Evaluating the shifts in the South African cotton industry: The effects of institutional transformation and international cotton price dynamics

By

Dipuo Sylvia Boshomane

Dissertation submitted in partial fulfilment of the requirements for the degree MSc (Agric) Agricultural Economics

Department of Agricultural Economics, Extension and Rural Development

Faculty of Natural and Agricultural Sciences

University of Pretoria

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DECLARATION

I, Dipuo Sylvia Boshomane, declare that the dissertation, which I hereby submit for the degree MSc (Agric) Agricultural Economics at the University of Pretoria, is my own work and has not been submitted for a degree at any other tertiary institution.

Signature: ……………………….…………………

Date: ……………………………………………..

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ABSTRACT

Cotton used to be a thriving agricultural commodity in South Africa (SA), with dryland production being the backbone of the industry. In the 1980s and early 1990s, the total cotton area covered over 200 thousand hectares but has since decreased dramatically, to less than 10 thousand hectares post-2000. Fluctuating and decreased cotton production has been the South African cotton industry's biggest challenge. The cotton industry's demise has been to the detriment of SA's economy due to the loss of the associated employment and value addition in the production, processing, distribution and trade stages of the value chain. To revive cotton production, sustain livelihoods through job creation, and protect and sustain the domestic cotton industry, several interventions (under the auspice of the Sustainable Cotton Cluster) have been implemented in the sector over the past decade.

The main objective of this study is to determine the relative contributions of international market dynamics and local value chain interventions to variations in cotton area. First Engle-Granger (1987) cointegration procedures were used to analyse price transmission between the local and global cotton markets. Empirical findings confirm a long-run relationship between the two markets; thus, the local lint price is determined by the international cotton price (A-Index). Also, employing the same procedures to estimate domestic producer prices for seed cotton, indicated a cointegration relationship between producer prices, seedcotton supply and the local lint price.

The Autoregressive-Distributed Lag (ARDL) cointegration approach was applied to determine the drivers of cotton area in SA. Prices were analysed as a component of revenue in the empirical analysis. Empirical findings indicate that cotton area is more responsive to domestic procurement volumes, in line with typical contracted production practices, but producer revenue was also an important determinant. Domestic procurement in this context refers to the volume of locally produced lint, which is processed by local spinners. It is important to note that domestic procurement is an imperfect proxy for the cotton cluster, but the best alternative given the lack of available data on annual commitments by the cluster. Also, exports are important and may well have been a driver of additional procurement of seedcotton by ginners as seedcotton is processed into lint either to sell in the local market to spinners or for export.

As such, lint processing at the spinning level is used as a measure of local procurement, instead of seedcotton procurement by ginners since we cannot separate between seedcotton processing for the local market and export. Thus, the results of the study should be considered carefully given the limitations indicated above.

The results of the analysis suggest that cotton growers will increase the area planted to cotton in the current season, on basis of increased procurement in the previous season. In the same way, cotton area increases in response to higher cotton revenue. White maize is an important substitute crop in the long-run for irrigation areas while sunflower competes with dryland cotton, suggesting that farmers will consider shifting towards maize or sunflower in the next season if these provided better returns than cotton in previous seasons.

Empirical outcomes show that both industry interventions focused on local beneficiation (between 2014 and 2018) and improvements in revenue resulting from price gains were important drivers of increased cotton area, but local beneficiation was found to have the biggest impact on area. An important takeout from the study is that there is a need for a diversified market approach to utilise opportunities on a local and global scale (i.e when global prices are favourable). Additionally, there is potential for local byproduct value chains to boost the viability of the cotton industry.

Keywords: Value chain interventions, Sustainable Cotton Cluster (SCC), lint price, seedcotton price, white maize price, sunflower price, local procurement, Engle-Granger cointegration procedures, ARDL cointegration procedures, Error Correction Model.

