Greece, which accounted for a combined 18 per cent of global production (Baffes, 2004)

.World area planted to cotton, has not been changing much, fluctuating in the range of between 30000 to 35000 thousand hectares.

In terms of cotton consumption, countries with the largest textile industries in the world tend to be the largest importers of cotton lint. China the leading textile producer absorbed more than a quarter of global cotton output during the late 1990s(Baffes,2004).Other major textile producers are United States,India,and Pakistan, account for half of world cotton consumption.

**Table 2.1: Main Producers of cotton**

| **Country** | **1961** | | **2002** | |
|---|---|---|---|---|
| | **Cotton Production(1000 tonnes)** | **Share in Global Production (%)** | **Cotton Production(1000 tonnes)** | **Share in Global Production (%)** |
| Australia | 2.6 | 0 | 795 | 3 |
| China | 800 | 5 | 4900 | 25 |
| Greece | 93.8 | 0 | 370 | 2 |
| India | 88.4 | 5 | 1900 | 9 |
| Pakistan | 324.1 | 2 | 1700 | 9 |
| Turkey | 212 | 1 | 850 | 4 |
| West and Central Africa | 116 | 1 | 1160 | 6 |
| United States | 3120 | 16 | 3733 | 21 |
| Former Soviet Union | 1528 | 8 | 1407 | 5 |
| Sudan | 116 | 1 | 59 | 0 |
| Uganda | 67 | 0 | 1208 | 0 |

**Source: Gillson et al (2004).**

Of all the cotton produced in the world about one-third is traded in the international markets and the major exporters are the United States, Uzbekistan, Francophone Africa,

Australia (Baffes, 2004).These countries accounted for more than two-thirds of world exports. According to a report by Baffes(2004) eight largest importers in the world during the 2000-01 season were Indonesia, India, Mexico, Thailand, Turkey, Russia, Italy, and Korea. World cotton trade rose by more than 400,000 tonnes during 2002, reaching 6.2 million tonnes.

Given the fact cotton lint is traded internationally, there is need to look at the direction of movement of world prices of cotton lint. Real cotton prices over the last two centuries have followed a declining pattern showing some temporary increases. According to a report by Gillson et al (2004), cotton prices averaged US$2.31 per kilogram during the 1960s and during the 1990s they averaged US$1.34 per kilogram. The world price of cotton fell to its thirty year low in the 2001/02 season. These lower prices resulted in lower production and higher consumption the following season (2002/03).The instability and downward movements in prices have been caused by a number of factors. These include; reductions in the costs of production due to technological advancement, unpredictable fluctuations in production and exports from India, Pakistan and China, strong competition from substitutes (synthetic fibres) and subsidies granted to key cotton producing countries.

The most important reasons for decline in cotton prices in the international market were a structural shift in support policy of the United States and EU.Increased production subsidies in these nations depressed world prices as they encouraged overproduction. In 1985 lint prices declined following the introduction of the Farm Bill in the United States. The Bill reduced support prices for cotton and most of the U.S stocks were released to the market, depressing world prices (Baffes, 2004).The 2002 Farm Bill retained the earlier support through various loans, flexibility contracts and insurance payments. These market price payments, designed to compensate cotton growers for the difference between the world price and the loan rate (target price), have resulted in lower prices in 2001/02 season.EU has also been supporting cotton growers. Under the Common Agricultural Policy(CAP),support is given to cotton growers based on the difference between the market price and a guide(support) price(Gillson,2004).Between 1995-96 and 1999-2000 the budgetary expenditure on cotton aid ranged between 740 million and 903 million

euros, implying that on average,EU cotton growers received more than twice the world price of cotton(Baffes,2004).The EU cotton support consist of; a single farm payment scheme; a production aid scheme and development measures.

These distortions in the world market have impacted negatively on the world prices and a number of SSA countries who depend on cotton production have suffered. A number of studies have concluded that, in the absence of subsidies, average cotton prices would have been higher. For example, ICAC (2003) concluded that during the 2000-01 and 2001-02 seasons average world prices would have been higher by 17 and 31 cents a pound.Tokarick (2003) found out that multilateral trade liberalization in all agricultural markets (including cotton) is expected to induce a 2.8 per cent increase in the world prices of cotton, with 0.8 per cent from the removal of market price support and 2 per cent coming from the removal of production subsidies.

### 2.1.1 Cotton Production and Marketing in Sub-Saharan Africa

Cotton production in Sub-Saharan Africa is mainly concentrated in Francophone countries. These nations are located in the West and Central parts of the continent, with some from East Africa. Table 2.2 below shows production of cotton in West and Central Africa.

The production of cotton has increased in West Africa since the early 1980s.Cotton has proved to be an economically viable with a significant and positive impact on exports, economic growth and rural development (Gillson et al, 2004).Cotton related activities account for a large share of rural employment and exports and generation of government revenue in the region.

Cotton production declined in the West African region in the six years preceding the devaluation of the CFA franc in 1994, but accelerated after the devaluation. Production increased by 16 percent a year on average from 1993/94 to 1997/98, then declined for three years before reaching a new peak in 2001/02 of 983,000 tonnes (Poulton et

al,2004). In Mali, Cote d'Ivoire, Burkina Faso and Cameroon production has increased substantially over the past four years.

**Table 2.2: Cotton production in West and Central Africa**

| **Country** | **Production (tonnes)** | **Earnings From cotton (US$ thousands)** |
|---|---|---|
| Benin | 107334 | 124679 |
| Burkina Faso | 59308 | 68892 |
| Cameroon | 83865 | 97418 |
| Central African Republic | 11100 | 12894 |
| Chad | 46087 | 53535 |
| Congo | 9315 | 10820 |
| Cote d'Ivoire | 88034 | 102260 |
| Gambia | 100 | 116 |
| Ghana | 7672 | 8912 |
| Guinea | 1330 | 1545 |
| Guinea-Bissau | 2949 | 3426 |
| Liberia | 402 | 46 |
| Mali | 251748 | 292430 |
| Niger | 6889 | 8002 |
| Nigeria | 149595 | 173770 |
| Togo | 3575 | 4153 |
| Total | 828941 | 962898 |

**Source: Gillson et al (2004)**

The factors which contributed to successful cotton production in the region are; application of appropriate soil nutrient replenishment; pest management and seed varieties well-suited to local conditions; the provision, by the government and cotton companies, of support services and infrastructure; guaranteed producer prices and output markets; high input-credit recovery rates; and well organised village-level associations (Minot and Daniels, 2002).With the exception of Benin and Cote d'Ivoire, the cotton sector in the region is under the control of a single company that controls the provision of

inputs and other services to farmers and that operates as the sole buyer of the entire cotton crop. National governments are majority stakeholders of these companies. Most of the cotton produced in the region is for export.Gillson(2004) reported that about 90 per cent of cotton produced in the region is exported and in the 2002/3 season cotton exports peaked at 793000 tonnes.Other major producers of cotton in SSA include Mozambique, Nigeria, Tanzania, Uganda, Zambia, and Zimbabwe.

## 2.2 Cotton Production and Marketing in Zimbabwe

Production of cotton in Zimbabwe started in the early 1920s and the first research station was set up in 1925.By then the country had become one of the most important producers in the World and this was due to advanced technologies in production. Cotton marketing was initially the sole responsibility of Cotton Marketing Board (CMB), which was established in 1969.CMB, controlled every aspects of production, from the sale of planting seed to the purchase of cotton from farmers (creating a monopoly in the sector). Cotton production in Zimbabwe experienced a dramatic increase in the 1980s, particularly in the smallholder sector. In 1979/1980 season, communal lands contributed 20% of the national seed cotton production and by the end of the 1980s this sector accounted for 75% of the national production (Rukuni, 1994).The trends in national cotton production since independence are shown in table 2.3.

| Year | Area(000ha) | Production(metric tons) |
|---|---|---|
| 1980 | 89921 | 157533 |
| 1981 | 125054 | 170594 |
| 1982 | 109014 | 134886 |
| 1983 | 132976 | 146521 |
| 1984 | 180155 | 221746 |
| 1985 | 209658 | 274186 |
| 1986 | 194053 | 257031 |
| 1987 | 224604 | 228043 |
| 1988 | 247853 | 295591 |
| 1989 | 227270 | 260290 |
| 1990 | 221225 | 202603 |
| 1991 | 265167 | 242706 |
| 1992 | 238282 | 69409 |
| 1993 | 235455 | 199184 |
| 1994 | 224462 | 194269 |
| 1995 | 208147 | 98411 |
| 1996 | 232518 | 233979 |
| 1997 | 300542 | 195212 |
| 1998 | 236287 | 179347 |
| 1999 | 310534 | 197259 |
| 2000 | 282469 | 241964 |
| 2001 | 384574 | 280254 |
| 2002 | 401897 | 194089 |
| 2003 | 195077 | 159497 |
| 2004 | 326956 | 364266 |
| 2005 | 293813 | 196300 |
| 2006 | 260156 | 248257 |

**Table 2.3: Cotton Production in Zimbabwe.**

The table clearly shows that area under cotton has been increasing since 1980s with the highest area planted in 2002.Production of cotton in the country increased as shown in the table, with low figures obtained in the 1992 drought year. Most of the cotton production comes from the smallholder sector. Prior to independence the LSCF were the major contributors to national cotton output (Mariga, 2004).Zimbabwe's cotton boom in the period after 1980 made it the fourth largest producer of seed in Africa after Egypt, Sudan and Ivory Coast. According to Mariga(2004),cotton production continued to expand from 274000 hectares in the 1990/91 season to 330450 hectares in the1998/99 season.Mariga(2004) also noted that the area devoted to cotton increased to about 350000 hectares during the fast track land reform programme as compared to the 1990s average area of 260000 hectares planted.However,during the period 1990-2004 there has been drop in yield from 6.5 tonnes per hectare in the 1990s to 4.9 tonnes per hectare during the fast track period(Mariga,2004).The cotton success story in Zimbabwe is attributed to its crop research programme which was supported by effective extension, marketing and economic policies.

In the 1990s Structural Adjustment Programmes were introduced and this affected the cotton industry as well. In 1994 CMB monopoly was broken and private companies joined the industry of marketing cotton. As of 2004/5 season the number of companies in the sector increased to about twelve (Mlambo and Poulton, 2005).Prior to reforms the government through CMB controlled every aspects of cotton marketing and production. The producer prices were announced by CMB at levels below prices which would have been obtained from exporting of cotton lint. Since liberalisation in 1994 to present the number of companies in the cotton marketing industry have increased to twelve. The impact of new companies in the sector has resulted in increased credit provision and input supply has improved. The price of seed cotton is now determined by market forces and the newly formed NACGMB announces the price. As of the 2006/7 season the producer price of cotton seed is ranging from Z$6000/kg to Z$14000/kg.

## 2.3 Importance of Cotton Production to Developing Countries

Cotton is one of the cash crops, which is believed to be at the mainstay of any developing country's rural economy, contributing significantly to the nation's GDP and foreign currency, while playing a pivotal role in poverty reduction. According to FAO, more than 100million people are engaged directly in cotton production making cotton an important commodity. Cash crops have been considered to be important in poverty alleviation as they provide increased incomes to rural households. In Africa cotton is typically a smallholder crop and the main cash crop. It is grown in rain-fed land with minimal use of purchased inputs such as chemicals and fertilizers (Baffes, 2004). In low income countries where the majority of the poor live in rural areas, as in much of Africa(IFAD,2001), an increase in income from export cash crop production is widely recognised to be one of the best short-term measures to alleviate poverty. Deininger and Okidi (2003) examined panel data from 1300 households across Uganda between 1992 and 2000 and found that higher coffee prices over the period were a major factor contributing to reduced poverty levels.

Booth and Kweka (2004) noted the poor performance of Tanzania's main cash crop sectors (including both coffee and cotton) as one of the main reasons why rural poverty did not fall in Tanzania during the 1990s, despite sustained per capita GDP growth. The large impact of increased income from export cash crop production on rural poverty occurs firstly because the direct increases in income tend to be widely distributed within the rural population, including for large numbers of households who fall below recognised poverty lines (Gillson et al, 2004). Thus, in the case of cotton, Oxfam International (2002) estimate that over two million households (comprising over 10 million people) in West and Central Africa are directly involved in cotton production. Cotton accounted for between 30 and 44 percent of total merchandise exports in five West African countries (Burkina Faso, Benin, Chad, Mali, and Togo) during 1998-1999(Baffes, 2004).

The increased number of people and nations depending on cotton has important implications for poverty, especially when prices change. A study by Minot and Daniels(2004) in rural Benin found out that a 40 per cent reduction in farm-level prices of

cotton results in an increase in rural poverty by 8 percentage points in the short-run and 6-7 percentage points in the long-run.

Another important point is that cotton is a labour-intensive crop. Thus increased production will result in increased demand for hired labour, thereby increasing incomes of those not directly involved in cotton production. In their study Minot and Daniels (2004) also estimated econometrically the determinants of the demand of hired labour in rural Benin and found out that falling prices will not greatly reduce labour demand since the labour intensity of cotton is similar to that of competing crops. These findings have important implications for those not involved in cotton farming.

### 2.3.1 Importance of Cotton Production in Zimbabwe

In Zimbabwe cotton production is the business of many smallholder farmers, given the fact that about 99 percent of total production in the 2002/3 season came from this sector (Mlambo and Poulton, 2003).The cotton industry is now the mainstay of Zimbabwe's economy and cotton has overtaken tobacco as the country's biggest foreign exchange earner, bringing in an annual export revenue of well above US$150 million (GOZ, 2004). The fast track land reform programme which has seen a decline in several sectors of the agricultural industry (for example tobacco) has had a minimal impact on the cotton industry since this sector has traditionally relied heavily on small-holder farmers. Actually, the land reform has benefited cotton production in the 2000/1-2001/2 seasons through the opening up of new cotton producing areas. The participation of more than 200 000 growers and a dozen or so buyers in a competitive environment without government subsidies has resulted in a vibrant cotton industry. Table 2.4 below shows the extent of cotton dependency in the country.

**Table 2.4: Extent of farmer dependency on cotton**

| Area | Percentage Dependency |
|---|---|
| Gokwe and parts of Sanyati | 90% |
| Hurungwe, Chinhoyi, Karoi, Doma, Kadoma | 70% |
| Glendale, Bindura, Mount Darwin, Rushinga, Mukumbura, Guruve, Greater Part of Muzarabani,Ngundu, Zaka | 50% |
| Checheche, Chipinge | 60% |

**Source: Chizarura (2005)**

The table clearly shows that cotton is an important cash crop for many rural households in Zimbabwe. Most of the 200,000 cotton growers are peasant farmers located in the arid and semi-arid regions of the country. Cotton is important to Zimbabwe's economy, representing the major source of cash income for farmers and a principal source of export earnings for the country as a whole. It is important for the maintenance of rural social & economic livelihoods, ensuring food security and generates export revenue (Chizarura, 2005).

Cotton has been an important crop for peasant farmers in Zimbabwe in terms of improving farmers' livelihoods, especially when price changes occur.Mlambo et al (2004) modeled the impacts on poverty of alternative seed cotton prices. Using a microeconomic model of seven smallholder cotton households types calibrated on 2001/2 survey data from Muzarabani and Guruve districts, they found out that increasing seed cotton prices to Z$80(to give farmers 35 per cent share of f.o.b export value) will reduce the proportion of households below nationally defined Total Poverty Line from 56 percent to 38 per cent. They also show that households without access to credit are highly responsive to price changes (that is area under cotton increase as price changes).

In terms of improving food security, Govereh and Jayne (2002) empirically measured the synergies/trade-offs between cash cropping and food crop productivity in Gokwe North District. An analysis of survey data on 430 rural households in 1996, show that, after controlling for household assets, education and locational differences, households engaging intensively in cotton production obtain higher grain yields than non-cotton and marginal cotton producers. They concluded that the potential spill-over benefits for food crops through participation in cash crop programs are important to consider in the development of strategies to intensify African food crop (Govereh and Jayne, 2002).

### 2.3.2 Constraints to Cotton Production in Zimbabwe

There are many factors that currently constraint cotton production in Zimbabwe. Imported agricultural inputs and chemicals are important to cotton production however the high duty that is taxed on imported agricultural inputs significantly pushes up the cost of production. Also the shortage of foreign currency to import such agricultural inputs is another problem facing the sector. Since 2000 the sector has faced many daunting challenges. The country faced many macroeconomic difficulties, which include galloping inflation, distortion of the official exchange rate and shortages of key commodities such as fuel (Mlambo and Poulton, 2003). In addition farmers experience labour bottlenecks at all points along the production cycle. Labour is a crucial input in cotton production in all sectors because the crop is labour intensive for several operations including planting, weeding, pest control and picking. Given the fact that cotton is a smallholder crop, most of these farmers use their own labour and hiring of labour is not very common.

Compared to the large-scale commercial sector yields realized in the smallholder sector are still low. This is because research targeted on new improved seed varieties is inadequately funded. Cotton also needs rotation but the majority of smallholder farmers' still face land related constraints, resulting in reduced potential for this sector.

Another constraint facing the cotton sector is the small domestic market, which only demands 20 – 30 percent of the national output (Hanyani-Mlambo et al, 2002). The variable rainfall patterns experienced in the marginal areas of Zimbabwe translate into yet

another constraint, resulting in huge yield fluctuations. The 2001/2 production season was a drought year, which had a negative impact on production, input credit schemes and quality of seed cotton (Mlambo and Poulton, 2003).

World cotton prices have fallen over the years impacting negatively on producer viability; while costs of production have sky rocketed. Since 2000, the attractiveness of seed cotton prices to producers has been observed to fall.

Another major problem for communal farmers is the late marketing of seed cotton due to transport bottlenecks (Mariga, 1994). This results in late purchase of inputs, late planting and reduced yield potential. There is general consensus that inadequate government support is given to research and extension initiatives to help increase productivity levels in the smallholder sector, this is evidenced by the huge gap in yields between the large scale commercial sector and the communal farmers.

Poulton et al (2003) also cited a weak institutional environment as one of the problems the sector is facing. Since about 70 per cent of cotton farming in the country is conducted through contracts with cotton buyers and merchants (Chizarura, 2007), there is need to put in proper institutions to enforce such contracts. In the industry, the role of trust as an enforcement mechanism through its effect on reducing opportunism and improving coordination in the supply chain is missing in the sector. Problems of side-marketing have increased in the sector. The concept of side-marketing refers to a situation where farmers fail to honour their forward contracts, such as taking inputs from company X and selling all seed cotton to company Y(Mlambo and Poulton,2003).The increased number of players in the sector in recent years have resulted in ineffective coordination mechanisms(for example, common understanding between key players about grading and respecting each others' dealings with individual farmers).Thus there is need to put in a proper institutional environment. The following section will review the current policies and regulations in the sector.

### 2.3.3 Domestic Policies and Regulations affecting the Cotton Sub sector (Institutional Environment)

On the production side government has a standing regulation that enforces the destruction of all cotton stocks by the end of the cotton growing season; this is a way of ensuring that the risk of disease and pests associated with cotton production is reduced.
The liberalization of the cotton market allowed the entry of new players into the cotton market; however existing regulations serve as barriers to entry into the cotton sector. In order to establish a buying company or ginnery an application has to be made to the Zimbabwe Revenue Authority (ZIMRA), furthermore the whole process is complex and slowed down by bureaucratic and political obstacles.

By law all operators intending to export cotton lint are required to obtain export permits for each batch they intend to export. From the farmers point of view the requirement for export permits disadvantages farmers since such a policy effectively bars individuals to export their own lint. Farmer organizations have placed a proposal for the introduction of an export retention scheme similar to what is enjoyed by tobacco growers.

Prior to liberalisation regulatory framework was established through CMB.After privatization some form of coordination and collaboration emerged as an institutional arrangement.
1) State-Private Sector Coordination
National Cotton Council(NCC) was established by the Ministry of Agriculture in collaboration with the producers( Cotton Growers Association and Zimbabwe Farmers Union),buying and ginning companies,spinners,oil expressors and research institutions(CRI and AREX).NCC is vital for regulation and coordination. The main objectives of the council is to provide a forum of discussion and mutual exchange of information among stakeholders and to act as an advisory body to the Ministry of Agriculture(Larsen,2002).Stakeholders agreed to impose uniform grading system and legislation was formed to reinforce grading standards. Marketing companies employ and pay the salary of an independent cotton arbitrator. Function of the arbitrator are to check companies if they are grading to standards, and resolving disputes between farmers and

ginneries. Information on opportunistic behavior in grading by individual ginneries is made available to all members of the NCC through the arbitrator. This provides the most effective mechanism to enforce informal agreements because no company wants its reputation jeopardized. Thus the introduction of NCC's state- private institutional framework for coordination and mutual exchange of information has been pivotal for the viability of effective cotton marketing after liberalisation (Larsen, 2002).