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
ARDL	Autoregressive Distributed Lag Model
Cotton SA	Cotton South Africa
DAFF	Department of Agriculture, Forestry and Fisheries
Dti	Department of trade and industry
ECM	Error Correction Model
EU	European Union
FAO	Food and Agricultural Organization of the United Nations
GDP	Gross Domestic Product
Ha	Hectares
ITC	International Trade Centre
OLS	Ordinary Least Squares
SA	South Africa
SADC	Southern African Development Community
SAWS	South African Weather Services
SCC	Sustainable Cotton Cluster
WTO	World Trade Organization
USDA	United States Department of Agriculture

CHAPTER 1

INTRODUCTION

1.1 Background

Despite its relatively small share in the total GDP (2%), agriculture is an important sector in the South African (SA) economy. Its economic importance is justified by the contribution to formal employment (5%), the earning of foreign revenue through its positive trade balance, as well as backward and forward linkages with the manufacturing sector. Backward linkages exist in the form of purchases of goods including fertilisers and implements, whereas forward linkages are established through the manufacturing of food and fibre based products (Matsei, 2020).

The agricultural sector's contribution to the total GDP is highly dependent on the performance of the relative sub-sectors. When farmers are doing well, positive impacts can be expected for agro-processing and the demand for goods produced in the non-agricultural sector.

The cotton sub-sector also contributes to the economic development of the country through contributions to agricultural GDP and employment at different levels of the value chain, from production to processing, distribution and trade. Cotton production in SA has a long history – it commenced as early as 1690 and was largely planted in Natal (Zululand) and the Cape Colony in response to high demand for cotton fibre between 1860 and 1870 (CottonSA, 2015). Cotton production almost came to a halt after 1870 but picked up at the beginning of the 20th century (CottonSA, 2015).

The biggest expansion in cotton area of the 20th century, occurred between 1920 and 1924, following the formation of the Union of South Africa[1] as cotton was central to national agricultural priorities. The prioritisation of cotton in national agriculture was signalled by the formation of the Tobacco and Cotton Division, which focused on extensive research (experiments) to determine suitable cotton cultivation conditions (Schnurr, 2011). The formation of the Tobacco and Cotton Institute[2] facilitated the establishment of the Rustenburg experimental station in 1913 (Randela, 2005; CottonSA, 2021). The results of the experiments showed that cotton production is correlated to heat exposure and susceptible to wind and frost damage; therefore, recommending the northern parts of the country as the centre for cotton production (Schnurr, 2011).

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[1] The formation of the Union of South Africa in 1910, marked first the unifying of the Dutch and British settler groups, followed by the amalgamation of the four different colonies Cape, Natal (Zululand), Transvaal and Free State (Government, 2020), forming the new Department of Agriculture (Schnurr, 2011). The consolidation of the Union, the 1910 and 1920 decades were crucial periods of government intervention in agriculture, through the provision of capital and credit, dissemination of improved production techniques and the subsidization of inputs (Schnurr, 2011).

[2] The Tobacco and Cotton Institute is currently known as the Industrial Crop Institute of the Agricultural and Research Council (ARC) ((Randela, 2005).

At the inception of the Union, Zululand was a traditional sugar-producing region; however, most producers switched to cotton due to increased competition with foreign markets, specifically from Mozambique and low producer prices (from £46/ton in 1920 to £29/ton in 1929) as a result of overproduction globally (Schnurr, 2011).

In the period between 1919 and 1924, cotton yields, mainly in Zululand more than doubled, giving the best yields in Southern Africa. During these years average yields ranged between 0.36 and 0.46 tons/ha, supported by dry conditions in the harvesting season, availability of labour and the absence of insect pests. Dry conditions prevailed in the first few growing seasons following the prioritization of cotton in Zululand and having implemented mixed farming and grazing initially, most growers were convinced that cotton, being a drought-resistant crop was the most viable alternative to sugar and cattle rearing[3] (Schnurr, 2011).