2) Established formal institutional linkages and informal networks have emerged. Cotton marketing companies collaborate with cotton research by, multiplying new seeds for sale to farmers, taking part in field days and other joint activities, providing loans and extension officers, initiating and sponsoring tours to enable interested farmers from new cotton growing regions to visit the Cotton Research Institute and offering training, research facilities and trial sites at the Cotton Training Centre, a private institute, which is owned by the Cotton Growers' Association, has particularly supportive links to the Cotton Research Institute and also offers training to smallholder farmers.

3) Private sector initiatives
In order to curb the problem of side marketing that has been increasing in the period 2003-2006, NACGMB was formed. Under this body new rules were put in place.Due the influx of private and unscrupulous buyers, all cotton buyers are now be required to prove that they supported growers during production before they are issued with export permits

## 2.4 Factors Affecting Production and Empirical Review

### 2.4.1 Review of Studies on Cotton Production

According to Dixit (1976), a production process is a technique in which there is a combination of inputs to produce a particular output. The collection of all available techniques is described by an isoquant map or a production function or indirectly by a cost or profit function. Cotton production is also about combining inputs to produce

output. Studies conducted either in Zimbabwe or elsewhere have identified several factors affecting cotton production. Some of these studies are reviewed in this section.

Study by Thirtle et al (1990) has shown that in general agricultural production in Zimbabwe (LSCF) is affected by the adoption of new technology, generated by R&D expenditures, or imported from abroad, and spread to the farmers by the extension service. They concluded that the determining variables that shift the production function were assumed to be R&D and extension expenditures, and the weather. In their study they aggregated all outputs (crops and Livestock) into an index, they did not disaggregate to individual crops. The problems which may arise from conclusions based on such research is that, different crops respond differently to various factors in the production process, so they is need to specifically study how individual crops respond to different factors.

Another study by Jayne et al (1993) used a profit function to econometrically estimate determinants of agricultural production in the country. The study indicated the importance of state marketing infrastructure and increased credit availability in stimulating crop production. They also found out that R&D had insignificant effect on crop production in contrast with the findings of Thirtle et al (1990).

Another study in the Tanzanian cotton sector by Dercon (1993) provides evidence on the importance of both price and non-price related government policies toward cotton production since the 1950s.Results show that no aggregate supply response exists for cotton. They found out that pricing policy has resulted in a reduction in cotton production in the 1970s and early 1980s.The effect of macroeconomic policies was found to have a negative effect on cotton production.

Govereh and Jayne (2002) studied the determinants of cotton production in Gokwe North district and found out that cotton production is positively associated with farm size, education of the household head, the value of farm capital, the number of cotton sprayers and a relatively early clearing of tsetse from the village in question. This study brought about the importance of education as one of the factors affecting cotton production, but

there is also need to look at other factors which affect cotton production from a historical perspective for policy evaluation purposes.

Mariga (2004) documented that, the development of support services was an important explanation of the cotton success story. He noted that the development of marketing services, extension and training, seed production and access to inputs was fundamental in improving cotton production especially in the smallholder sector of Zimbabwe.

Gillson et al (2004) analysed long-term determinants of cotton production in several African countries including Zimbabwe for the period 1960-2002. In Zimbabwe, both (smallholder) area planted and seed cotton production are moderately, but significantly, correlated with both current and past season's seed-cotton price for the 1990–2001 period. For example, the Pearson correlation coefficient for current seed-cotton price (expressed in 1990 ZW$) and quantity of seed cotton produced, over this period, is (0 .53 (significant at five percent).

In another study which compares cotton producing households in Zimbabwe and Tanzania, Larsen (2006) noted that in the Tanzanian case, variations in respondents' cotton sales revolve around households' access to cropping land and possession of draught power, while observed differences in the Zimbabwean case are based on a combination of ownership-related assets and respondents' access to manufactured inputs. This result closely resembles findings of Govereh and Jones (2002), in which on-farm capital was found to be significantly related to cotton production.

### 2.4.2 Empirical Review

#### 2.4.2.1 Production Function Approach

After reviewing the factors affecting cotton production, there is also need to review models commonly used in analysing determinants of production and response to policies

by farmers. Methods vary from production, cost or profit function approach to linear programming methods. Alternative methods of measuring supply response are also reviewed.

In terms of production function approach, estimation may be done from cross-sectional (farm surveys) and time series data. Using first-order conditions for profit maximization supply responses can then be derived (de Janvry, 1995).From the basic theory of production, the production function of a farm is given by:

$F(q, x, z) = 0$,

Where q is the vector of output quantities, x is the vector of variable input quantities, and z is a vector of fixed factor quantities. Variable inputs may include, labour, fertilizer, water, pesticides, and seeds which can be purchased in desired quantities. Fixed factors include land, public factors (infrastructure and extension services), or exogenous features (such as weather and distance to markets).Given output and input prices ,the farmer is assumed to choose the combinations of variable inputs that will maximize profit subject to the technology constraint. The solution to this maximization problem is a set of input demand and output supply functions. Several empirical studies have used this framework in production analysis.

For example, a review by de Janvry and Sadoulet (1995) shows a number of studies that applied the theory of production economics.Binswanger et al (1984) estimated a cropping system for the semi-arid tropical areas of India using a production system, with data from 19 –year time series of 93 districts. The study employed a generalized Leontief and normalized quadratic models. Since output prices are not known at the time of planting, expected prices were used.

In a related study Fulgniti and Perrin (1990) examined the effects of agricultural price policy on production in Argentina by specifying a translog model for the sector. They used time series data over a long period (1940-1980).They considered three variable inputs and three fixed factors (land, rainfall and time in years as a proxy for technological change).In another study Fulginiti and Perrin(1993) analysed the effects of prices on agricultural productivity of several LDCs,by estimated a Cobb-Douglas function.

Other studies used the profit function approach in trying to determine the factors affecting production. Using the concepts of duality between production and profit functions, Jayne et al (1993) specified a normalized quadratic function to estimate the effects of various policy incentives on production Zimbabwe.

### 2.4.2.2 Models of Supply Response

In order to determine factors affecting production and supply of agricultural commodities some researchers have used direct estimation of supply response without first specifying production functions. The Nerlovian (1956) partial adjustment model has been extensively used in literature. Some analysts have also used the model in connection with the adaptive expectations model (Abdulai and Rieder, 1997).Time series data are commonly used for commodity under study and the prices of few directly related commodities. The supply response equation derived from profit maximizing conditions of the farmer is estimated here. The function usually takes the form;

Q=q(p,z),

Where p represents prices and z is a set of exogenous shifters (private and public factors) and Q is output supply. In agricultural production, farmers respond to expected as opposed to actual prices. Usually observed prices are market or effective farm-gate prices after production has occurred, while production decisions have to be based on the prices farmers expect to prevail several months to prevail later at harvest time (de Janvry and Sadoulet, 1995).Thus modeling of expectation formation is an important issue in supply response.

The general models of supply response can be formulated in terms of yield, area, or output response of individual crops, for instance, the desired area to be allocated to a crop in period t is a function of expected relative prices and a number of shifters (de Janvry and Sadoulet, 1995):

1) $q_t = \alpha_1 + \alpha_2 p_t^e + \alpha_3 z_t + \mu_t$

In this equation; $q_t$ = desired cultivated area, $p_t^e$ = the expected prices vector, $z_t$ = set of exogenous shifters(policies, private and public fixed factors), $\mu_t$ accounts for unobserved random factors affecting production and has expected value of zero, and the $\alpha_i$'s are parameters. The advantage with these models is that they are quite practical, and their numerous variants have been applied to many crops in many countries.

A study by Cuddihy (1980) estimated a model of area response for the five major crops of Egyptian agriculture (long season berseem, cotton, wheat, maize, and rice).Expectations were modeled with a one-year lag specification.

In a study done in Zimbabwe by Muir-Leresche (1984), estimation of supply response to prices in the LSCF was done for five major crops. Model specifications were based on Nerlove's partial adjustment method. Area under crops was also used as a dependent variable with lagged producer price variables and dependent variables. The problem with the study is that results are based on one sector of agriculture being analysed (LSCF) and no considering the smallholder's responsiveness to policies.

In another related study Chipika (1994) estimated supply response function for maize and cotton in the communal sector of Zimbabwe. Both the Price Expectations Model and the Expectations Adjustment Model were tried. The study documented elasticities of supply response. In the short-run elasticity with respect to price for cotton was 1.42 and 1.51 in the long-run.

### 2.5 Conclusion and Insights from Literature

This chapter reviewed literature on the economics of cotton production. The chapter started by assessing global cotton production and found out that global output has increased during the 1960-2002 period. The major contributors to growth in world cotton production were found to be the United States and China, although new entrants such as Australia and Francophone Africa contributed a significant share. The chapter then went on to review topical issues in international marketing of cotton and found out that the

global market of cotton is distorted, with subsidies in the developed countries which depresses world price of cotton.

A review of cotton production in SSA was also done and it was found that West and Central Africa contributed most of the SSA cotton output. In terms of marketing in the region most of the cotton is internationally marketed by government parastatals and other private companies.

Review of cotton production in Zimbabwe show that production was done in two sectors, LSCF and the smallholder sector and it was found that the smallholder sector was the important producer of cotton. It was noted in literature that the reasons for growth in smallholder cotton production stems from development of support services. But also the review also noted serious constraints in cotton production and marketing in the country, that is, the need for a proper institutional environment to govern cotton trade.

Cotton was found to be an important cash crop for developing countries including Zimbabwe. Literature noted that an increasing number of rural population in Zimbabwe depend on cotton production for their livelihoods. And also nationally cotton has become an important foreign currency earner for Zimbabwe.

# CHAPTER 3: METHODOLOGY

## 3.0 Introduction

This chapter will provide a general description of the methods used to conduct the research. A conceptual framework was developed first for the study. The second part will cover data collection approaches, techniques, sources of data and the reliability of data. Data management techniques and empirical tools of analysis are also discussed. The advantages and disadvantages of the method of analysis are also presented.

## 3.1 Conceptual Framework: The Impact of and Factors Affecting Cotton Production in Zimbabwe

Literature has developed on the determinants of cotton production and likely effects of such production on national governments and individual households involved in the production process. Consistent with literature determinants of cotton production are decomposed as follows; institutional arrangements (legal framework, organizational and marketing arrangements); macroeconomic and policy environment; private and pubic factors (access to credit, provision of research and extension, development of irrigation infrastructure). The diagram below tries to show various factors affecting production performance. From the diagram macroeconomic and policy environment, institutional environment and other exogenous factors (such as research and extension and provision of agricultural credit) have any effect on cotton production which in turn affects farmers' income and profits for cotton companies. This will also affect the amount of foreign exchange earnings for the nation and the general well being of the macro economy.

The framework below tries to analytically decompose the determinants of cotton production in order to identify and define variables for the study.

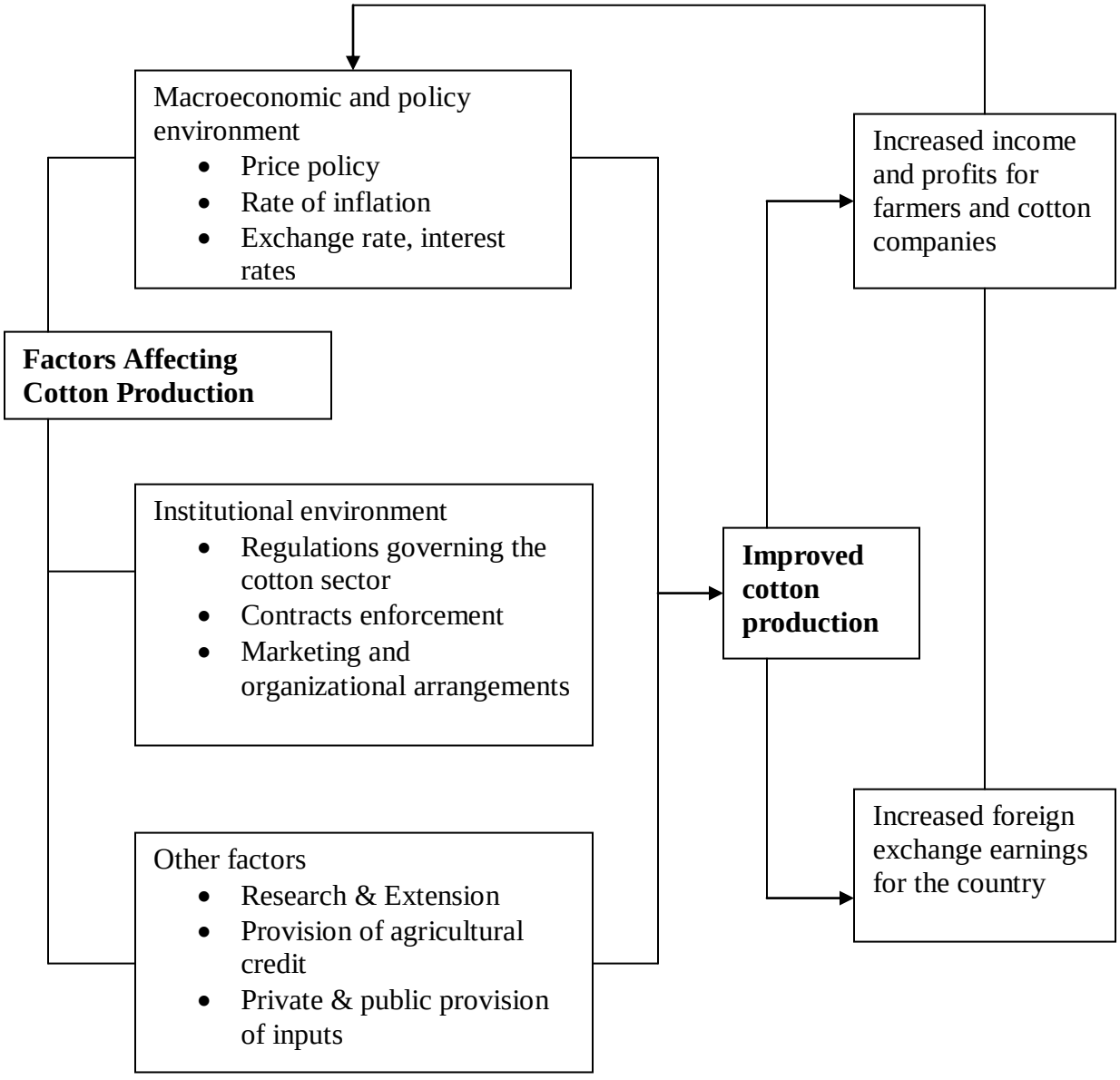



**Figure 3.1: Conceptual Framework-The Impact of and Factors affecting Cotton Production in Zimbabwe**

## 3.2 Data Collection and Management

### 3.2.1 Relationship between objectives, hypothesis and the method of analysis

**Table 3.1: Summary of objectives and research approach**

| Objectives | Hypothesis | Data Required | Method of Analysis |
|---|---|---|---|
| To characterize cotton production performance in Zimbabwe | Smallholder farmers have become the major producers of cotton as compared to large-scale commercial farmers | Secondary data on crop production, producer prices and area planted. | Descriptive Statistics and trend analysis. |
| To examine domestic marketing trends in relation to international markets. | International marketing of cotton is significantly related to domestic marketing of cotton in Zimbabwe. | Secondary data on world cotton prices, domestic producer prices, global output and consumption, Main suppliers and buyers of cotton(i.e. number of buyers and sellers) | Literature review, correlation analysis and Nominal Protection Coefficient. |
| To examine the factors affecting cotton production in Zimbabwe and the role of policy and institutional incentives. | Price incentives, institutional environment and macroeconomic policies have a significant effect on the production of cotton in Zimbabwe | Prices, production and area planted, macroeconomic variables(e.g. inflation) | Regression Analysis, T-statistics and policy simulations. |

The table shows quantitative and qualitative data used for the study and the method of analysis for each objective and hypothesis. The following section will discuss the sources of data and describe the analytical tools used for the study.

### 3.2.2 Sources of Data and Reliability

The study made use of both quantitative and qualitative data. Annual data for the period 1965-2006 was used for the analysis. Major sources of data were CSO publications and FAOSTAT website. Data on cotton, maize nominal producer price and area under irrigation were obtained from FAOSTAT website. The data on world cotton price was obtained from Cotlook and ICAC website. Yearly data on cotton, maize production and short-term credit extended to farmers were taken from the Compendium of Statistics, Statistical Yearbook of Zimbabwe and Quarterly Digest of Statistics, while rainfall data was taken from the Department of Meteorological Services. Government expenditure on research and extension was taken from Estimates of Budget Expenditure. Consumer price index (CPI) and inflation rate were taken from RBZ publications. Exchange rate data were taken from Chipika (1994), Rukuni et al (2004) and some from RBZ publications.CPI was used to deflate nominal producer prices of maize and cotton to year 2000 prices. Real prices were used for the analysis. And also agricultural credit and expenditure on research and extension were deflated to year 2000 prices using the CPI.

Generally data collected on aggregate cotton production is reliable for Zimbabwe, although some data collected from different sources shows little differences. When data from different sources were compared it was observed that the differences were not significant. However, the unavailability of an important variable (agricultural credit) after 2002 forced the analysis to be done for the period 1965-2002 in some instances and also unavailability of world price series prior 1969 forced the analysis to be done for the period 1969-2005.The other problem may be that, official economic data may be a very inaccurate source of statistics in situations where the informal economy and or black market account for a significant share of economic transactions, as is the case with Zimbabwe from 2000 onwards.

### 3.3 Analytical Framework

The analytical techniques used in the study include, descriptive statistics, correlation analysis, nominal protection coefficients, regression analysis and policy experiments. These tools will be discussed below with their limitations.

#### 3.3.1 Descriptive Statistics

Use was made of measures of location and dispersion. These measures include mean, standard deviation, minimum and maximum. The mean provides a good measure of central location. It is obtained by adding all the data values and dividing by the number of items. Percentages were also used for the anlysis.This is a measure which locates values in the data that are not necessarily central locations. Use was also made of standard deviations, which is the square root of the variance. In summarizing data line graphs were also used and growth rates were also calculated for certain variables. In order to analyse production performance of time series data, there is need to use trends which is measured by growth rates. The calculation of growth rates was performed using Excel.

#### 3.3.2 Literature review, correlation analysis and Nominal Protection Coefficient.

**Literature review and correlation analysis**

For objective number two, a comprehensive literature review on existing issues in cotton marketing in Zimbabwe and the world market was done to make comparisons between the two. The major problems that may be associated with reliance on review of literature from secondary documents published by other agents are source bias. The objectivity of the authors may be affected when it comes to reporting situations.

A spearman correlation analysis was calculated to analyse the association between world price and domestic producer price. A statistical technique referred to as correlation analysis can be used to determine the strength of the relationship between two variables.

The output of a correlation study is a number referred to as the correlation coefficient. Values of the correlation coefficient are always between -1 and +1.A value of +1 indicates that the two variables being considered are perfectly related in a positive linear sense. A value of -1 indicates that the two variables are perfectly related in a negative linear sense. Values of the correlation coefficient close to zero indicate that the two variables are not linearly related.

**Nominal Protection Coefficient**

Nominal Protection Coefficient (NPC) as an indicator of protection and incentives was employed.NPC is the simplest indicator of price distortion and the easiest to measure. It is equal to the ratio of the domestic price of cotton to its border price using the official exchange rate:

$$NPC_c = \frac{P_c^d}{P_c^b}$$

$P_c^d$ = observed domestic prices

$P_c^b$ = observed border prices=e* $P^{US\$}$

Where $P^{US\$}$ = the world price of cotton and, e is the exchange rate,

If NPC > 1, producers are protected and consumers taxed,
If NPC<1, producers are taxed and consumers subsidized,
If NPC=1, the structure of protection is neutral.
Given the distortions in the foreign exchange market, it is acknowledged that the use of such method will tend to overestimate the degree of protection, so efforts were made to use a blend exchange rate.