By 1925 Zululand's cotton situation changed, cotton yields decreased by more than 80% on average in the next three years, while production costs ballooned by 38% between 1925/26 and the 1926/27 production seasons. Zululand's cotton bust (1925-1927) resulted from a combination of ecological and logistical factors, including drought as cotton was mainly grown on dryland and irregular rainfall patterns resulting in floods occurring at a time when most of the cotton crop had already matured. Overall losses of the crop to floods were estimated at 80% which were inclusive of losses on the field and those resulting from the inability to transport whatever that was left of the crop due to impassible roads (Schnurr, 2011). As a result, increasing debt, stock and crop losses led to the liquidation of cotton operations and/ or the desertion of cotton lands (Schnurr, 2011).

Cotton was grown for the first time under irrigation in 1927, in the Lower Orange River region. By 1935, four ginneries were operational in SA and at this point, cotton lint was exported to Liverpool for further processing given that SA had not yet developed spinning and weaving facilities (CottonSA, 2021). In 1939, cotton was officially declared as an agricultural crop, according to Section 102 of the Co-operative societies Act[4] (CottonSA, 2021).

Figure 1.1 shows the trends in cotton area post the formation of the Union of South Africa and subsequent prioritisation of the crop in SA. The change in cotton production over the years is largely attributed to the prevailing market structure in addition to ecological factors, specifically in the period 1948-1994[5] and post 1995. Between 1948 and 1994, agricultural markets were regulated by the state, with significant interventions in commercial agriculture through the provision of subsidies, protection from international markets and marketing of agricultural commodities (Van Zyl, et al., 1987; Van Zyl, et al., 1992). For the cotton industry, in particular, the Cotton Board was responsible for the regulation of the industry and marketing of the cotton crop on an import-substitution framework. As a result of state intervention in the cotton market, production picked up in the 1950s and 1960s (Figure 1.1) albeit showing great variation between the late 1960s and 1970s decade.

[3] Farmers moved from cattle farming, towards cotton production due to risks of disease spreads by tsetse fly (Schnurr, 2011).

[4] Act 29 of 1929 (CottonSA, 2021).

[5] The period of the apartheid era.

While the apartheid system (1948-1994) protected the local industry from global competition and was successful in developing storage and logistics infrastructure for the agricultural sector, it was not without distortions and inefficiencies (UNCATD, 2009). For example, in the 1980s, changes in farm policies[6] led to significant impacts on the agricultural sector, while the sector became more flexible in some regions of the country, the increase in farm debt was of increasing concern to farmers elsewhere as debt repayments became the biggest cost component for commercial farmers (Kirsten, et al., 1994).

For the cotton sector, the effects of these changes in agricultural policy were reflected by changing land-use patterns from 1981 until 1988. This is shown by the decrease in the area planted to cotton between 1981 and 1984 (Figure 1.1) due to relative product prices and factor costs, farmers' cash flow position and changes in taxation[7] (Kirsten, et al., 1994).

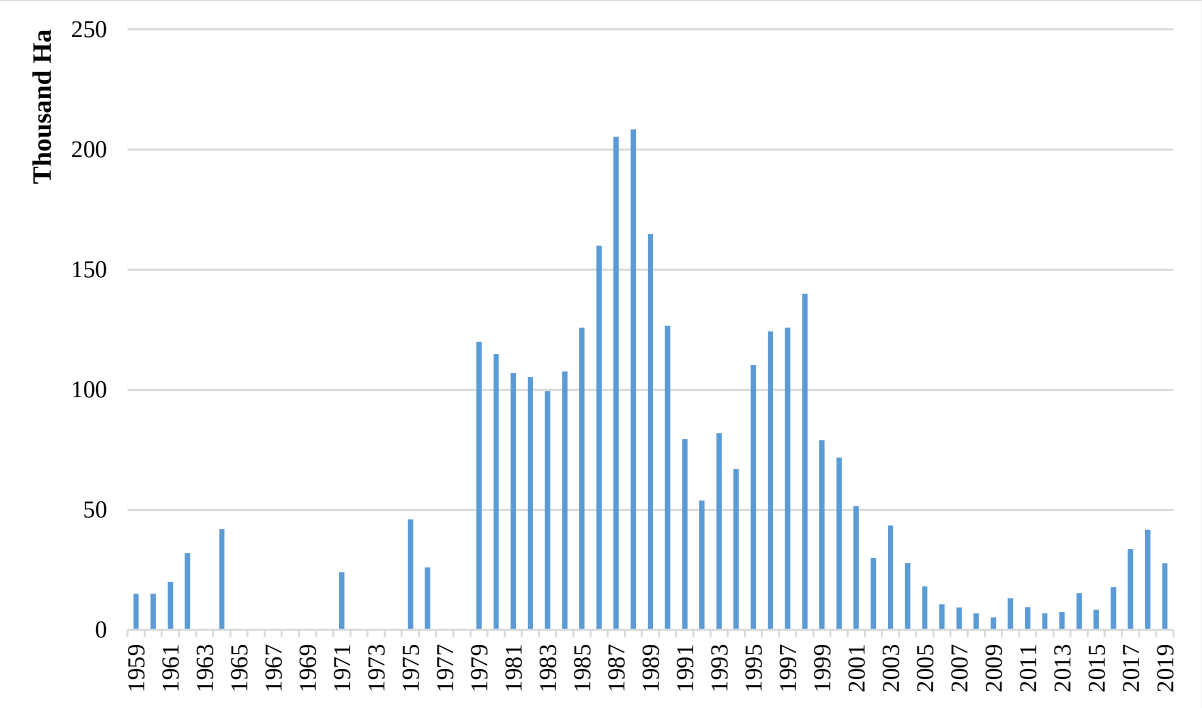

Figure 1.1: SA Cotton Area over time

Source: CottonSA Statistics, 2020

Having performed well historically under the regulation of the state through the Cotton Board, with the total area reaching a maximum of 208 thousand hectares in 1988/89 according to

[6] Prescribed by the White Paper on Agricultural Policy (1984), which put emphasis on the development of agriculture by utilizing factors of production in ways that will sustain/maintain optimal economic, political and social development. The objectives of the paper were to be achieved through various production and marketing goals (Kirsten, et al., 1994).

[7] Prior to changes in the tax policy in 1980, farmers were allowed to depreciate assets entirely within the first year of purchase for tax purposes but tax concessions were later reduced, allowing for the depreciation of assets over three years, at 50%, 30% and 20% per annum (Kirsten, et al., 1994).

CottonSA (2020) statistics[8], cotton production has been characterised by decreasing and low hectarage from the late 1980s and especially over the past two decades (1998-2018) (Figure 1.1). The volatility in cotton production is attributed to structural changes in the agricultural sector and markets. First, agricultural liberalization following financial liberalization in the early 1980s, which saw a reduction in government support and price control. Subsequently, the most substantial structural reform occurred in 1994 with the transition to a democratic Government, which brought some changes in SA agriculture to overcome the legacy of the apartheid system[9] by developing an inclusive agricultural sector (UNCATD, 2009). As a result, agricultural markets were deregulated in the mid-1990s. This brought significant changes in the agricultural sector through reductions in import tariffs and state support to commercial agriculture, as well as the removal of export control measures. The transition of the agricultural sector was administered through the Marketing Act of 1996, to increase market access for all participants of the sector, promote the efficiency of agricultural marketing, optimise agricultural export earnings, and enhance the viability and resilience of the sector overall (UNCATD, 2009).

Following the reform of the agricultural sector in 1996/97, the Cotton Board was dissolved in 1998 (DAFF, 2019), transitioning the cotton sector from a protected market where local cotton production was procured by the state irrespective of the quality available, to an open market system whereby the local industry competes with the global market through imports.