### 3.3.3 Regression Analysis, T-statistics and policy simulations.

**Regression Analysis and T-statistics**

A log-linear regression analysis was done to identify factors affecting cotton production and the response to policies. General model of supply response was used. Ordinary Least Squares (OLS) regression techniques were applied on the Nerlovian supply response model. The first specification of the model is,

$$\ln A_t = \beta_0 + \beta_1 \ln A_{t-1} + \beta_2 \ln P_{c,t-1} + \beta_3 \ln P_{m,t-1} + \beta_4 \ln \pi_{t-1} + \beta_5 \ln R_{t-1} + \beta_6 \ln RE_t + \beta_7 \ln Acredit_t + \beta_8 t + \mu_t;$$

Where:

$A_t$ = Area Planted to cotton in time t (hectares),

$A_{t-1}$ =Area planted to cotton at time t-1,

$P_{c,t-1}$ =Real producer price of cotton lint (Z$ per tonne) in 2000Z$ terms at time t-1,

$P_{m,t-1}$ =Real producer price of maize (Z$ per tonne), at time t-1,

$\pi_{t-1}$ =Inflation at time t-1, in 2000 Z$ terms,

$R_{t-1}$ =Rainfall at time t-1 (millimeters),

RE =Real expenditure on research and Extension (Z$ millions in 2000 Z$ terms) in time t,

Acredit =Real agricultural credit (Z$ thousands in 2000 Z$ terms) in time t,

$D_t$ =dummy for structural adjustment programmes: 1=1990 onwards and 0=1965-1989.This represents a change in the institutional environment,

$Wp_t$ =World price (US cents/pound) in time t.

$\mu_t$ is the error term, which is assumed to follow a normal distribution ,

$\beta_i$'s are parameters. With a log-linear specification like this, the parameters represent short-run elasticities with respect to that variable. Long-run elasticities are calculated as follows (de Janvry and Sadoulet, 1995):

$$E_i = \frac{E^{sr}}{1-\beta_1},$$

$E^{sr}$ = short-run elasticity and, $\beta_1$ is the coefficient for the lagged dependent variable.

About six models were estimated in STATA with different specifications. Some variables such as the ESAP dummy, world price and the price ratio were included in other estimations and dropped in other models. T-statistics were used to test the significance of parameters.

The advantage of Nerlovian supply response models is that they are practical and they have been applied to many crops in many developing countries, compared to theoretical specifications of profit and production functions. The data requirements of such models are limited as compared to theoretical functions. In the Nerlovian supply response models theory is badly mistreated, but they offer a very large body of empirical results on which policy makers can rely on.

Another problem of supply response models is that models estimated from time series data are subject to the fundamental Lucas critique. In estimating the relevant parameters, the objective is to estimate the outcome of the joint interaction of optimizing agents' decision rules and market clearing conditions for a given policy regime. Any change in policy regime will affect the decision rules and thus will affect the parameter estimates. Hence, time series coefficients will not be useful in appraising the impact of policy changes that affect the economic environment (Schiff and Montenegro, 1997).

General Limitations of Regression Models are;

1. Statistical limitation-regression procedures yield unbiased estimates only under certain conditions(assumptions),
2. Reliance on numerical data-narrow focus on hard data blind modelers to less tangible but no less important factors (soft data/qualitative data and ones for which numerical data exists),
3. Failure to distinguish between correlations and causal relationships.

**Policy simulations**

In order to use regression models for counterfactual policy analysis, it is first necessary to solve models for the parameters using the observed data. Counterfactual equilibria are typically computed in models, since data generated in the presence of existing policies provide a direct observation on initial equilibrium solution. Simulations were performed as follows; a policy change specified first and counterfactual equilibria for new policy regime is computed and a policy appraisal is done based on pairwise comparison between counterfactual and benchmark. Elasticities computed were used to perform the simulations.

# CHAPTER 4: CHARACTERISATION OF PRODUCTION PERFOMANCE

## 4.1 Introduction

This is one of the analysis Chapters. This chapter will characterize production performance of the cotton sector during the period 1965-2006.The chapter starts by looking at aggregate cotton production performance over the years and proceed to look at evolution of production in LSCF and SSCF separately. This chapter will then analyse which of the two sectors contributed more to cotton production over the years and test the hypothesis that Smallholder farmers contribute more than 50 per cent of cotton output. The chapter then finally looks at the possible explanations of differences in production performance over the years.

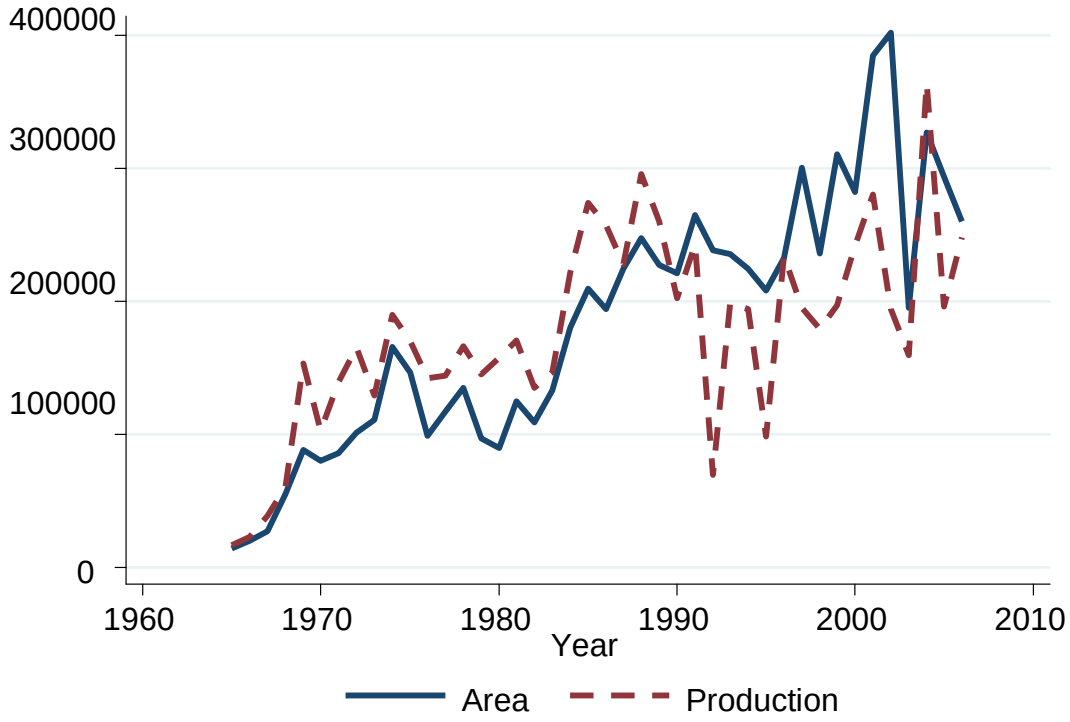
## 4.2 Aggregate cotton production performance 1965-2006

Table 4.1 shows a summary of descriptive statistics for the period under review. During the period under study area planted to cotton averaged 183376 hectares and fluctuated from a maximum of 401897 hectares in 2002 to a minimum of 14261 in 1965.Cotton production averaged 176897 tonnes and fluctuated from a minimum of 16704 tonnes in 1965 to a maximum figure of 364266 tonnes in 2004.Cotton yields averaged 1.09 tonnes per hectare. The lowest figure of 0.29 tonnes per hectare was recorded in 1992.This could be attributed to drought that was experienced in the 1991/92 season. This suggests possible explanatory variables for differences in production over the years and the following chapters will analyse this. Figure 4.1 below shows the trend in aggregate cotton production during the period. Generally area planted and production of cotton was on an upward trend during the period under study. From 1965 to 1975 area planted and production of cotton was on an upward trend, growing at an average of 23.15 and 23.28 percent annually, respectively. But the period after 1975 shows a decline in the production of cotton nationwide. This may be attributed to the intensification of the liberation war during this period. During this period the estimated average growth rate of area planted and production was -3.8 and 2.15 per cent respectively. This shows that area

planted was declining at rate of 3.8 percent annually and production was increasing at a lower rate than the period before. The period after 1980 shows area planted and production growing at lower rates than the period before. In 1982 there was also a decline in production because of the drought. The period 1990 to 2000 shows a further decline in growth rates as reported in table 4.2.Annual average growth rate for the period of 4.63 per cent was recorded for production. The period 2000 to 2006 shows a decline in both production and area planted to cotton. The trend might be explained by the unstable macroeconomic environment. During the period annual inflation averaged 355.5 per cent. The hyper-inflationary environment seems to be imposing major challenges to farmers in the cotton sub sector.

**Figure 4.1: Area planted and Production of Cotton in Zimbabwe (Aggregate)**

Production (Metric tonnes and




During the period the amount of rainfall received in the country averaged 634.7 mm and fluctuated from a low of 335 mm in 1992 to a high of 1003.5 mm in 1975.The year 1992 also recorded lower yields and this might be explained by lower rainfall figures recorded for the year. Real expenditure on research and extension averaged 6.33 million

Zimbabwean dollars and the amount of money allocated to research and extension was highest in 1996(10.97 millions).

**Table 4.1: Summary of Descriptive Statistics**

| Variable | Observation | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| Area Planted in LSCF | 42 | 45059.19 | 25457.29 | 25 | 87001 |
| Production in LSCF | 42 | 80196.71 | 47592.04 | 33 | 154960 |
| Yield in LSCF | 42 | 1.734048 | 0.328114 | 0.88 | 2.35 |
| Area planted in the Smallholder Sector | 41 | 142424.1 | 109269.4 | 2000 | 390500 |
| Production in the Smallholder Sector | 41 | 99669.71 | 81926.63 | 1148 | 363720 |
| Yield in the Smallholder Sector | 42 | 0.7395238 | 0.22541 | 0.19 | 1.51 |
| Total Area Planted | 42 | 183376.6 | 95916.37 | 14261 | 401897 |
| Total Production | 42 | 176897.5 | 73882.93 | 16704 | 364266 |
| Total Yield | 42 | 1.086054 | 0.33852 | 0.291289 | 1.751904 |
| Domestic Producer Price of Cotton | 41 | 109921.4 | 403474.5 | 408.4 | 1900000 |
| Rainfall(mm) | 42 | 634.7381 | 167.1739 | 335.2 | 1003.5 |
| Prices of Cotton C.I.F.North Europe | 38 | 66.99553 | 15.87802 | 31.11 | 94.1 |
| Real Producer Price Of Cotton | 41 | 533.1654 | 164.8673 | 63.51 | 844.11 |
| Inflation | 39 | 43.53128 | 81.94112 | 1.56 | 1017 |
| Area under Irrigation | 39 | 95.78 | 42.35 | 34 | 174 |
| Maize Producer Price | 30 | 167.145 | 226.4808 | 30.5 | 900 |
| Real Expenditure on Research & Extension | 41 | 6.33 | 2.79 | 1.12 | 10.97 |
| Agricultural Credit | 37 | 129213.5 | 113081.7 | 44803.82 | 614555.4 |

**Source: Own Calculations**

The fluctuations in area planted as shown by the reported coefficient of variation shows that variability in area planted and production was decreasing over the period under study. Yields fluctuation was also declining although picking up in the late 1990s.

**Table 4.2: Estimated Aggregate Average growth rates (Percentages)**

| Period | Area Planted (%) | Production (%) | Yield (%) |
|---|---|---|---|
| 1965-1975 | 23.15 | 23.28 | 0.12 |
| 1976-1980 | -3.80 | 2.15 | 5.95 |
| 1981-1990 | 8.47 | 5.87 | -2.60 |
| 1991-2000 | 2.08 | 4.63 | 2.55 |
| 2001-2006 | -6.79 | 0.72 | 7.52 |
| 1965-2006 | 5.16 | 3.18 | -1.98 |

**Coefficient of variation**

| Period | Area | Production | yield |
|---|---|---|---|
| 1965-1975 | 31.45 | 48.25 | 18.11 |
| 1976-1980 | 16.23 | 6.02 | 11.52 |
| 1981-1990 | 13.24 | 19.97 | 9.67 |
| 1991-2000 | 11.77 | 36.29 | 33.5 |
| 2001-2006 | 20.31 | 32.09 | 25.47 |
| 1965-2006 | 34.03 | 42.07 | 24.46 |

**Source: Own Calculations**

### 4.3 Evolution of cotton production performance in LSCF and SSCF

#### 4.3.1 LSCF

The LSCF sector was traditionally the main producer of most crops including cotton, therefore it is necessary to analyse production performance in this sector during the period under consideration. Table 4.1 shows that Area planted and production of cotton averaged 45059 hectares and 80196 metric tonnes respectively. Production fluctuated from a low of 33 metric tonnes in 2006 to a high of 154960 metric tonnes in 1985.The figures recorded in 2006 can be a result of the Land Reform policy which dismantled the Large Scale farming community. Productivity averaged 1.73 tonnes per hectare with the lowest yield of 0.88 tonnes per hectare recorded in 1992 and a high of 2.35 tonnes per hectare in 1986.The high productivity can be attributed to development of irrigation infrastructure in the LSCF.

Table 4.3 and figure 4.2 summarises growth rates and trends in production during the period. During the period 1965-1975 area planted to cotton grew at an average rate of 17.06 per cent and this may be explained by the government policy during the UDI era. The government during this era heavily supported white farmers who formed the majority of the large scale farming community. From 1976 onwards area planted was growing at lower rate than the period before, mainly because of disturbances during the war. Production of cotton was increasing at a rate of 19.7 per cent annually during the period 1965-1975.Production was growing at a rate of 7.2 per cent per annum during the period 1976-80.From 1980 onwards area planted and production was declining in this sector. Results reported on table 4.3 shows negative growth rates. The trend can also be explained by the government's land reform policy after independence. On average yields were increasing at a rate of 0.31 per cent annually.

**Table 4.3: Estimated Average growth rates in LSCF (Percentages)**

| Period | Area Planted (%) | Production (%) | Yield (%) |
|---|---|---|---|
| 1965-1975 | 17.06 | 19.70 | 2.5 |
| 1976-1980 | 5.4 | 7.2 | 1.8 |
| 1981-1990 | -2.13 | -1.62 | 0.51 |
| 1991-2000 | -5.44 | -3.39 | 2.04 |
| 2001-2006 | -142.27 | -148.77 | -6.49 |
| 1965-2006 | -8.15 | -7.84 | 0.31 |

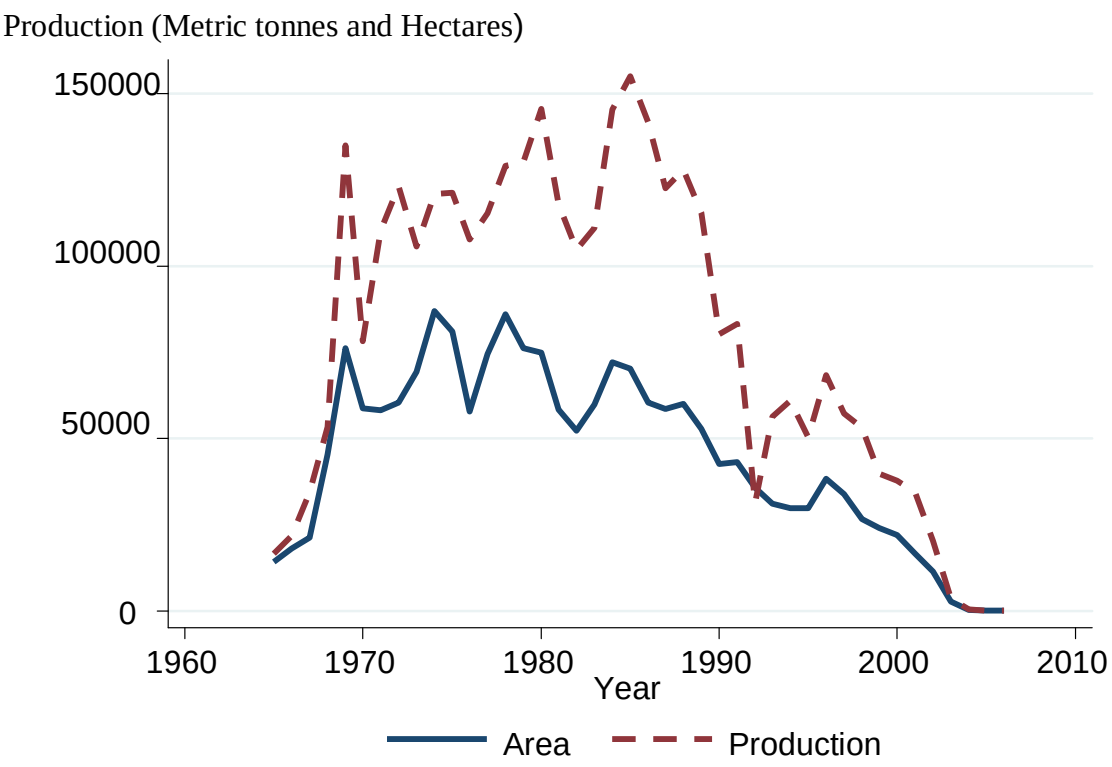
**Coefficient of variation**

| Period | Area | Production | yield |
|---|---|---|---|
| 1965-75 | 37.35 | 49.46 | 18.15 |
| 1976-80 | 12.05 | 2.32 | 11.04 |
| 1981-90 | 13.51 | 17.86 | 7.04 |
| 1991-00 | 13.56 | 24.96 | 18.35 |
| 2001-06 | 44.21 | 36.66 | 13.67 |

**Source: Own Calculations**

Fluctuations have generally decreased in the sector, maybe as a result of development of irrigation.

**Figure 4.2: Area Planted and Production of Cotton in LSCF**



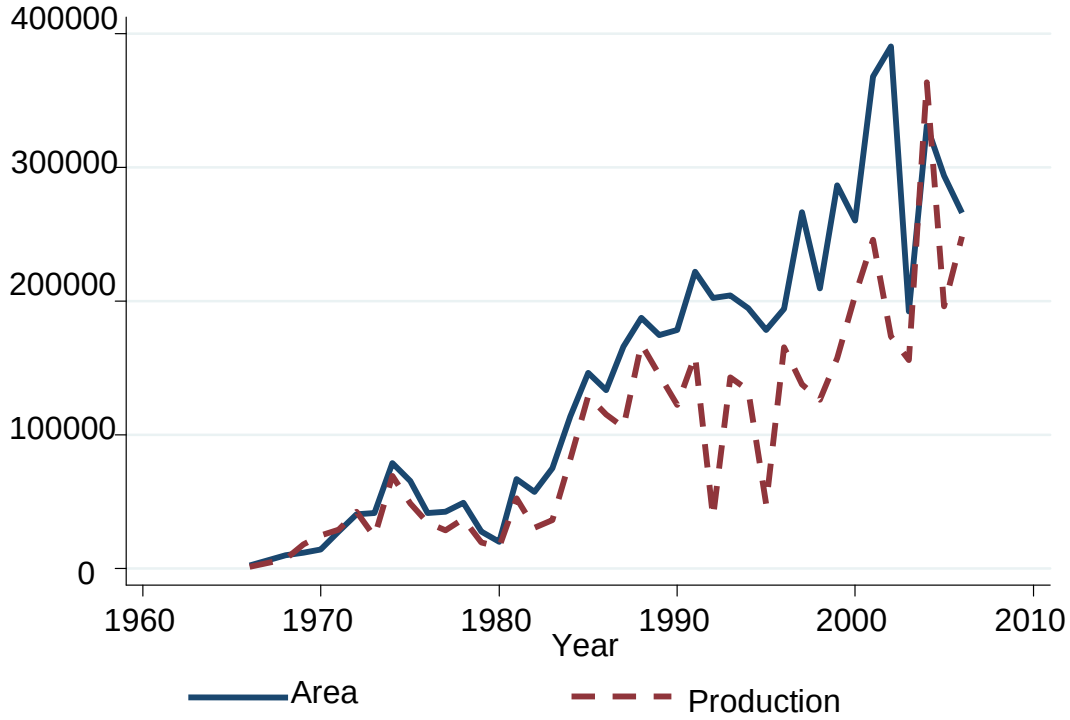

**Source: Central Statistics Office Publications.**

### 4.3.2 Smallholder Farmers

This section will characterize production performance of smallholder farmers during the period under study. From table 4.1, results show that farmers in this sector averaged 142424 hectares of area planted to cotton during the period. Area planted fluctuated from a minimum of 2000 hectares in 1965 to a maximum of 390500 hectares in 2002.Production averaged 99669 metric tonnes of cotton and fluctuated from a low of 1148 metric tonnes in 1966 to a high of 363720 metric tonnes in 2004.Productivity in the sector was far below that recorded in LSCF sector.Smallholder farmers averaged 0.74 tonnes per hectare during the period as compared to the 1.73 tonnes per hectare recorded for SSA.The trends in production and area planted are shown in figure 4.3 below.