The transition of the cotton market from a protected system offering both production and price support to a free market system that only supports farmers under strictly defined parameters is the biggest contributor to the decline in the SA cotton area over the past two decades (1998-2018). In addition, literature has attributed the dwindled cotton area to irregular climatic conditions (Gouse, 2006; CottonSA, 2019), price volatility in the world market (Gouse, 2006; Malinga, 2019; CottonSA, 2019), the profitability of cotton relative to substitute crops such as maize and sunflower (Randela, 2005; Gouse, 2006; Malinga, 2019); as well as, the competition of the local industry with textile imports from low cost producing counties (CottonSA, 2019; De Klerk, 2002; Malinga, 2020).

A variety of initiatives have been implemented in response to challenges faced by producers and the overall industry, to improve cotton production and sustain the local industry. In the period between 1989 and 2012, the South African government, specifically the Department of Trade and Industry (DTI) implemented import control measures (tariffs and quota) but the effects of these measures were limited by the existence of bilateral trade agreements, such as the SADC Free Trade Area[10]. In addition to trade protection measures, the DTI funded a five-year business plan in 2013, aimed to develop the cotton textile and apparel sector. This intervention was initially called the National Cluster for the South African cotton textile and

[8] CottonSA crop estimates are generated from monthly ginners' reports (crop reports and cotton returns), the data is aggregated before publication to maintain confidentiality of the ginners. These records are inclusive of both large-scale and smallholder production.

[9] A dual agricultural sector inclusive of well-developed commercial farming and smallholder subsistence farming (UNCATD, 2009)

[10] Import quotas on textiles from low cost producing countries have shown to be ineffective as importers compensated for this through increased imports from other low-cost countries (van Eeden, 2009)

apparel sector, the initial objective of the cluster being to build and improve capacity in the cotton value chain for sustainable textiles and apparel. The cluster was subsequently amended to include only cotton-growing interests, thus changing to the Sustainable Cotton Cluster (SCC) (CottonSA, 2019). The SCC follows a holistic value chain approach, directed at issues of access to credit, machinery, and retailer commitments to local cotton sourcing (Claassens, 2019; Aucamp, 2019).

1.2 Problem Statement

Following a drastic decline in the local cotton area, from above 200 thousand hectares in the 1980s to 5 thousand hectares in 2008/2009, the cotton area grew by 34%, reaching a high of about 38 thousand hectares in the 2018/19 production year and seemingly indicating a revival in the local cotton industry.

In the 5 years, 2014-2018, the global cotton price was moving on a positive growth path with a growth rate of 4%, and a weaker exchange rate resulted in considerably higher seedcotton prices for SA producers. In addition, during this same period, the SCC interventions were being implemented, likely contributing to the growth in the cotton area between 2014 and 2018. Between 1994 and 1999 there was also an observed upswing in cotton hectares planted, but this was not sustained. It is thus important to understand the determinants (drivers) of the changes in cotton production, to ensure the sustainability of the sector in the long-run, particularly given the discontinuation of SCC in 2019. Therefore, it is important to evaluate the effectiveness of the SCC pending its renewal.

This study seeks to analyse the effectiveness of the SCC interventions in reviving the cotton industry and to contrast it to the role that improved world cotton prices played. The success of SCC interventions in re-building the cotton industry could serve as a benchmark of success and a model that other industries can consider following, it could also warrant the extension of cluster initiatives over a longer time frame. On the other hand, if industry growth was just driven by higher producer prices emanating from stronger global markets, what measures can be implemented to maintain producer confidence in the industry if prices were to decline again?

1.3 Purpose Statement

This study aims to explain the underlying causes of the apparent turnaround in the SA cotton industry by analysing the link between the domestic and global cotton markets and the transformation in the local value chain through the introduction of the SCC interventions. The main goal is to determine the relative contributions of global prices and the SCC on changes in cotton area.

1.4 Research Objectives

To evaluate the relative contributions of changing institutions versus world market dynamics in driving the turnaround observed in the cotton industry in the years between 2014 to 2018, this study has two core objectives:

i. Determine the relationship between the local and global cotton markets to quantify the extent to which international cotton market dynamics spill into the South African market.

ii. Determine the elasticity of response in cotton area to both changes in cotton revenue and the introduction of the SCC.