**Figure 4.3: Area Planted and Production of Cotton in Smallholder Sector**

Production (Metric tonnes and




**Source: Central Statistics Office Publications**

The figure shows a general upward trend in area planted and production of cotton in the Smallholder sector. The period 1965 to 1975 shows an upward trend in area planted with a decline in production reported in 1975 up to 1980.Factors such as the liberation war are to account for such trends. Estimated average growth rates are reported in table 4.4.In the period after independence up to the period before the implementation of ESAP in the 1990s production increased at a higher rate than before (16.27 per cent annually instead of 3.58 per cent and a decline in production of 5.1 percent during the period 1976-80). This may be due to policies that were aimed at enhancing development in communal areas. The government increased expenditure for infrastructure development in areas serviced by smallholder farmers. The period 1990 onwards shows a sharp decline in production as the country was hit by a major drought during that period.ESAP implementation seem not to have generated a positive response from the farmers as production was increasing at a slower rate than the period before (7.8 per cent).During the ESAP period area planted was declining at a rate of 5.52 per cent. The period is

marked by frequent fluctuation in production. During the whole period under review productivity was decreasing at a rate of 0.68 per cent.

**Table 4.4: Estimated Average growth rates in the Smallholder Sector (Percentages)**

| Period | Area Planted (%) | Production (%) | Yield (%) |
|---|---|---|---|
| 1965-1975 | 6.09 | 3.58 | -2.38 |
| 1976-1980 | -9.2 | -5.05 | 4.18 |
| 1981-1990 | 13.5 | 16.27 | 2.74 |
| 1991-2000 | 3.04 | 7.80 | 4.76 |
| 2001-2006 | -5.52 | 3.60 | 9.12 |
| 1965-2006 | 9.3 | 8.41 | -0.68 |

**Coefficient of variation**

| Period | Area | Production | yield |
|---|---|---|---|
| 1965-75 | 3.45 | 1.21 | 0.39 |
| 1976-80 | 4.18 | 2.21 | 0.48 |
| 1981-90 | 5.77 | 18.43 | 26.46 |
| 1991-00 | 2.21 | 7.13 | 7.1 |
| 2001-06 | 20.21 | 10.07 | 11.41 |

**Source: Own Calculations**

Although results show that production was increasing in the sector, fluctuations have somewhat increased, probably because of lack of development of irrigation infrastructure in communal areas.

### 4.3.3 Comparing production performance in LSCF and Smallholder Farmers

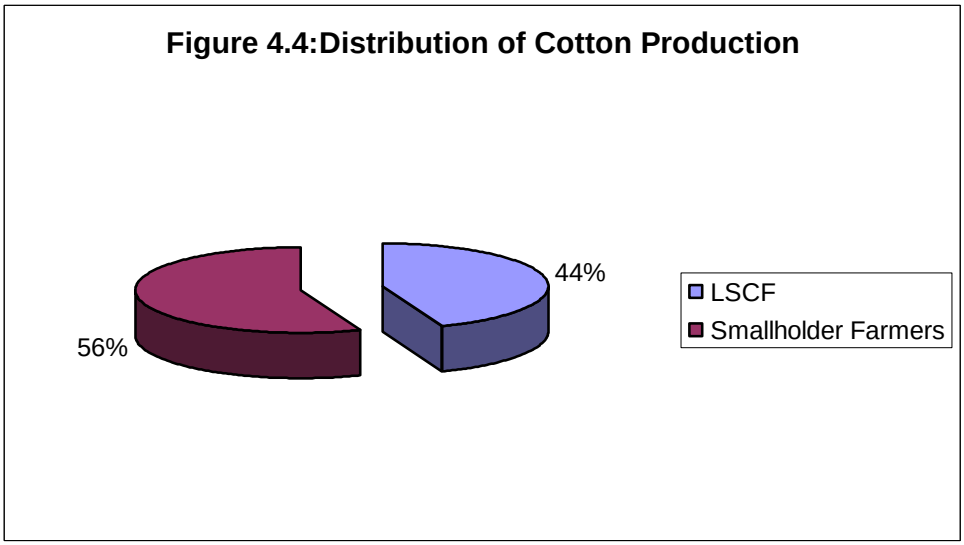
Figure 4.5 below shows the trends in production in both LSCF and Smallholder farmers. Since the 1960s Large scale farmers contributed more to cotton production than smallholder farmers but production in the sector declined in the 1980s. The decline in the number of large-scale commercial cotton growers is due to an increasing number of farmers diversifying into more lucrative export crops such as paprika and horticulture due to reduced viability in the cotton sector. Contributions by the smallholder sector to cotton production have continued to rise especially after market liberalization in 1994. In the 1998/1999 season total production was estimated to be about 300 000 metric tonnes and

of that about 80 percent was produced by the smallholder sector. Table 4.5 below shows that smallholder farmers contributed about 56.0 per cent of total production on average while LSCF accounted for the remainder. Results also show that smallholder farmers accounted for about 76.0 per cent of the area planted to cotton on average.

**Table 4.5: Percentage Contributions to Cotton Production (1965-2006)**

| Sector | Area Planted | Production |
|---|---|---|
| LSCF | 24.0 | 44.0 |
| Smallholder Farmers | 76.0 | 56.0 |

**Source: Own Calculations**

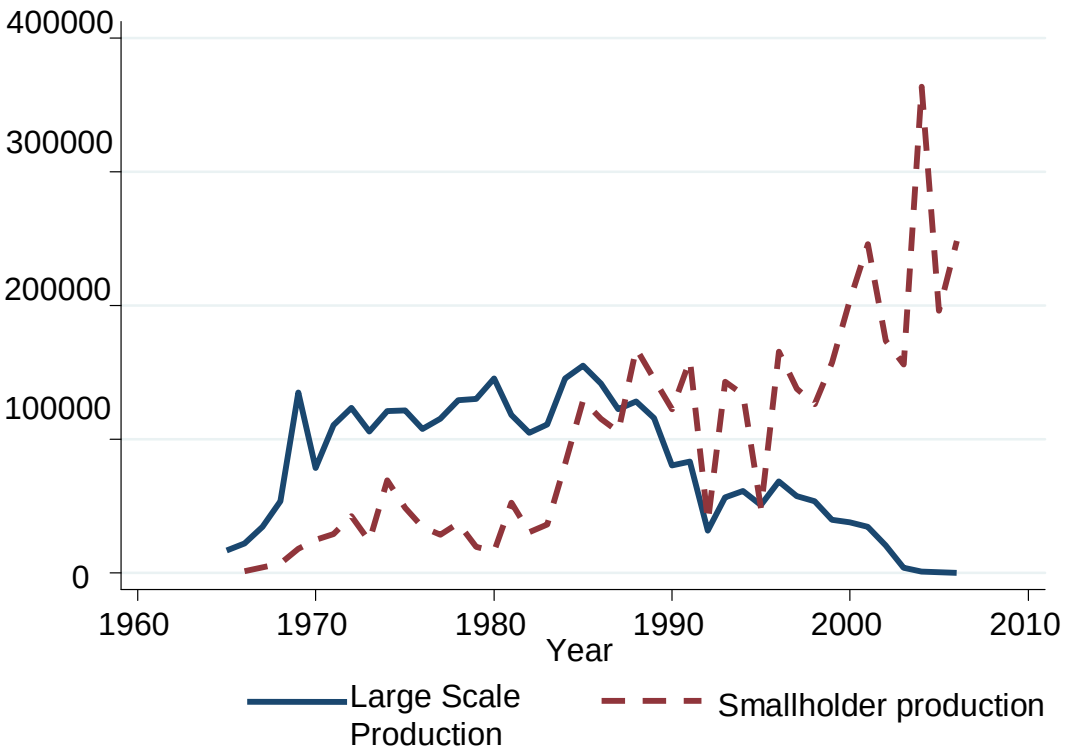



**Source: Data Collected from CSO**

The smallholder sector has been responsible for making increasingly important contributions to national output as shown by the chart above. The chart shows that cotton in Zimbabwe is predominantly a smallholder crop.

**Figure 4.5: Production performance in LSCF and Smallholder Farmers**

Production (Metric tonnes)

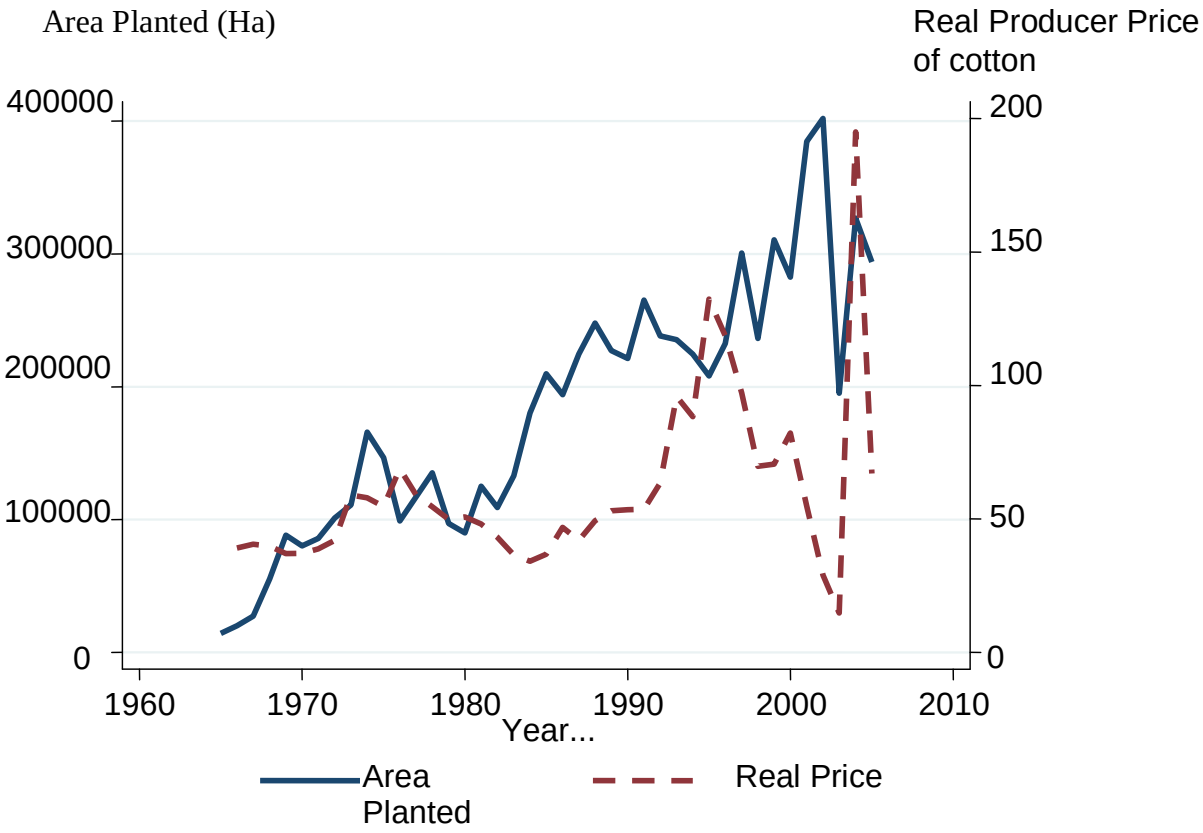



**Source: CSO Publications**

### 4.4 Explaining Cotton Production in Zimbabwe.

Before embarking on any econometric analysis of the factors affecting cotton production, possible explanatory variables will be discussed in this section. First real cotton prices are likely to be important in explaining production. The graphs of real cotton prices and area planted (Figure 4.6) compares the evolution of prices and area planted.

**Figure 4.6: Area planted and real price of cotton in Zimbabwe.**

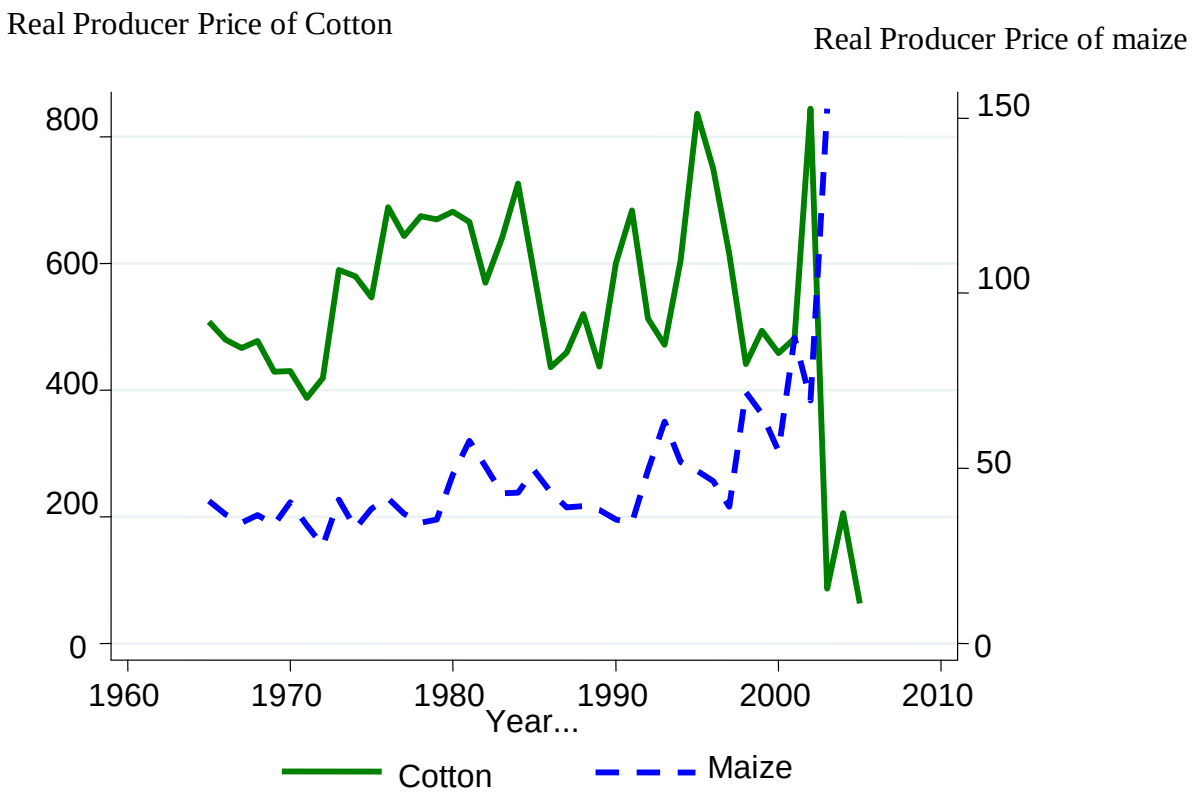



**Source: Data Collected from CSO and FAOSTAT.**

The graphs show reasonable parallel movements, with declines in 1974-1975 and 2000-2006, upward trends in 1983-2003.This indicates that real prices may have been an important variable in explaining the planting decisions. Exceptions are in 1965-1974 period, were there are negative trends in real prices while area planted was steadily increasing. From this discussion it is highly unlikely that real cotton prices are the only variable explaining farmer's planting decisions. This indicates that there are some factors which affect cotton production. Real prices of competing crops are likely to be another contributing factor. Farming systems analysis has suggested that the most important competing crop for land and labour in cotton growing areas is maize. Figure 4.7 below shows reasonable parallel movements in both the price of cotton and maize with the exception of the period 2002 onwards where there is an upward trend in the price of maize and downward trend in the price of cotton. The period 1995-2000 also shows

movements in different directions of both prices. As the price of maize was declining the price of cotton was increasing and the price of maize increased as cotton price declined. Cotton prices reached their highest in 2002 and after that there was a sharp fall in prices of cotton. But prices may not be the only important determinant of decisions to plant. There are some other variables which will be considered in the following chapters. The variables may include efficient marketing institutions brought about by ESAP.A dummy variable for ESAP periods will also be considered. To capture the effects of climatic variability rainfall variable will be considered.

**Figure 4.7: Real Cotton and Maize Prices (2000-100)**




**Source: FAOSTAT**

## 4.5 Conclusion and Insights from the chapter

This chapter analysed cotton production performance in Zimbabwe. It started by looking at aggregate production and found out that yield averaged 1.08 tonnes per hectare and generally production of cotton has increased. Following that the chapter characterised production in both LSCF and Smallholder farmers. Results show that LSCF's contribution to national output declined at a rate of 7.84 per cent annually, but reported high average yields. This is in contrast to smallholder farmers' contribution to national output which increased at a rate of 8.41 per cent but reported low yields (Table 4.1 and 4.4).Results show that over the years smallholders contributed more than 50 per cent of total output (Table 4.5) and have become important producers of the crop. Therefore it can be concluded that more than half of cotton output is produced by smallholder farmers.

The chapter then finally looked at the possible determinants of cotton production in Zimbabwe. Possible explanations where found to be price of cotton and of other competing crops. Other variables were also suggested and chapter six will determine whether these factors are important in explaining area planted to cotton.

# CHAPTER 5: COMPARATIVE ANALYSIS OF INTERNATIONAL COTTON MARKETS AND DOMESTIC MARKETING

## 5.0 Introduction

The previous chapter characterized production performance of the cotton sub sector and found out that cotton producer prices is partly to explain for such differences in production performance. The producer price offered to farmers is somewhat related to international prices of cotton since more than half of cotton produced is destined for world markets. This chapter will examine the trends in domestic marketing in relation to international marketing trends. The main objective of the chapter is to test the hypothesis that trends in international market have a significant effect in domestic marketing trends. Before doing any econometric analysis of the determinants of cotton production there is need to examine this phenomena. The first section of the chapter will analyse marketing arrangements in both international and domestic markets. The second section will compare the world price of cotton lint and the domestic producer price of seed cotton.

## 5.1 Marketing Arrangements

### 5.1.2 International Market

In the mid 1990s about 80 per cent of the cotton lint produced in Zimbabwe was exported to international markets (Larsen, 2002).The amount of lint exports have since declined to about 70 percent in 2005.According to Mariga (2004),about 60 per cent is sold to Europe(Italy, Germany and Portugal),28 per cent to South Africa and the balance to Japan, Hong Kong and Taiwan. Main competitors of Zimbabwean cotton in the world markets are the USA, Uzbekistan, Syria, Pakistan, Sudan, Brazil, Australia and China. In trying to model the world cotton market there is need to focus on producing and consuming countries. Four major cotton exporters in the world are the United States, Uzbekistan, Francophone Africa, and Australia. Cotton consumption pattern is

determined by the size of textile industries in importing countries. China as the leading textile producer has absorbed more than one-quarter of global cotton output during the late 1990s(Baffes,2004).Other major textile producers are India, Turkey, and the United States. Also several East Asian countries like Indonesia, Korea, Taiwan, Thailand and Korea have emerged recently as important cotton consumers. Baffes(2004)noted that in 2002 these countries accounted for about for 22 percent of world cotton imports as compared to just 3 percent in 1960.The structure, conduct and performance of the world market is shaped by wide range of issues, some of them emanating from producing countries up to the consuming countries.

In the 1980s onwards widespread liberalisation of cotton sectors have generally resulted in several exporters operating in a given producer country and often a larger number of spinners in consuming countries (Gillson et al, 2004).Because of large number of producers international trading companies have emerged between producers and spinners. These trading companies have developed contacts with a range of suppliers (exporters and/or ginners).

One issue that determines the structure of international markets is the quality of cotton. Spinners' decisions on where to source lint are influenced by quality attributes of the lint product. Quality of lint is often determined by the structure of the cotton sector in the producing country. Where a national cotton sector is dominated by one or two firms, coordination efforts between the few companies may be sufficient to ensure that quality is adequately controlled throughout the sector (Poulton, 2003). However, where sectors consist of numerous small players, lint quality can be affected negatively because of poor coordination between various actors. Spinners will have to choose a particular blend of different lint types that suits the products they are making and if they are satisfied with the quality they are likely to stay with that type. This tend to result in stickiness in the world market were spinners are sourcing from one supplier. But because of quality considerations market shares have shifted over time from the traditional dominant players to new players in the world market. Most notable is the recent rise in import penetration by Australian lint, reflecting its rise to prominence during the 1990s as a supplier of Asian markets, based on a superb quality reputation. The change in market shares is also

attributed to water shortages experienced in Central Asia which led to production declines and Pakistan was also a victim of drought in 2001/02(Gillson et al,2004).Such a scenario will lead spinners to source their lint from different suppliers. For example, the quality control problems encountered by various African sectors immediately after liberalisation have resulted in change in trade flows. Or if a new source (Brazil) appears that can supply lint at lower prices than more established competitors, then some spinners will eventually decide to modify their blend in response to the change in relative prices(Gillson et al,2004).

According to Gillson et al (2004), the world cotton market is best described as a monopolistic competition. Particular country origins are valued by particular spinners, who have evolved blends incorporating them. Thus, small changes in relative prices will not induce changes in trade flows. However, when a larger margin opens up or when a particular supply source becomes less reliable in either quality or quantity, many spinners will, however reluctantly, decide to switch.

The largest trading companies in the world have expanded their operations significantly in terms of increasing the number of supplying countries from which they purchase. These companies have also increased investment in ginneries and their involvement with in-country marketing. The liberalisation of markets in cotton producing countries of the southern hemisphere have enabled international trading companies to become more involved in producing countries in order to ensure a constant supply to spinners from a variety of origins and of sufficient volume. For example in Zimbabwe the liberalisation of cotton markets in 1994 saw a USA International entering the market (Cargill) and two French-based trading companies.

Trading companies are important intermediate agents in cotton trade because, the geographical and economic fragmentation in global cotton production, in comparison with other commodity chains means that cotton producers and consumers are many and dispersed. As such, it would be costly for producers and consumers to oversee the entire market and perform all trade functions themselves (Gillson et al,2004).Because of the considerable amount of resources needed by spinners to gather market information about

quality and managing the sourcing process directly, there is need to outsource the service to trading companies. In the Zimbabwean context international marketing of cotton by Cottco the major company in sector is not done through trading companies but the company sells its lint directly to spinners. By by-passing international traders Cottco obtained prices above the market average. Another player in the sector Cargill transfers its lint to one of its subsidiaries called Ralli Brothers based in Liverpool (Larsen, 2002).

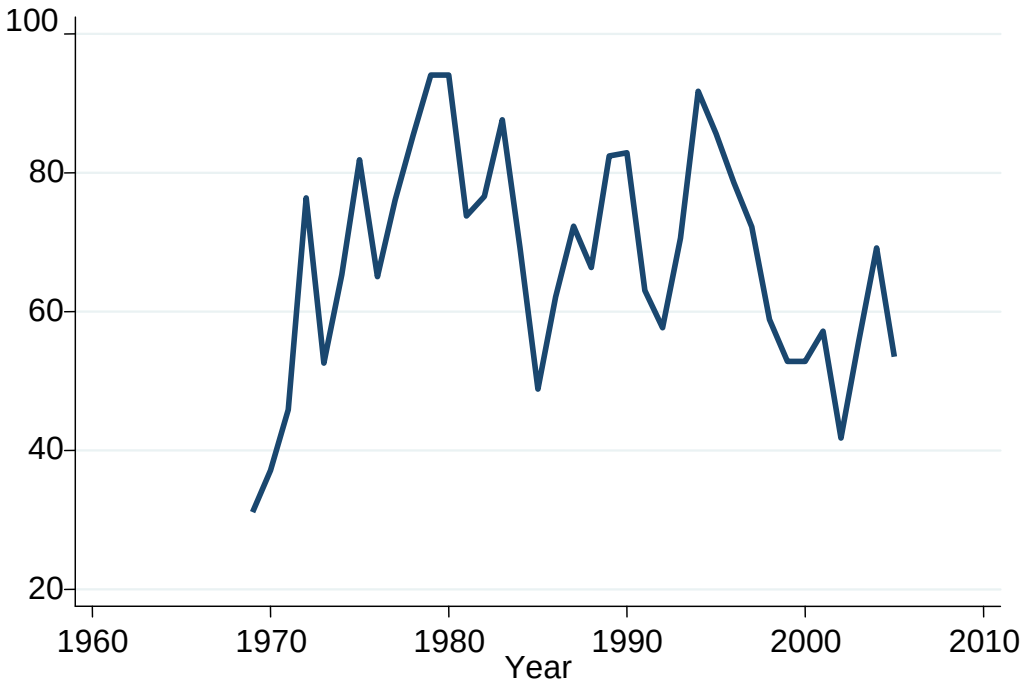
The world cotton market has been subject to various distortions. The interventions include subsidization in the US, EU, and China and taxation in Africa and Central Asia. Townsend and Guitchounts (1994) estimated that in the early 1990s, more than two-thirds of cotton was produced in countries that had some type of taxation or subsidization policy. Eight countries that have consistently supported cotton production are Brazil, China, Egypt, Greece, Mexico, Spain, Turkey, and the United States. During 2002 support to the cotton sector by major players reached almost US$6 billion, more than one quarter of the global value of production (Baffes, 2004). In 2002 the U.S supported cotton production to the tune of US$3.6 billion,

China's totaled $1.2 billion or 0.10 US$/pound, and the EU provided almost US$1 billion to small number of cotton producers in Spain and Greece. Producers in Brazil, Egypt, Mexico, and Turkey received a combined total of US$110 million. India also supported its cotton sector in 2002 with an estimated $0.5 billion (ICAC, 2003).

These subsidies have resulted in flooding the world market with cotton as this encouraged surplus production and this has seen global prices falling. Some recent studies have attempted to model the impact of these subsidies on global prices.A study by ICAC estimate that the impact of removing US cotton subsidies would have increased the world price by 0.03 US$/pound in 1999-2000,0.06 US$/pound in 2000-2001, and 0.11 US$/pound in 2001-2002(ICAC,2002).CIE uses a five-region world model of fibre,textile, and garments market in 2000-2001 to simulate the impact of US and EU subsidies on cotton production and export. They found that removing subsidies to cotton growers would raise the world price by 0.06 US$/pound or 11 percent. Finally Summer(2003) estimated that over the marketing years 1999-2002,U.S.subsidies

depressed the world cotton price by 0.065 US$/pound or 12.6 percent. Real cotton prices have declined over the last two centuries. Between 1960–64 and 1999–2003 real cotton prices fell by 55 percent. Figure 5.1 below shows the evolution of world cotton prices since the 1960s.

**Fig 5.1.Cotton Prices CIF Northern Europe (Cotlook A-Index)**




Cotton prices have been volatile, very common among most primary commodities.
The degree of volatility, however, has changed considerably during the last 40 years. The world price peaked in the period 1979-1980 and this might be attributed to the 1973 oil-induced commodity price boom. From 1985 onwards world prices were declining before starting to pick up again. From table 4.1 in the previous chapter world price reached a low figure of 31.11 US cents/pound in 1966 and maximum figure of about 94.1 US cents/pound in 1979-80 periods.

Policy interventions by EU and US affect the world market of cotton in a significant way and have an affect on the economies of poor Sub-Saharan countries as well as the welfare of a large number of poor households who are directly or indirectly associated with the cotton industry. The link between cotton subsidies and incomes in poor countries (especially in West Africa) has been studied by many researchers.Badiane et al (2002) estimated that removing US cotton subsidies would generate 250m US$/year in additional revenues for West African cotton farmers. Small and Norman (2004) used a panel data set for the period 1975-2001 covering seven West African countries and found that a 30 percent increase in world price would lead to a 13.95 percent increase in GDP per capita.As shown by these studies and other studies by Oxfam (2002) the adverse impact of cotton subsidies on export revenue and GDP in cotton exporting countries like Zimbabwe is very clear, but does this lead to lower production. And also with the liberalisation of cotton marketing in Zimbabwe, farm-gate prices are more likely to be closely related to world prices. In Zimbabwe cotton is grown by mainly smallholder farmers as shown in the previous chapter, will the effect of cotton prices be felt by these farmers. This is the subject matter of the remaining sections of the chapter.

### 5.1.1 Domestic Market

In 1980 the Government of Zimbabwe inherited from the settler economy a highly regulated marketing arrangement. During the UDI period the white settler economy established a comprehensive regulatory framework in which controlled crops(cotton included) were regulated through the AMA and four statutory marketing boards(CMB in the case of cotton).CMB was established in 1969 and had monopoly trading in the purchase, processing and export of all cotton products until after economic structural adjustment programmes.The regulatory framework adopted by the government at independence was further developed to redirect marketing and institutional arrangements to benefit black farmers.CMB's purchasing monopsony was reaffirmed through an act of parliament, along with the responsibility for coordinating and regulating the cotton chain from input delivery to primary purchase and lint sales(Jackson and Cheater,1994).In 1976 the then government introduced pre-planting producer prices on seed cotton in order to

increase producer incentives, but this was later abolished in the early 1980s.Producer price were set annually through negotiations between the government,CMB and the growers association. The procedure ensured that prices were sufficiently remunerative to stimulate increases in production, especially by the smallholder sector.Herbst(1990) noted that there was an effective alliance between the two main groups of cotton farmers, the LSCF and smallholder growers, which contributed to a positive trend in producer prices. Because of the favorable administered prices and a single marketing channel, production in the smallholder sector increased. Despite the success, cotton marketing had constraints. The expansion of marketing infrastructure to communal areas was financed by borrowing and this resulted in CMB in huge debts and also, in the early 1980s when the world price of lint rose significantly, the CMB was instructed to provide lint to local spinners at a discount. According to Robinson (1995), this implicit subsidy remained for a decade and local spinners paid less than 60 per cent of export prices received by the early 1990s.This amounted to an increase in CMB debt and the government budget was constrained. The continued increase in budget expenditure prompted the government to embark on structural adjustment programmes to allow private companies to participate in the provision of marketing services. With advice from the World Bank and IMF that liberalization of agricultural markets and the resultant price competition would improve production responses, the government introduced ESAP.

Larsen (2002) noted that government regulation and intervention in the cotton sub sector had been a persistent pattern until the country embarked on structural adjustment programs in the early 1990s.The privatization of CMB resulted in the entry of new players in every link of marketing chain from primary purchase of seed cotton through to export of lint. Between 1994 and 1996 two new ginning and marketing companies entered the market, Cargill(US International),Cotpro(association of cotton growers and two French-based cotton trading companies).A concentrated market structure characterise domestic cotton marketing in Zimbabwe at the moment. Table 5.1 shows major players in the cotton industry, with the year they started operations. In terms of market share, Cottco dominated the market in the mid 1990s with a market share of 90 per cent (Larsen, 2002). Cottco as the leader has seen its market share falling to an average market share of 60 per cent, followed by Cargill, at 25 per cent (Rusare et al, 2006). Other players such as FSI

Agricom, Grafax, Alliance, Parrogate, Terafern, Cottrade, ZESA, Flemming, Comtex and Dynamic cotton, among others, share the remainder. This structure is a result of several years of government policy in which agricultural marketing boards (CMB in the case of cotton) were favored at the expense of private players. Liberalization transformed CMB into Cottco, and thus still maintained the dominance through its inheritance of most of the infrastructure and market of its predecessor (CMB).The reduction in Cottco's market share was attributed to side-marketing by other companies.

**Table 5.1 Companies in the cotton industry**

| Company | Period of operation | Activities |
|---|---|---|
| Cottco(year privatized) | 1994/5 | Operate 9 ginneries |
| Cargill | 1996/7 | Operate 3 ginneries, exports lint |
| Grafax | 2002/3 | Operate 1 ginnery, exports lint |
| FSI Agricom | 2001/2 | Operate 1 ginnery, exports lint |
| Alliance | 2003/4 | * |
| Romsdal | 2001/2 | Operate 1 ginnery, exports lint |
| Terafern | 1997/8 | * |
| Cottrade | 2002/3 | Operate 1 ginnery exports lint |
| Zesa | 2002/3 | Buy and toll gin and exports lint |
| Flemming | 2001/2 | Operate 1ginnery, exports lint |
| Comtex | 2002/3 | * |
| Insing | 2003/4 | Exports lint |
| Parrogate | 2003/4 | * |
| Dynamic Cotton/New Cabview | 2001/2 | * |
| Farmers world | 2000/1 | Ceased trading cotton(focus on fertilizer) |
| Cholima and Motherly care | 1999/00 | Ceased full trading |
| IDAI Modzone | 2002/3 | Ceased operation |
| Comtex | * | Operates 1 ginnery, exports lint |
| Cynthesis | * | * |

**Source: Rusare et al (2006), Mlambo and Poulton (2003),** * No information

The privatization of the cotton marketing system in 1994 replaced the state monopoly with private oligopoly and competition is still underdeveloped (Larsen, 2002).This is because the entrance of new players has not resulted in price competition as you would expect in a perfect competition. In game theoretic terms players in the industry played a Betrand-type of game. The weakness in price competition reflected a high degree of price leadership by Cottco and others follow.Cottco announces its buying prices at the beginning of the season, while the practice of other companies is to wait for this announcement and then follow suit. Larsen (2002) noted that Cottco and Cotpro offered identical opening prices of Z$7.22 and Z$11.30 in 1997/8 and 1998/9 respectively, while Cargill's opening prices were Z$7.50 and Z$12.50 during the same period. These pricing strategies consist of choosing prices which must exceed marginal costs of the cotton firms (no firm would opt to play a game that promised a certain loss).In this case of Betrand-type of price competition the only Nash equilibrium is when price offered by Cottco is equal to price offered by a fringe of quasi-competitive firms (in this case Cargill and others) which must also be equal to the marginal cost, that is $P_{cottco}=P_{other\ firms}$=Marginal Cost. As long as Cottco chooses a price above marginal cost, the profit maximizing response of other firms will be to choose a price slightly above Cottco's.This is the reasoning behind Cargill offering prices slightly higher than those offered by Cottco in the 1997/8 and 1998/9 season. Thus in terms of reaching equilibrium, the price offered by Cargill, if it exceeds marginal costs, still cannot be Nash equilibrium(this equilibrium will be competitive solution) since it provides an incentive for Cottco to increase its price, thus only choosing $P_{cottco}=P_{other\ firms}$=Marginal Cost will the firms in the market have achieved Nash equilibrium. Thus there is sub optimal pricing.

Despite the relatively weak competition, a positive response occurred when there was improvement in the payment system as compared to the period prior to liberalization where farmers had to wait for weeks or even months to get their payments from CMB depot in Harare. The participation of more than 200 000 growers and a dozen or so buyers in a competitive environment without government subsidies has resulted in a vibrant cotton industry.Privatisation has also resulted in a higher share of lint export prices by farmers. According to Muir-Leresche (1998), from 1990 to 1995, the average producer price was 42 per cent of the world price, while it reached an average 53 per cent

in the five years since liberalization. But although farmers have benefited from the competitive purchase of their crops, the new buyers have not been adhering to high quality standards that which have been traditionally associated with Zimbabwean cotton lint. This has resulted in Zimbabwean lint fetching lower prices on the international market because of lower quality. In addition to that cotton companies do not pay farmers in foreign currency, as is the case with tobacco. Given the current macroeconomic environment of hyper inflation and distortions which characterise the foreign exchange market, farmers suffer a double blow, one from sub optimal pricing way below the premium it fetches on the world market and also not getting their revenue in foreign currency (Mupandawana, 2007).The issue of the fixed exchange rate has resulted in farmers' share of lint export price reduced significantly.

Section 5.2 below explores the relationship between what farmers are being paid (in US dollar terms) and the Cotlook A Index and tries to compare what farmers have been paid in US dollar terms to the world price for the period under study. Table 5.2 summarizes the changing marketing structure of the cotton sector in Zimbabwe from 1965 to 2005.

**Table 5.2: Changes to cotton markets in Zimbabwe.**

**1965-1994:**

- Monopsony buyer(CMB) used lower producer prices to subsidize inputs into textile industry;

- Commercial farmers diversified into unregulated crops such as horticulture and tobacco; small farmers suffered:

**1994-1997:**

- Deregulation and privatization;

- Competition between three buyers(Cottco,Cargill and Cotpro);
- Some buyers offering input supply;
- Prices have risen and an efficient payment system;

**1998-2005:**

- Competition between twelve buyers;
- Input credit schemes increased;
- Problem of side-marketing;
- Negative impact on quality of lint exported to international markets;
- Institutional mechanisms to ensure coordination introduced (NCC).

**Source: Adapted from Winters (2000).**

## 5.2 Analysing the Relationship between World Price of Cotton Lint and Domestic Lint Cotton Prices

In trying to analyse the relationship between world prices and domestic prices there is also need to study what farmers have been receiving as the share of the of world prices and the degree of government protection. Thus nominal protection coefficients for selected years are shown on table 5.1 below .Results show that during the period under review farmers have been taxed as NPC averaged 0.72.Producers of cotton are getting lower prices compared to world prices, NPC indicate that there was a general decline in the level of protection. Highest level of protection was in the period 1981-1990 with the lowest level of protection in the period 2001-2005.

**Table 5.2: Nominal Protection Coefficient for Cotton Lint**

| **Period/Year** | **Nominal Protection Coefficient (NPC)** |
|---|---|
| 1969-80 | 0.80 |
| 1981-90 | 0.89 |
| 1991-00 | 0.73 |
| 2001-05 | 0.24 |
| 1969-05 | 0.72 |

**Source: Own calculations**

But generally farmers have been receiving relatively less in terms of the world price.

Table 5.2 below shows summary statistics of the share of world price, and figure 5.1 shows the trends in the share of world prices received by cotton farmers in Zimbabwe during the period under study. Farmers received the lowest share of world price of 1.94 percent in 2005 and they obtained the highest share of world price of 99.35 percent in 1985(Table 5.2).This means that in 1985 cotton producers were getting prices nearer to the world price.

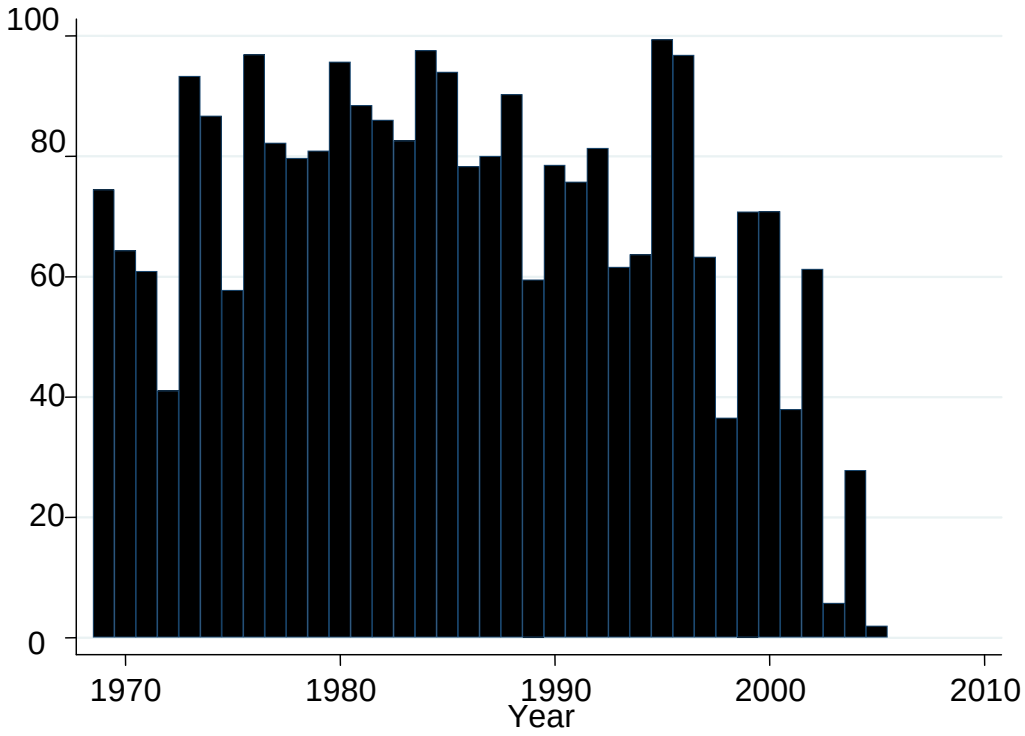
**Table 5.3: Summary Statistics**

| Variable | Observations | Mean | Std. Dev | Min | Max |
|---|---|---|---|---|---|
| **Share of World Price** | 37 | 70.34027 | 24.26788 | 1.94 | 99.35 |

**Source: Own calculations**

**Figure 5.2: Share of world price received by cotton farmers**

Share of world price (percentages)




### 5.2.1 Relationship between Cotton-A Index and domestic producer price of lint

In this section a statistical test based on Spearman correlation coefficient was performed to determine if there is any positive association between the two prices. Results reported in table 5.3 below shows the estimated Spearman correlation coefficient between world price of cotton lint and the domestic price offered to farmers.