The study employs the Engle-Granger (1987) procedure to achieve objective (i) and the Autoregressive-Distributed Lag (ARDL) cointegration methodology to attain objective (ii). Cointegration models are best suitable for this study given their benefit of providing both long-run and short-run effects.

1.5 Study Outline

Following this introductory chapter, Chapter 2 provides context on cotton markets, through an overview of the global, continental, and local cotton markets. It also provides a breakdown of the shifts in cotton production (area) and processing, along with an overview of the various interventions implemented to revive the local cotton industry, including aspects of the SCC. Chapter 3 introduces the topic of price formation and pricing dynamics to describe the link between the international and the local market. Chapter 4 is focused on the supply response to changes in the domestic market and value chain, which contributed towards reshaping the industry. In conclusion, chapter 5 provides recommendations for the industry, based on the quantitative analysis.

CHAPTER 2

PERSPECTIVE ON THE SA COTTON SECTOR

2.1 Introduction

Cotton is one of the most widely grown agricultural and industrial crops, cultivated by more than 100 countries in the world, and annually covering about 2.5% of the world's arable land. This makes it one of the most important crops after soybeans, maize, wheat, and rice in terms of land use (ITC, n.d.; Townsend, 2018). Cotton is exported by about 150 countries; hence it represents an important source of foreign exchange earnings, in addition to its significant share in GDP. Because of its important role in world trade and many developing economies, cotton is a very political crop. It is a vital cash crop, which also serves as a catalyst for industrialization and rising social welfare and cotton industries are central to economic growth for developed and developing countries. In addition, cotton cultivation contributes towards sustainable and socially responsible development through food security and improved livelihoods in rural areas of developing countries (ITC, n.d.).

As a precursor to the empirical analysis, this chapter provides background on the dynamics of the international cotton market from 2000 up to the period of higher cotton prices (2014-2018). In addition, it introduces concepts of the SCC and how these are thought to have contributed towards the increased area under cotton between 2014 and 2018. Considering the research objectives, this chapter is key to understanding how attributes of the world market play a role in determining market factors locally (for example price, the scale of production, production methods, trade etc). Moreover, introducing aspects of the SCC provides a theoretical context on how the sector has responded to the intervention by analysing the trends in cotton area, cotton production and processing, as well as imports of cotton products before and during the period of the SCC.

2.2 International and Regional Context

The global cotton market is largely driven by demand for its use in the textile and apparel industries. The worldwide demand for cotton is a major determinant of market prices. It is therefore also this demand that determines whether cotton will be grown in competition with other crops (Moodley, 2003). The demand for cotton in the global fibre industry has been affected negatively by the rapid expansion in chemical/synthetic fibres, mainly polyester given advancements in technology and subsequent reductions in production costs (Baffes, 2005).

2.2.1 Global fibre demand

Cotton is the most common natural fibre of the 19th and 20th centuries (Baffes, 2005). The use of cotton expanded significantly after the introduction of cotton ginning and the first industrial revolution, which reduced the costs of producing textiles (Baffes, 2005). The demand for cotton fibre increased relative to the increase in the global population, between 1960 and 2000, while the consumption of other natural fibres, specifically wool remained stagnant. However, during the same period, the global consumption of chemical fibres grew by 4.7% annually, which led to a decline in cotton utilisation in comparison to synthetics. As a result, cotton represented a global share of 38% in total fibre consumption by 2000, compared to 68% in 1960 (OECD, 2006).

According to Terhaar (2012), the demand for cotton rose at least at the pace of overall fibre demand between 2000 and 2010 but was suppressed by the global economic crisis (2007-2008) and volatile global food prices (2011). Terhaar (2012) also argued that the share of fibre consumption (from the consumer's perspective) in an economy is influenced by the stage of economic development. This is a phenomenon described as the 'natural cycle of fibre consumption, which implies that in the early stages of economic development, the consumption of synthetic fibres is more dominant but this cycle changes as consumers of the growing middle class expresses their preferences by shifting towards natural fibres (Terhaar, 2012).

By analysing consumer preferences in countries with developing (for example, India and China) and well-developed economies (US and UK) textile and apparel industries, it was discovered that factors such as quality, colour, price, style, durability and finishing influence purchasing decisions. Consumers also consider the environmental footprint of textiles, and they view cotton as an environmentally friendly fibre. In addition, most consumers prefer clothing made of cotton or cotton blends (85%) and presumed that cotton fibre is suitable for today's fashion (81%). Thus, fibre content is an important attribute for consumers in some of the rapidly developing markets globally (Italy, India, Brazil and China) (Terhaar, 2012). In addition, the preference for cotton products is indicated by the fibre allocation of total apparel offered by retail stores. In these countries, between 80-85% of cotton products are available for sale in retail outlets and consumers are aware of these products. Cotton products have the highest presence in these markets given vast retail outlets (mass merchants, chain stores, department stores and speciality stores). There also exists opportunities to replace products made from synthetic material (for example swimwear) by making these available in cotton fibre as the customer base expressed their preferences (driven by the notion of comfort and durability) for pure cotton apparel (Terhaar, 2012).

Terhaar (2012) further indicated that although the cost of cotton is not a determining factor for consumers in developed countries, consumers in developing countries spend a larger portion of their income on food (40% in China and 50% in India), therefore having limited disposable income; thus, food prices have a greater effect on cotton consumption. Johnson et al. (2015) also stressed that man-made fibres have replaced cotton in most industrial applications but the utilisation of cotton at the spinning level is driven by the utilisation of cotton by households through clothing purchases. Clothing is purchased to update or build up on inventories in contrast to food which is a daily need implying that clothing purchases are responsive to income changes in the short run.

The factors highlighted by Terhaar (2012) and Johnson et al. (2015) indicate that there is a demand for cotton in the global market but this is dependent on the consumer's knowledge of such products, the affordability (disposable income and cost) for these products, the availability (if these products are readily offered in distribution centres); as well as, the consumer's perception of cotton's environmental impact (in comparison to man-made fibres). Although synthetic fibres overtook cotton in the global fibre market, since the mid-1990s, there are opportunities in replacing products made from synthetic fibres with cotton or cotton blends. These are important issues to consider, first for the textile and apparel industry in SA (utilisation of cotton), secondly in enhancing the demand for South African cotton products (market opportunities in both SA and the world). The demand by spinners (utilisation) is driven by the demand (utilisation) by consumers (for cotton products).

2.2.2 Global price dynamics

A period of low global prices

Between 2000 and 2008, international agricultural commodity prices increased. The sharp spike in international market prices was primarily a result of two events/factors, the introduction of bioethanol blending mandates in the US and strong economic growth, which supported meat demand and hence feed grain demand in China. During this period, the World Bank index of nominal food prices increased by 147%; however, cotton prices only increased by 21% (Baffes, 2010). Cotton prices did not increase much during the commodity price boom compared to other agricultural commodities for several reasons. According to Baffes (2010), subsidies received by cotton growers encouraged more production than would have taken place without the support. Secondly, given that the spike in food prices was in part attributed to the growth in demand for agricultural commodities to produce biofuels, the direct impact of the demand was seen only for maize, sugarcane and some edible oils but the indirect impact was seen for almost all food crops given strong substitutability on the input (land use[11]) and output side (i.e edible oils[12]). For cotton, the indirect impact is limited as it is not substitutable with any other commodity on the output side while the input substitutability is limited. Lastly, cotton consumption underwent a sharp decline during the global recession (2008-2009), implying that cotton did not experience the same demand pull as other commodities (FAO, 2021).

It is also important to note that India and China experienced a rapid increase in cotton production following the commercial release and adoption of genetically modified cotton in the years 2002 to 2007 (Baffes, 2010) which suppressed prices on the international market. During this period cotton output in China increased by 56% from 5.2 to 8.1 million tons, while production in India grew by 127% an increase from 2.3 to 5.2 million tons.