**Table 5.4: Measure of degree of Association between World Price and Domestic Price**

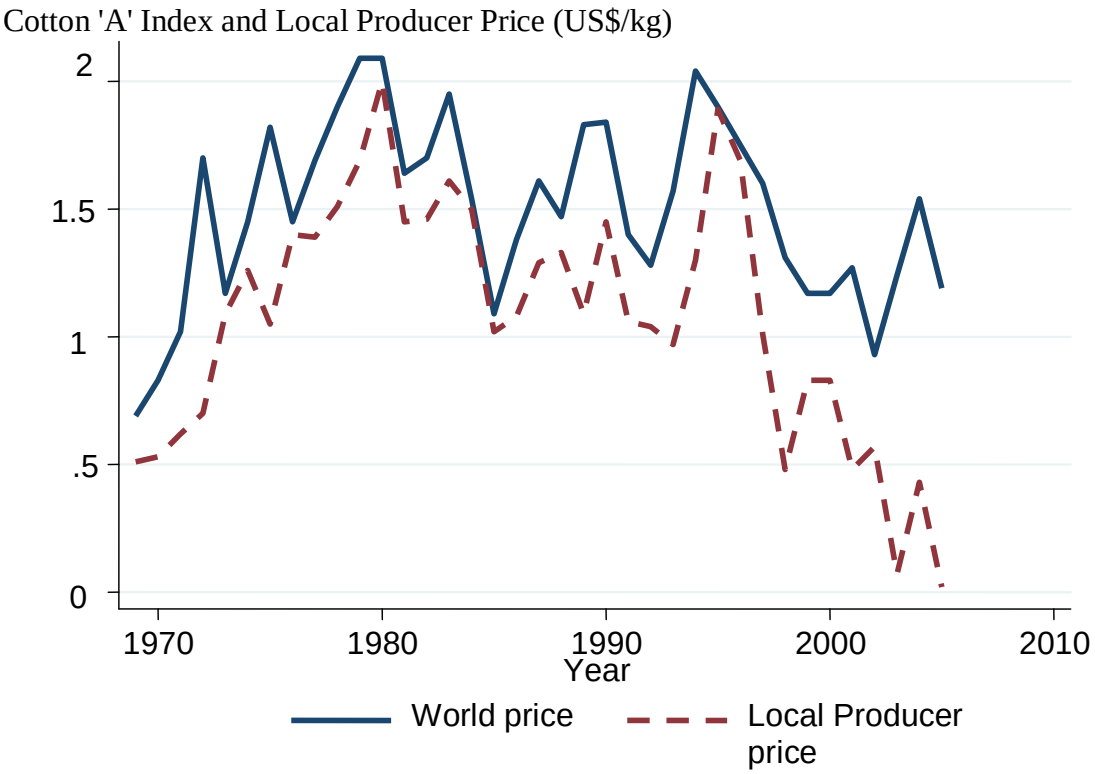
| | |
|---|---|
| **Observations** | 37 |
| **Correlation coefficient**[a] | 0.7203 |
| **P-Value** | 0.0000* |

* Correlation coefficient significant at 0.05 and 0.01 level

[a] Based on Spearman's rho.

Spearman correlation coefficient of Cotton 'A' Index and local seed cotton price offered to farmers, expressed in US$ per kilogram, was calculated for the period 1969-2005 and was found to be 72.03 percent. This coefficient was found to be significant at one percent. This indicates that there is positive linear association between world price of cotton lint and the local producer price of lint cotton offered to farmers. This means that a fall in world prices will also induce a fall in domestic producer prices. In terms of trends figure 5.3 below shows reasonable parallel movements between world price and domestic producer price. From the period 1960-1980 the movement in world price shows a general upward trend but after that period there was a general decline in world prices before picking up again in the late 1980s to mid 1990s.From then onwards world prices have been declining. This trend may be explained by increased support of the cotton sector by members of OECD countries.

**Figure 5.3: Local Producer and World Price of Cotton**




The US 2002 Farm Bill was introduced which approved support to the cotton sector of about US$474 million for production flexibility contract payments (Minot and Daniels, 2004).This has the effects of dampening world prices through increased supply in the world market. The trend in domestic producer price follows a similar pattern. Local producer prices were also on an upward trend in the period 1969-1980 and a general decline afterwards.

### 5.3 Conclusion and Insights from the chapter

In this chapter characteristics of both the world and domestic market were analysed through a comprehensive literature review of existing issues in the industry. It was shown that liberalisation of the cotton sector in Zimbabwe had an effect in the way cotton is marketed in international markets. International companies were allowed to participate in

the domestic marketing of cotton, for example Cargill. It was also shown that the degree of protection in the sector was generally declining with farmers receiving less than world price for their cotton.

This chapter also found that there is a significant positive relationship between Cotton-A Index and domestic producer price. Implications from these results are that policy interventions in the developed world which affect world price will affect the domestic producer price. Thus farmers will also respond to policies in the developed world. From this chapter it can be concluded that trends in international cotton marketing do have any effect on domestic cotton marketing.

# CHAPTER 6: ECONOMETRIC MODELING OF FACTORS AFFECTING COTTON PRODUCTION AND RESPONSE TO POLICIES IN ZIMBABWE

## 6.0 Introduction

Chapter 4 characterised production performance of the cotton farming sector and Chapter 6 compared domestic cotton marketing and international marketing. Characteristics of cotton production were discussed and some possible explanatory variables for differences in performance over the years were also analysed.The previous chapter found out very important results about the relationship between world prices and producer prices offered to farmers. This chapter is build around the findings of two previous chapters. Cotton production in Zimbabwe is complex and may be a result of a number of issues, such as weather, government policy and characteristics of the farmers. In order to determine which factors account for production differences, there is need to do a quantitative analysis. A regression analysis was done to determine the factors affecting cotton production and farmer's response to policy and institutional incentives. This chapter will test the hypothesis that price and macroeconomic policies have a significant effect on the production of cotton in Zimbabwe.

## 6.1 Analytical Approach

The study used area under cotton as a proxy for cotton production and follows from the general Nerlovian models of supply response. The reason for choosing area was because it shows the decisions of farmers to plant more of the crop. It is a good indicator of farmers' response to policies, as farmers will decide how many hectares to plant cotton given the policy environment. In the previous chapters, real cotton producer prices and maize prices were identified as likely explanatory variables for the evolution of cotton production since 1965.Also non price factors such as research and extension, weather, Economic Structural Adjustment Programme and development of irrigation facilities can be expected to account for part of the explanation in the period. Time series data for

selected variables was used to perform the analysis. Model specification is based on the price determination mechanism observed in the country. At the time of planting farmers do not know the producer price as prices are announced after the harvesting season and also since the extent of inflation will not be known. Price expectations, not actual prices and inflation expectations were used as explanatory variables. Expectations were modeled by using lagged variables on prices and inflation. A standard supply response specification based on Nerlove-model which assumes partial adjustment in production and adaptive expectations was used. A log-linear specification was used in which natural logarithm of area was regressed against natural logarithm of explanatory variables. Six alternative specifications of the model were tried and Ordinary Least Squares (OLS) was used to estimate the equations.

Table 6.1 below explains the a priori expectations about the variables as dictated by theory and other literature concerning supply response. Expected price of cotton lint modeled as lagged variable is expected to have a positive relationship with area planted. Expected price of maize is expected to have a negative relationship since maize and cotton compete for factors of production. Relative prices, that is natural log of cotton price (lagged) divided by the natural log of maize price, are expected to be similar to price responses of competing crops (positive).Expected inflation is expected to have a negative relationship with area planted. This is because high inflation causes uncertainty in production and farmers are constrained in their farming activities. The effect of rainfall on cotton production is not clear as cotton is a drought resistant crop and it is not a function of the amount of rainfall but of rainfall distribution. The inclusion of research and extension variable is to capture government policy in the provision of pubic goods. This variable is expected to have a positive relationship with area planted to cotton. The same is expected of agricultural credit extended to farmers by commercial banks and Agribank (former AFC).Dummy for the introduction of ESAP was also included to capture the effects of changes in the institutional reform on cotton production. This dummy is expected to be positively related to area planted. Such programmes are expected to improve the responsiveness of farmers due to improvements in marketing infrastructure.

**Table 6.1: Variable Explanation and Expected Impact**

| Variable | Explanation | Expected Impact |
|---|---|---|
| $A_t$ | Dependent variable: Area Planted to cotton in time t (hectares) | |
| $A_{t-1}$ | Area of cotton at time t-1 | + |
| $P_{c,t-1}$ | Real producer price of cotton lint (Z$ per tonne) in 2000Z$ terms at time t-1. | + |
| $P_{m,t-1}$ | Real producer price of maize (Z$ per tonne), at time t-1. | - |
| $\pi_{t-1}$ | Inflation at time t-1 is expected to have negative relationship with area planted, in 2000 Z$ terms. | - |
| $R_{t-1}$ | Rainfall at time t-1 (millimeters) | +- |
| RE | Real expenditure on research and Extension (Z$ millions in 2000 Z$ terms) in time t | + |
| Acredit | Real agricultural credit(Z$ thousands in 2000 Z$ terms) in time t | + |
| $D_t$ | Dummy for structural adjustment programmes:1=1990 onwards and 0=1965-1989 | + |
| $Wp_t$ | World price(US cents/pound) in time t | + |
| $P_{c,t-1}/ P_{m,t-1}$ | Price ratio | + |

## 6.2 Factors Affecting Cotton Production

Results of regression analysis are reported in table 6.2 and figure 6.1.The results show a relatively good fit for all the six models estimated, with R-squared ranging from 0.92 to 0.93(adjusted R-squared range from 0.89 to 0.92).The Durbin-Watson statistic for autocorrelation is not likely to be valid when there is a lagged dependent variable in the equation. The statistic will usually be biased toward finding of no autocorrelation. Thus the alternative Durbin test was used, which examines the partial correlations between the residuals and the lagged residuals, controlling for the intervening effect of the independent variables and the lagged dependent variable (Greene, 2003). The advantage of log-linear specification is that the elasticity estimates do not vary with the point at which they are evaluated and the short-run elasticities are simply parameter estimates of the price variables. The direct price elasticity is positive but insignificant in all models. These price elasticities are higher in models one and three (0.05 and 0.1 respectively).The price elasticity is higher when the world price is included in the estimation of the model. When structural adjustment variable is included direct price elasticities are low. Contrary to expectations the cross price elasticities with respect to maize price are all positive and insignificant, indicating no competition between the two products. This may be caused by the fact that cotton farmers are located in dry areas not suitable for full scale maize production. Maize is mainly grown by smallholder farmers for subsistence purposes and not for sale. When the price ratio was included it was negative and not significant. The estimated relative price elasticity shows that a price increase of cotton relative to maize by 1 per cent will result in a 0.06 per cent decrease in cotton production. On all the models estimated rainfall variable had a negative effect on planting decisions and is significant. This implies that farmers allocate less area to cotton because of the high amount of rainfall last year. This may also be attributed to the fact that cotton is grown mainly in dry areas. Credit extended to agriculture and expenditure on research and extension were significant and had a positive effect on planting decisions. The impact of liberalisation/privatization on cotton production is positive but low and insignificant. The entry of new players, the price competition and efficient payment system that resulted from privatization increased production of cotton.Liberalisation is also expected to increase the price responsiveness of farmers. When either one of the two adjustment

variables is introduced, it is insignificant and positive; in fact, the results of models 4 and 5 are similar. When both of them are simultaneously included, the results show a negative effect on the multiplicative dummy(-0.017),while the additive dummy is positive(0.105).From the results, equation six is the model that best explains cotton acreage decision with an R- squared of 0.9291 and adjusted R-squared of 0.9175 as compared to other models. This shows that about 92.9 percent of the variation in area planted is explained by the variation in the explanatory variables included in the model. Figure 6.1 shows that estimated model six best approximate observed values of area under cotton as compared to other models. Results of the model which best fit the observed data will be discussed here (model number six).

**Table 6.2: Supply response of cotton in Zimbabwe: Regression Results**

| | **Parameter estimates of different equations(Dependent variable-natural log of area under cotton)** | | | | | |
|---|---|---|---|---|---|---|
| **Variables** | **1** | **2** | **3** | **4** | **5** | **6** |
| Area planted to cotton in time t-1 | 0.576<br>(5.89)*** | 0.589<br>(6.10)*** | 0.509<br>(4.00)*** | 0.572<br>(5.68)*** | 0.572<br>(5.70)*** | 0.571<br>(5.50) |
| Producer price of cotton lint at time t-1 | 0.048<br>(0.42) | | 0.092<br>(0.89) | 0.023<br>(0.16) | 0.019<br>(0.12) | 0.034<br>(0.15) |
| Producer price of maize at time t-1 | 0.058<br>(0.29) | | 0.056<br>(0.31) | 0.067<br>(0.32) | 0.066<br>(0.32) | 0.069<br>(0.32) |
| World price in time t | | | -0.28<br>(-2.19)** | | | |
| Price ratio | | -0.057<br>(-0.65) | | | | |
| Inflation at time t-1 | -0.054<br>(-0.83) | -0.045<br>(-0.78) | -0.011<br>(-0.18) | -0.058<br>(-0.85) | -0.057<br>(-0.85) | -0.058<br>(-0.84) |
| Rainfall at time t-1 | -0.293<br>(-2.57)** | -0.302<br>(-2.85)*** | -0.236<br>(-2.25)** | -0.28<br>(-2.23)** | -0.279<br>(-2.21)** | -0.28<br>(-2.15)** |
| Real Expenditure on Research and Extension at time t | 0.166<br>(1.91)* | 0.159<br>(1.89)* | 0.246<br>(2.91)*** | 0.172<br>(1.90)* | 0.17<br>(1.90)* | 0.17<br>(1.86)* |
| Real agricultural Credit in time t | 0.321<br>(2.84)*** | 0.333<br>(3.12)*** | 0.286<br>(2.78)** | 0.314<br>(2.66)** | 0.314<br>(2.65)** | 0.315<br>(2.59)** |
| Dummy for Structural Adjustment(additive) | | | | 0.035<br>(0.30) | | 0.105<br>(0.09) |
| Dummy for Structural Adjustment(multiplicative) | | | | | 0.0084<br>(0.30) | -0.017<br>(-0.06) |
| Constant | 2.68<br>(1.92)* | 2.86<br>(2.46)** | 4.29<br>(2.71)** | 2.79<br>(1.90)* | 2.80<br>(1.90)* | 2.76<br>(1.73)* |
| R-squared | 0.9289 | 0.9291 | 0.9193 | 0.9291 | 0.9291 | 0.9291 |
| Adjusted R-Squared | 09097 | 0.9133 | 0.8912 | 0.9064 | 0.9064 | 0.9175 |
| F-Statistics | 48.49*** | 58.96*** | 32.75*** | 40.96*** | 40.95*** | 63.29*** |
| Durbin's alternative test-statistics(chi-square value) | 0.018 | 0.006 | 1.360 | 0.010 | 0.004 | 0.004 |

*** 0.01 level, **0.05 level, *0.1 level

Figures in parenthesis represent t- values.

For equation six a 1 per cent increase in cotton prices will result in a (lagged) increase in production of about 0.03 per cent. Also a percentage increase in inflation will result in 0.06 per cent reduction in cotton production. A 1 per cent increase in government expenditure on research and extension will result in a 0.17 per cent increase in production. Results show that farmers are very responsive to the availability of agricultural credit (0.32) as compared to other factors considered in the study. A 1 per cent increase in credit will result in a 0.32 per cent increase in production of cotton. Table 6.3 below report elasticities calculated.

**Table 6.3: Elasticities table**

| | Elasticities of output supply(Cotton) and policy variables | |
|---|---|---|
| | Short-Run | Long-Run |
| Elasticities with respect to | | |
| Price | | |
| Cotton | 0.03 | 0.07 |
| Maize | 0.07 | 0.16 |
| Fixed Factor and Policy variables | | |
| Research and Extension | 0.17 | 0.4 |
| Agricultural credit | 0.32 | 0.74 |
| Inflation | -0.06 | -0.14 |
| Rainfall | -0.28 | -0.65 |

**Source: Own calculations**

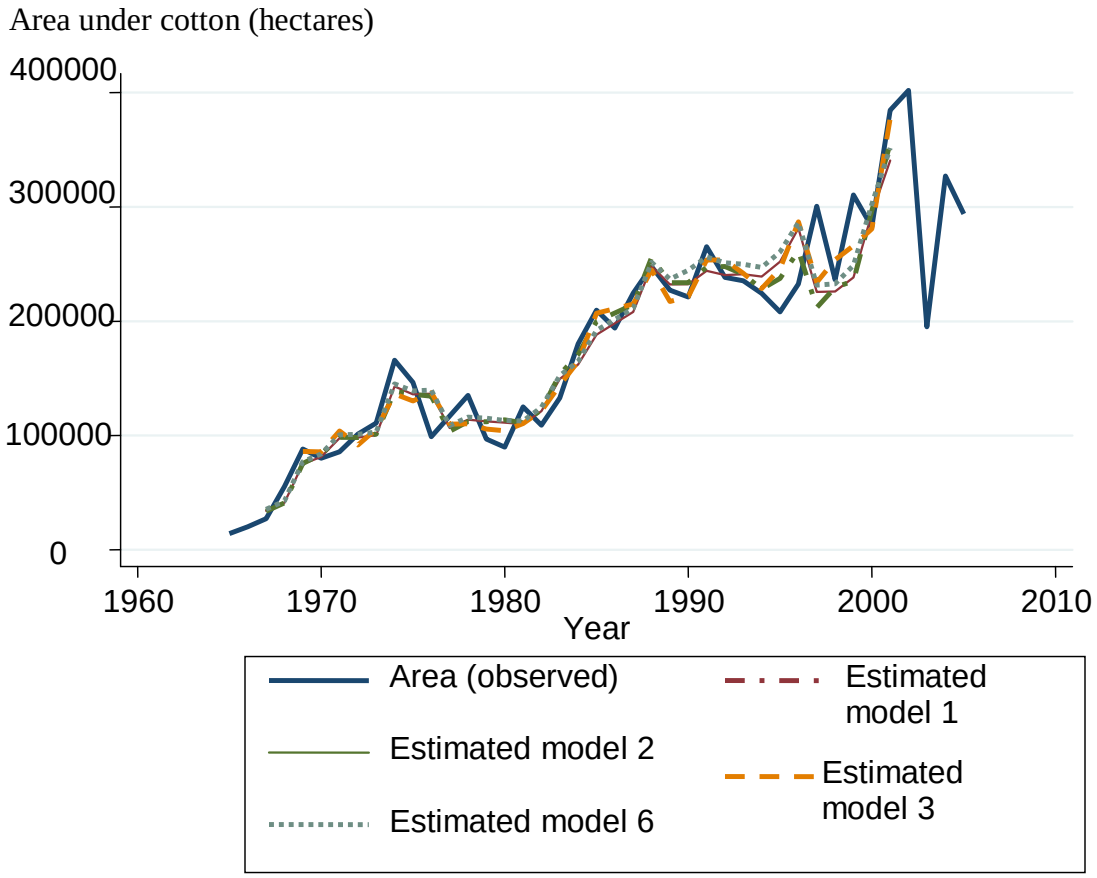
The table shows that cotton responds weakly to prices even in the long run. The long-run price elasticity (0.07) is, as expected, substantially higher than the short-run elasticity. The long-run elasticities reflect the response once the full change has taken place (including the change in those factors that would have been fixed in the short-run).It should also be noted that the price elasticities are less than one. The results also show the importance of public good provision, for example, farmers responded positively to research and extension.

## Table 6.4: Supply Response-Output

| Regression results: Dependent variable natural log of output | | | | | | |
|---|---|---|---|---|---|---|
| | Parameter estimates | | | | | |
| Variable | 1 | 2 | 3 | 4 | 5 | 6 |
| Production in time t-1 | 0.21(1.02) | 0.18(0.91) | -0.07(-0.28) | 0.02(0.08) | 0.01(0.03) | 0.08(0.36) |
| Producer price of cotton lint at time t-1 | 0.07(0.20) | | 0.1(-0.29) | 0.22(-0.67) | 0.15(0.48) | 0.33(0.93) |
| Producer price of maize at time t-1 | 0.18(0.46) | | 0.1(0.26) | -0.1(-0.25) | -0.04(-0.11) | -0.16(-0.41) |
| World price in time t | | | -0.03(-0.1) | | | |
| Price ratio | | -0.11(-0.64) | | | | |
| Inflation at time t-1 | -0.007(-0.04) | -0.02(-0.13) | -0.04(-0.2) | -0.06(-0.37) | -0.07(-0.46) | -0.01(-0.02) |
| Rainfall at time t-1 | -0.31(-1.26) | -0.32(-1.36) | -0.12(-0.5) | -0.26(-1.12) | -0.23(-1.00) | -0.32(-1.31) |
| Real Expenditure on Research and Extension at time t | 0.242(1.28) | 0.22(1.25) | 0.28(1.33) | 0.18(1.01) | 0.19(1.05) | 0.17(0.18) |
| Real agricultural credit in time t | 0.498(2.01*) | 0.52(2.19**) | 0.5(2.08**) | 0.46(1.99*) | 0.46(1.97*) | 0.46(0.23) |
| Dummy (additive) | | | | 0.59(2.25**) | | 1.82(1.20) |
| Dummy (multiplicative) | | | | | -0.13(-2.03*) | 0.3(0.83) |
| time trend | 0.02(1.01) | 0.01(0.75) | 0.01(-0.64) | 0.02(0.86) | 0.02(0.79) | 0.02(0.53) |
| Constant | 5.49(1.32) | 5.91(2.18**) | 8.04(1.86*) | 9.48(2.25**) | 8.86(2.10*) | 10.06(2.34) |
| R-squared | 0.4341 | 0.4371 | 0.3354 | 0.5396 | 0.5235 | 0.5541 |
| Adjusted R-Squared | 0.2372 | 0.2729 | 0.0506 | 0.3512 | 0.3286 | 0.3417 |
| F-Statistics | 2.21* | 2.66** | 1.18 | 2.86** | 2.69** | 2.61** |
| Durbin's alternative test-statistics (Chi-square value) | 2.34 | 3.307* | 0.027 | 6.74*** | 5.70 | 7.33*** |

Table 6.4 above shows results from output regression against the same variables used in area regression. Generally the models estimated did not fit the data well as compared to acreage response models, with R-squared ranging from 0.34 to 0.55. Durbin's alternative test for autocorrelation shows that models 2, 4 and 6 have autocorrelation. F calculated for all the models was significant. In all the models credit extended to farmers was found to be significant in influencing cotton production. Parameter estimates of the models represent elasticities of supply response with respect to the variable. Results show that area response is less than output response, consistent with what theory postulates.

**Figure 6.1: Observed values and estimated values of Area under Cotton**



## 6.3 Policy Experiments

In this section estimation of the impact of policy changes on cotton production is done using the estimated model number six, because it best explains cotton acreage decision. The data used to estimate the model represents behavior under the existing policies. So the data can be considered as representing equilibrium solution (data created as a result of some optimization process).In this section a policy change is specified, where a counterfactual equilibrium will be computed based on the specified policy change and policy evaluation is done by a pairwise comparison of the counterfactual and the benchmark equilibrium.

### 6.3.1. Policy Scenario 1: A 10 percent decline in cotton price resulting from a similar fall in international prices- Price policy with or without ESAP.

This experiment is performed in order to find out what could be the possible effects of policies in the developed world on cotton planting decisions of farmers in Zimbabwe. The previous chapter alluded to the fact that the world market is distorted because of production subsidies in the EU and US, and these distortions tend to depress world prices. Given the above explanation and the fact that world prices were found to be positively related to domestic prices of lint cotton, this experiment will examine the effects of a 10 per cent decline in lint price resulting from a similar fall in international price. Using the elasticities reported in the above table the result a decline in price on area planted is found by multiplying 10 per cent by the reported elasticity. Thus a 10 per cent decrease in price will result in a decrease in area planted by 0.3 per cent in the short-run, and 0.7 per cent decrease in the long-run. In order to evaluate the effects of price policy with or without ESAP, there is need to compare estimated values of area planted after a price

change with estimated area planted before a price change. Table 6.3 below shows the results of policy on mean area planted (rest of the results are shown in the appendix).

**Table 6.3: Results of price policy with or without ESAP**

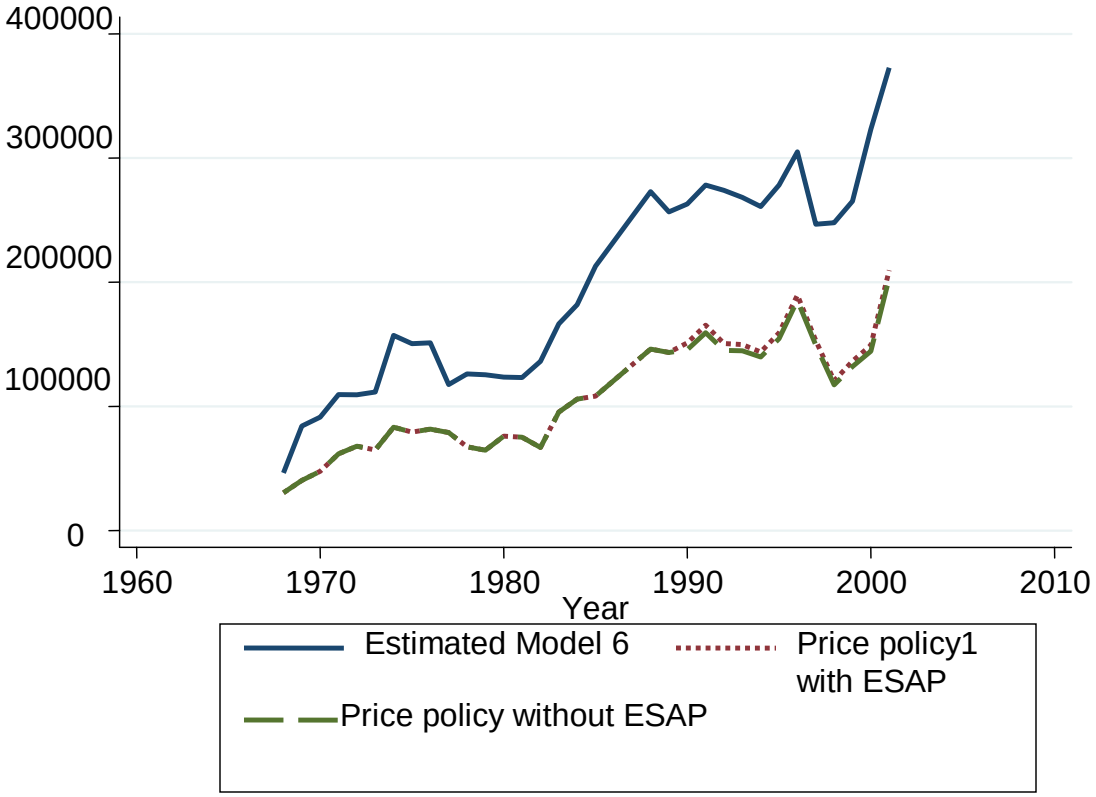
| **Policy Scenario 1** | **Average Estimated area in cotton-Base Model(hectares)** | **Average Estimated area in cotton under policy(hectares)** |
|---|---|---|
| 10 per cent decline in price in the presence of ESAP | 194915.5 | 108255.7 |
| 10 per cent decline in price in the absence of ESAP | 194915.5 | 106475.1 |

**Source: Own calculations**

Results show that in the presence of structural adjustment programmes area planted declined to 108255 hectares on average, while in the absence of such programs area planted will further decline to 106475 hectares. With structural adjustment in place, the induced fall in area planted is smaller than in the absence of such programs. This analysis shows that adjustment programmes reduces farmer responsiveness to price decline, because ESAP had a positive effect and a higher effect on cotton production (0.1 for ESAP dummy as compared to 0.034 of price).So a price decline would be offset by structural adjustment programmes which induces more production. Figure 6.2 shows the effects of a price decline with or without ESAP. The square-dashed line represents a price decline in the presence of ESAP.This shows that the effects of the policy are lesser as compared to the other line which is below that.

**Figure 6.2: Price policy with and without ESAP**

Area under cotton (hectares)




**6.3.2. Policy Scenario 2: A 10 percent increase in inflation-Macroeconomic policy shock.**

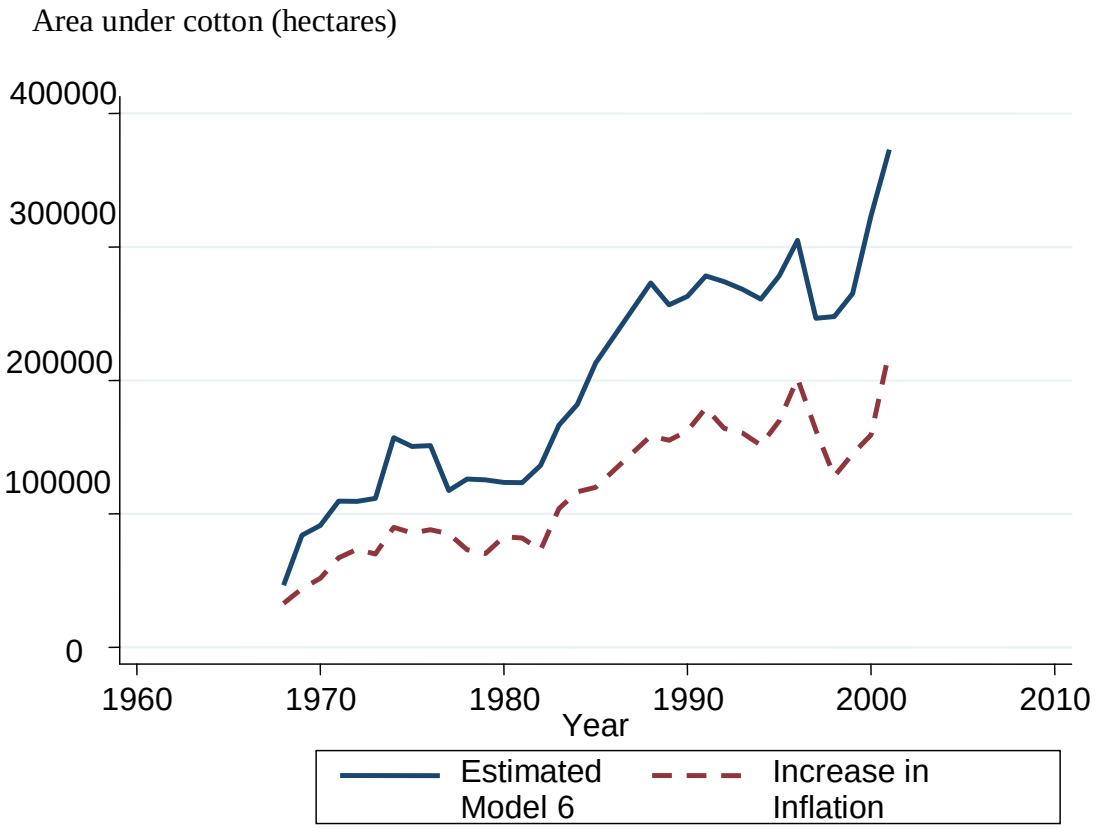
This experiment is performed to determine the effects of macroeconomic policies on planting decisions. Policy shocks are measured by the inflation rate in the model. An increase in inflation by 10 per cent as a result of macroeconomic policies result in 0.6 per cent decline in area planted in the short-run and a 1.4 per cent decline in area planted in the long-run. On average area planted declined from 194915.5 hectares to 116489.4 hectares in the short-run (Table 6.3).Rest of the results for all the years are presented in the appendix.

**Table 6.4: Result of change in inflation**

| Policy Scenario 2 | Average Estimated area in cotton-Base Model(hectares) | Average Estimated area in cotton under policy(hectares) |
|---|---|---|
| Increase in inflation | 194915.5 | 116489.4 |

**Source: Own calculations.**

**Figure 6.3: Policy scenario 2 and estimated model 6**




The above diagram shows the effect of 10 per cent change in inflation as a result of macroeconomic policies. Area planted to cotton declines as result of such policies as shown by the line labeled increase in inflation.

### 6.3.3. Policy Scenario 3: A 10 percent increase in expenditure on Research and Extension (Government policy).

Table 6.5 below shows the effects of increase in expenditure on research and extension. This shows effects of government policies of improving the provision of public goods on cotton production. A 10 per cent increase expenditure on research and extension result in a 1.7 per cent increase in area planted to cotton in the short-run and a 4 per cent increase in the long-run.

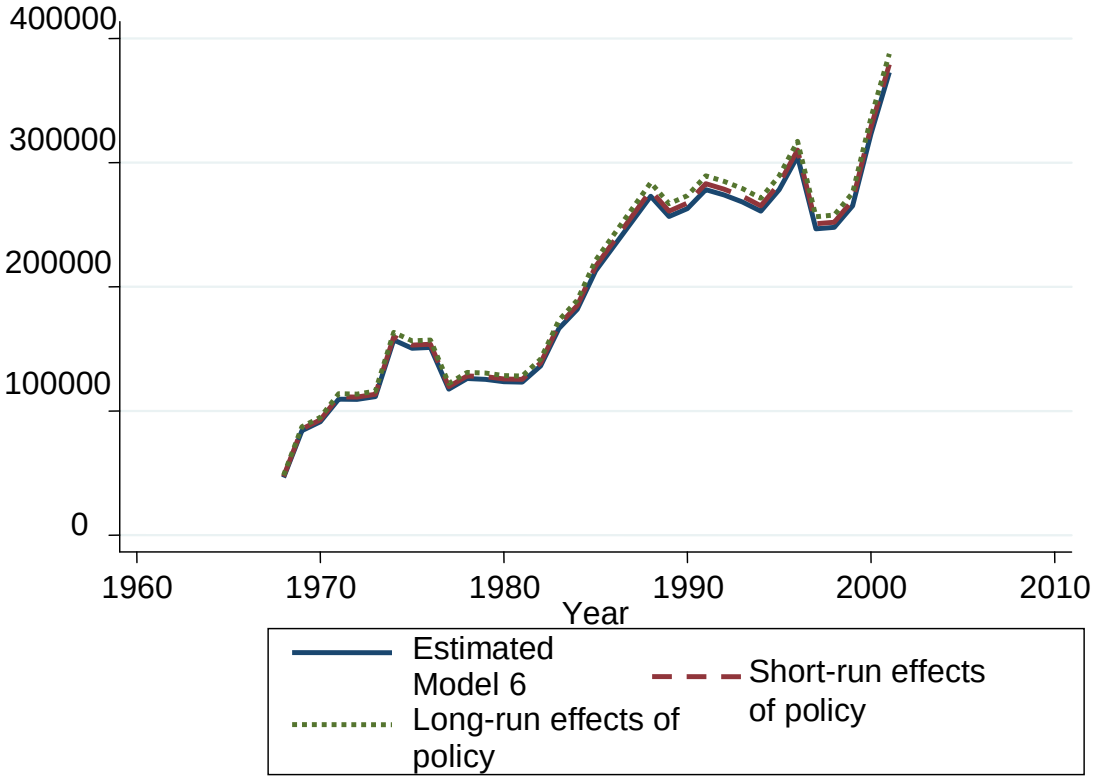
**Table 6.5: Results of an increase in Research and Extension**

| **Policy Scenario 3** | **Average Estimated area in cotton-Base Model(hectares)** | **Average Estimated area in cotton under policy(hectares)** |
|---|---|---|
| 10 per cent increase in expenditure on Research and Extension in the short-run | 194915.5 | 198229.1 |
| 10 per cent increase in expenditure on Research and Extension in the long-run | 194915.5 | 202712.1 |

**Source: Own calculations**

**Figure 6.4: Policy 3**

Area under cotton (hectares)




On average the increase in provision of research and extension result in an increase in area planted from 194915.5 hectares to 198229.1 in the short-run and an increase to 202712.1 hectares in the long-run. Figure 6.4 above also helps visualize the effects of pubic good policy on area planted to cotton. The effects of such policies are shown by the two lines above the line of the base model. In the long- run response is very high as can be seen from the graph compared to short-run effects.

### 6.3.4. Policy Scenario 4: A 10 percent increase in credit extended to farmers.

The last experiment was performed in order to find out how farmers respond to increased credit provision.Farmers'improved access to credit was shown to have positive effect on

area planted. If credit extended to farmers increase by 10 per cent, area planted will increase by 3.2 per cent in the short-run and 7.4 per cent in the long-run.

**Table 6.6: Results of an increase in credit extended to farmers.**

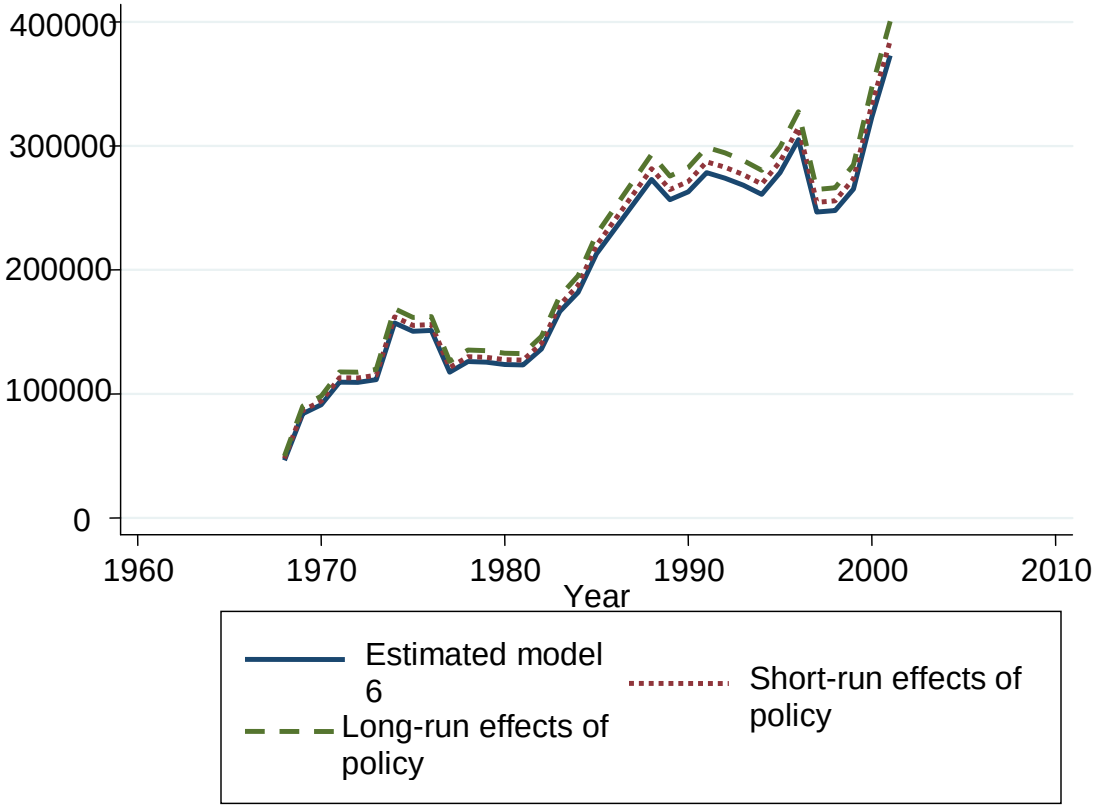
| **Policy Scenario 4** | **Average Estimated area in cotton-Base Model(hectares)** | **Average Estimated area in cotton under policy(hectares)** |
|---|---|---|
| 10 per cent increase in agricultural credit extended to farmers in the short-run. | 194915.5 | 201152.8 |
| 10 per cent increase in agricultural credit extended to farmers in the long-run. | 194915.5 | 209339.3 |

**Source: Own calculations**

Table 6.5 shows that on average area planted increased from 194915.5 hectares to 201152.8 hectares in the short-run, while it increased to 209339.3 hectares in the long-run.

**Figure 6.5: Policy 4**

Area under cotton (hectares)




To help visualize the effects increasing short-term credit to farmers, figure 6.5 above shows that a 10 per cent increase will result in the shift of the base model to models estimated with the effects of policy.

## 6.4. Conclusions and Insights from the chapter

The main objective of this chapter was to test the hypothesis that price and macroeconomic policies have a significant effect on cotton production and also determine other factors which affect cotton production. The chapter started by specifying the Nerlovian models used for estimation. Several models were estimated with different specifications. The best model that best fits the observed data was used for interpretation. From the results it was found that farmers are less responsive to prices of cotton lint and prices of competing crops, in this case maize. In all the models prices were found to be

insignificant in explaining cotton production, although they had a positive effect on cotton production. Although inflation had a negative effect on cotton production, it was found to be insignificant. And also farmers were less responsive to changes in inflation. So from the above discussion it can be safely concluded that although price and macroeconomic policies have the expected effect on cotton production, farmers respond weakly to such policies.

The role of institutional incentives was also found to be positive as shown by the dummy for structural adjustment programmes. Price decline in the presence of ESAP is lesser than in the absence of ESAP, showing the effect of the changing marketing environment brought about by the programmes.The factors that positively affected cotton production during the period under study were found to be the amount of short-term credit extended to farmers and government expenditure on research and extension. These variables were found to be significant in explaining cotton production.

# CHAPTER 7: SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

## 7.0 Introduction

This chapter will provide a summary of the findings of the analysis. The chapter will first summarize the hypothesis postulated by the study and the methods of analysis used and the findings from the study. Conclusions and policy recommendations will be drawn from the analysis and areas of further study will be suggested.

## 7.1 Summary of results

The first hypothesis tested in this study was:

*Smallholder farmers have become the major producers of cotton as compared to large-scale commercial farmers*

Descriptive statistics were used as a tool of analysis for this hypothesis. The study found out that over the period 1965-2006 the smallholder sector contributed about 56 per cent on average, while the LSCF contributed about 44 per cent of cotton production. The smallholder sector accounted for about 76 per cent of the area planted to cotton, while the LSC F accounted for about 24 per cent during the period under study. During the period 1965-2006 the area planted to cotton in the smallholder sector has been increasing at a rate of 9.3 per cent yearly, while in the LSCF sector area planted was declining at a rate of 8.15 per cent annually. Aggregate area under cotton was growing at a rate of 5.16 per cent annually during the period under study. This shows the effect of the negative growth rate in the LSCF sector.

In terms of cotton production, in the smallholder sector production increased at a rate of 8.41 per cent per annum, while LSCF sector production was declining at a rate of 7.84 per cent annually. Aggregate cotton production in Zimbabwe during the period was

growing at an annual rate of 3.18.This shows that aggregate production was growing at a slower rate than smallholder production. As seen from the study, this was attributed to decline in cotton production by the LSCF sector. Literature has attributed this to the land reform policy adopted by the Zimbabwean government which has dismantled the sector and led to the creation of many smallholder farmers. Also it was noted that the LSCF sector diversified into other crops because of the volatility of cotton prices in the world market. However, productivity of cotton in the LSCF sector was high as compared to the smallholder sector. Yields in the LSCF sector averaged 1.73 tonnes per hectare, while in the smallholder sector yields averaged 0.74 tonnes per hectare. Results show that, besides the fact that the smallholder sector is contributing much to cotton production, productivity in the sector was declining at a rate of 0.68 per cent during the period under study. In the LSCF sector productivity was growing at a rate of 0.31 per cent annually.Overally, productivity was declining at a rate of 1.98 per cent annually during the 1965-2006 period. This shows the effect of decline in yields in the smallholder sector which accounted for much of the cotton production.
Therefore as can be seen from the results the hypothesis cannot be rejected.

The second hypothesis tested in the study was:

*International marketing of cotton is significantly related to domestic marketing of cotton in Zimbabwe.*

Chapter 5 compared international marketing and domestic marketing of cotton. A combination of literature review, correlation analysis and indictors of protection were used as tools of analysis in the chapter. Review of the characteristics of the world and domestic markets show that liberalisation of Zimbabwean markets affected the way cotton lint is marketed internationally, as some international companies became involved in the domestic marketing of cotton. It was also shown that changes that characterize the domestic market in the late 1990s were actually driven by changes in the world market. In analysing the relationship between world prices and domestic lint prices, NPC was first used to see the extent of protection in the sector. It was actually shown that the degree of protection was declining during the period 1969-2005.The periods 1969-1990

shows high degree of protection, as indicated by an NPC of 0.84 for the period, compared to 0.49 for the period 1991-2005. In terms of the share of world price received by cotton growers, it was found that farmers have been receiving generally less share of the world price over the period 1969-2005.In comparing the world price with the domestic lint prices, it was found that growers received about 70 per cent of world price on average.

A correlation analysis of the relationship between Cotton-A Index and domestic lint prices expressed in US dollar terms, show that the two are positively related. Spearman's correlation coefficient of 0.72 was reported and found to be significant at 1 per cent level. Thus from the analysis it can also be concluded that international marketing of cotton is significantly related to the domestic marketing of cotton in Zimbabwe.

The third hypothesis tested in the study was:

*Price incentives, institutional environment and macroeconomic policies have a significant effect on the production of cotton in Zimbabwe*

Chapter 6 tested this hypothesis. The main tool of analysis in this chapter was regression analysis and the determinants of cotton production were explored. Six models were run and in all models the effect of prices were found to be insignificant and farmers were less responsive to price changes as shown by low elasticities reported in chapter 6.It was also shown that farmers respond positively to prices of competing products, maize in this case in contrast to what theory postulates. A dummy for ESAP was included in the modeling and results show that this has a positive effect on cotton production. This shows that the change in the institutional environment as the market institution was changed resulted in an increase in production. The impacts of such policies were low and insignificant. The other dummy included in the model was a multiplicative dummy (price of cotton times the ESAP dummy).This was included to show price responsiveness in the presence of adjustment programmes. Results show that in the presence of structural adjustment programmes area planted declined to 108255 hectares on average, while in the absence of such programs area planted will further decline to 106475 hectares. With structural adjustment in place, the induced fall in area planted is smaller than in the absence of such

programmes.The effect of inflation (measure of macroeconomic policy shock) on cotton production is negative but insignificant on all models tested. The effect of a 10 per cent increase in inflation as a result of macro policy shock will result in a fall in area under cotton from 194915.5 hectares to 116489.4 hectares in the short-run on average. Major determinants of cotton production were found to be research and extension and short-term credit extended to farmers. Credit extended to farmers by commercial banks and Agribank was found to be significantly related to cotton production, with farmers responding positively. A similar increase in the provision of credit to farmers induced an increase in cotton area from 194915.5 hectares to 201152.8 hectares in the short-run, while it increased to 209339.3 hectares in the long-run .Government expenditure on research and extension was also found to be significant and positive in affecting cotton production. A 10 per cent increase in expenditure on research and expenditure induced an increase in area planted from 194915.5 hectares to 198229.1 in the short-run and an increase to 202712.1 hectares in the long-run on average.

So from the above discussion it can be safely concluded that although price and macroeconomic policies have the expected effect on cotton production, farmers respond weakly to such policies.

### 7.2 Policy Implications

Empirical results show that during the period 1965-2006, smallholder farmers have become the most important producers of the crop. Farmers in this sector are mainly based in the communal areas of Zimbabwe, where the majority of the poor in the country reside. Since they depend on cotton for cash, there is need for policy to put in place measures to improve production in this sector in order to improve the livelihoods of smallholder farmers. The study also found out that productivity in the smallholder sector was declining during period. Policy measures should also be designed that will address this problem.

The study compared domestic cotton marketing and international marketing and found out that the two markets are related. A comparison of the world prices and the prices offered in the domestic market found out that the two are positively correlated. There are important policy messages from these findings. Implications from these results are that policy interventions in the developed world which affect world price will affect the domestic producer price. Thus the government, private sector and NGOs should continue to lobby in the international forums for scrapping up of policies which results in decline in world prices of cotton.

Empirical findings of the study also reveal that, farmers are responsive to the provision of short-term credit. Short-run and long-run elasticities with respect to agricultural credit were 0.32 and 0.74 respectively. In order to improve cotton production there is need for policy to put measures that will increase credit provision. Government should put a structure that enables financial institution to participate in the financing of cotton production. Short-run and long-run elasticities with respect to research and extension were 0.17 and 0.4 respectively. Thus there is need to provide training and extension to farmers and also increase funding for research in cotton( more funds to the Cotton Research Institute) in order to improve cotton production.

Empirical results show that the effect of macroeconomic policy was negative, although insignificant. Thus for the country to improve cotton production, policies should be put in place that reduce inflation. The effect of cotton prices was also found to be positive and it was found that farmers were less responsive to price changes. Thus a price policy that increases the producer price of cotton will also enhance cotton production but to a lesser extent.

Results also show that the effect of ESAP on production was positive. The change in the marketing environment as a result of adjustment programmes induced an increase in production. A price reduction in the presence of ESAP resulted in a less decrease in production than in the absence of such programmes.The indicates the importance of change in the institutional environment in cotton production. Policy messages that can be derived from this finding are that policymakers need to continue improve the institutional

environment in the cotton sector. Need to put in proper rules governing the marketing of the crop and there is need for more coordination among the players in the sector.

Generally the study documented elasticities which indicate responsiveness of farmers to policy incentives and found that farmers were less responsive to such incentives. The responsiveness of farmers to policy incentives influences the size of the welfare effect. Responsiveness is particularly important when one considers the vulnerability aspects of poverty. Policies which reduce farmers' ability to adjust to or cope with negative shocks could have major implications for translation of policy shocks into actual poverty. In the study it was found that with ESAP production did not decrease as it would happen in the absence of ESAP as a result of price reductions. Thus institutional mechanisms which enable farmers to cope with negative shocks of price reduction should be put in place by policymakers.

### 7.3 Areas of further research

Empirical findings of the study are based on aggregate analysis of time-series data as compared to farm level data. Conclusions based on such methods are likely to be misleading. Future study should concentrate on analysing response of farmers to policy and institutional incentives at farm level, using cross-sectional data. Also future studies should analyse supply responses in the smallholder sector. There is also need to study the factors that affect yield variability in the smallholder sector from a historical perspective. This study examined the effects of various policies on cotton production, but did not quantify the welfare effects of such policies on cotton producing households. There is also need to study the relationship between farmers' responsiveness to policies and welfare effects.

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## Appendices

### A1: Specifications of Models

The first model was specified as in equation 1

$$1)\quad \ln A_t = \beta_0 + \beta_1 \ln A_{t-1} + \beta_2 \ln P_{c,t-1} + \beta_3 \ln P_{m,t-1} + \beta_4 \ln \pi_{t-1} + \beta_5 \ln R_{t-1} + \beta_6 \ln RE_t + \beta_7 \ln Acredit_t + \beta_8 t + \mu_t;$$

Equation 2 was estimated with the inclusion of the world price of cotton

$$2)\quad \ln A_t = \beta_0 + \beta_1 \ln A_{t-1} + \beta_2 \ln P_{c,t-1} + \beta_3 \ln P_{m,t-1} + \beta_4 \ln \pi_{t-1} + \beta_5 \ln R_{t-1} + \beta_6 \ln RE_t + \beta_7 \ln Acredit_t + \beta_8 \ln Wp_t + \beta_9 t + \mu_t;$$

This equation included price ratio.

$$3)\quad \ln A_t = \beta_0 + \beta_1 \ln A_{t-1} + \beta_2 \ln \frac{P_{c,t-1}}{P_{m,t-1}} + \beta_4 \ln \pi_{t-1} + \beta_5 \ln R_{t-1} + \beta_6 \ln RE_{t-1} + \beta_7 \ln Acredit_t + \beta_8 t + \mu_t;$$

4) This model was estimated using an additive dummy of Structural Adjustment Programmes.

$$\ln A_t = \beta_0 + \beta_1 \ln A_{t-1} + \beta_2 \ln P_{c,t-1} + \beta_3 \ln P_{m,t-1} + \beta_4 \ln \pi_{t-1} + \beta_5 \ln R_{t-1} + \beta_6 \ln RE_t + \beta_7 \ln Acredit_t + \beta_9 D_t + \beta_{10} t + \mu_t;$$

5) This equation was estimated using a multiplicative dummy that modifies the price responsiveness

$$\ln A_t = \beta_0 + \beta_1 \ln A_{t-1} + \beta_2 \ln P_{c,t-1} + \beta_3 \ln P_{m,t-1} + \beta_4 \ln \pi_{t-1} + \beta_5 \ln R_{t-1} + \beta_6 \ln RE_t + \beta_7 \ln Acredit_t + \beta_9 D_t \ln P_{c,t-1} + \beta_{10} t + \mu_t;$$

6) This equation included both dummies simultaneously

$$\ln A_t = \beta_0 + \beta_1 \ln A_{t-1} + \beta_2 \ln P_{c,t-1} + \beta_3 \ln P_{m,t-1} + \beta_4 \ln \pi_{t-1} + \beta_5 \ln R_{t-1} + \beta_6 \ln RE_t$$
$$+\beta_7 \ln Acredit_t + \beta_8 D_t + \beta_9 D_t \ln P_{c,t-1} + \beta_{10} t + \mu_t .$$

## A2: Data Used in the Analysis

### a) Cotton Production in LSCF

| Year | Area 000 ha | Production tonnes | Yield tons/ha |
|---|---|---|---|
| 1965 | 14261 | 16704 | 1.17 |
| 1966 | 18138 | 21852 | 1.20 |
| 1967 | 21266 | 34349 | 1.62 |
| 1968 | 45349 | 53331 | 1.18 |
| 1969 | 76184 | 134965 | 1.77 |
| 1970 | 58808 | 78160 | 1.33 |
| 1971 | 58251 | 110320 | 1.89 |
| 1972 | 60432 | 123130 | 2.04 |
| 1973 | 69241 | 105708 | 1.53 |
| 1974 | 87001 | 120859 | 1.39 |
| 1975 | 81065 | 121345 | 1.50 |
| 1976 | 57727 | 107742 | 1.87 |
| 1977 | 74570 | 115238 | 1.55 |
| 1978 | 86071 | 129037 | 1.50 |
| 1979 | 76095 | 130218 | 1.71 |
| 1980 | 74921 | 145553 | 1.94 |
| 1981 | 58384 | 117960 | 2.02 |
| 1982 | 52251 | 104754 | 2.00 |
| 1983 | 59863 | 111093 | 1.86 |
| 1984 | 72155 | 145346 | 2.01 |
| 1985 | 70289 | 154960 | 2.20 |
| 1986 | 60421 | 141696 | 2.35 |
| 1987 | 58604 | 122643 | 2.09 |
| 1988 | 60095 | 127920 | 2.13 |
| 1989 | 52801 | 115467 | 2.19 |
| 1990 | 42652 | 80294 | 1.88 |
| 1991 | 43195 | 83239 | 1.93 |
| 1992 | 35705 | 31269 | 0.88 |
| 1993 | 31176 | 56358 | 1.81 |
| 1994 | 29745 | 60886 | 2.05 |
| 1995 | 29758 | 50413 | 1.69 |
| 1996 | 38312 | 68368 | 1.78 |
| 1997 | 33892 | 57245 | 1.69 |
| 1998 | 26648 | 53207 | 2.00 |
| 1999 | 23974 | 39743 | 1.66 |
| 2000 | 22071 | 37778 | 1.71 |
| 2001 | 16574 | 34469 | 2.08 |
| 2002 | 11397 | 20339 | 1.78 |
| 2003 | 2670 | 3606 | 1.35 |
| 2004 | 381 | 546 | 1.43 |
| 2005 | 68 | 119 | 1.75 |
| 2006 | 25 | 33 | 1.32 |

## b) Cotton Production in the Smallholder Sector

| Year | Area | Production | Yield |
|---|---|---|---|
| t | 000 ha | tonnes | tons/ha |
| 1965 | . | . | 0.67 |
| 1966 | 2000 | 1148 | 0.57 |
| 1967 | 6000 | 4251 | 0.71 |
| 1968 | 10000 | 7031 | 0.70 |
| 1969 | 12000 | 18135 | 1.51 |
| 1970 | 14000 | 24643 | 1.03 |
| 1971 | 27488 | 29018 | 1.06 |
| 1972 | 40741 | 42217 | 1.04 |
| 1973 | 41655 | 23748 | 0.57 |
| 1974 | 78857 | 69206 | 0.88 |
| 1975 | 65428 | 48766 | 0.75 |
| 1976 | 41276 | 34374 | 0.83 |
| 1977 | 42415 | 28710 | 0.68 |
| 1978 | 49073 | 37064 | 0.76 |
| 1979 | 27590 | 19500 | 0.71 |
| 1980 | 20000 | 16200 | 0.81 |
| 1981 | 66670 | 52634 | 0.79 |
| 1982 | 57071 | 30287 | 0.53 |
| 1983 | 74860 | 36219 | 0.48 |
| 1984 | 113784 | 81758 | 0.72 |
| 1985 | 146369 | 129226 | 0.88 |
| 1986 | 133632 | 115335 | 0.86 |
| 1987 | 166000 | 105400 | 0.63 |
| 1988 | 187758 | 167671 | 0.89 |
| 1989 | 174529 | 144823 | 0.83 |
| 1990 | 178573 | 122309 | 0.68 |
| 1991 | 221972 | 159467 | 0.72 |
| 1992 | 202577 | 38140 | 0.19 |
| 1993 | 204279 | 142826 | 0.70 |
| 1994 | 194717 | 133383 | 0.69 |
| 1995 | 178389 | 47998 | 0.27 |
| 1996 | 194206 | 165611 | 0.85 |
| 1997 | 266650 | 137967 | 0.52 |
| 1998 | 209639 | 126140 | 0.60 |
| 1999 | 286560 | 157516 | 0.55 |
| 2000 | 260398 | 204186 | 0.78 |
| 2001 | 368000 | 245785 | 0.67 |
| 2002 | 390500 | 173750 | 0.44 |
| 2003 | 192407 | 155891 | 0.81 |
| 2004 | 331335 | 363720 | 1.10 |
| 2005 | 293932 | 196181 | 0.67 |
| 2006 | 266059 | 248224 | 0.93 |

## c) Aggregate Cotton Production

| Year(t) | Area(000 ha) | Production(tonnes) | Yield (t/ha) |
|---|---|---|---|
| 1965 | 14261 | 16704 | 1.17 |
| 1966 | 20138 | 23000 | 1.14 |
| 1967 | 27266 | 38600 | 1.42 |
| 1968 | 55349 | 60362 | 1.09 |
| 1969 | 88184 | 153100 | 1.74 |
| 1970 | 80226 | 102803 | 1.28 |
| 1971 | 85739 | 139338 | 1.63 |
| 1972 | 101173 | 165347 | 1.63 |
| 1973 | 110896 | 129456 | 1.17 |
| 1974 | 165858 | 190065 | 1.15 |
| 1975 | 146493 | 170111 | 1.16 |
| 1976 | 99003 | 142116 | 1.44 |
| 1977 | 116985 | 143948 | 1.23 |
| 1978 | 135144 | 166101 | 1.23 |
| 1979 | 96985 | 145218 | 1.50 |
| 1980 | 89921 | 157533 | 1.75 |
| 1981 | 125054 | 170594 | 1.36 |
| 1982 | 109014 | 134886 | 1.24 |
| 1983 | 132976 | 146521 | 1.10 |
| 1984 | 180155 | 221746 | 1.23 |
| 1985 | 209658 | 274186 | 1.31 |
| 1986 | 194053 | 257031 | 1.32 |
| 1987 | 224604 | 228043 | 1.02 |
| 1988 | 247853 | 295591 | 1.19 |
| 1989 | 227270 | 260290 | 1.15 |
| 1990 | 221225 | 202603 | 0.92 |
| 1991 | 265167 | 242706 | 0.92 |
| 1992 | 238282 | 69409 | 0.29 |
| 1993 | 235455 | 199184 | 0.85 |
| 1994 | 224462 | 194269 | 0.87 |
| 1995 | 208147 | 98411 | 0.47 |
| 1996 | 232518 | 233979 | 1.01 |
| 1997 | 300542 | 195212 | 0.65 |
| 1998 | 236287 | 179347 | 0.76 |
| 1999 | 310534 | 197259 | 0.64 |
| 2000 | 282469 | 241964 | 0.86 |
| 2001 | 384574 | 280254 | 0.73 |
| 2002 | 401897 | 194089 | 0.48 |
| 2003 | 195077 | 159497 | 0.82 |
| 2004 | 326956 | 364266 | 1.11 |
| 2005 | 293813 | 196300 | 0.67 |

**Source: CSO Publications**