[11] Shifting land from one crop to another
[12] Substitutability in consumption

The global cotton price, termed the Cotlook A-Index is a representative of the level offering prices on the international raw cotton market (CottonOutlook, 2022). According to CottonOutlook (2022), the A-index is calculated as an average of the five cheapest quotations [13] from a selection of upland cotton traded in the world market[14].

Figure 2.1 presents the international cotton price trends over time. The international cotton market continued to experience low prices in the 1990s, but this trend reversed in 2010 when cotton prices were driven higher after most of Pakistan's cotton crop was demolished by floods. In the same period, India restricted lint exports to depress their domestic prices. As a result, the shortage in world cotton stocks resulted in a price peak above 2 U.S. dollars per pound (Bennet & Greenberg, 2011).

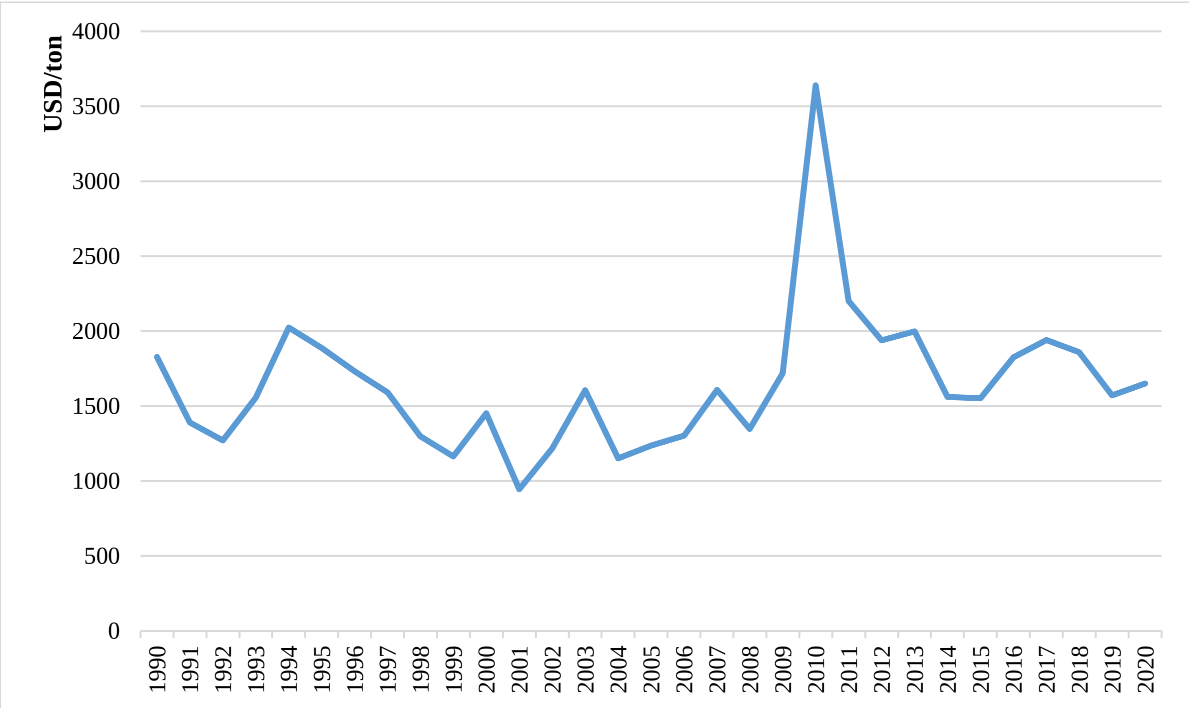

Figure 2.1: Cotton world price (A-index)

Source: OECD FAO, 2020

The changes in China's agricultural policy between the late 1990s and 2011 are important in explaining the volatility in international cotton prices. Being the world's largest cotton consumer, importer and stockholder imply that the world cotton market revolves around China, in many respects.

Until the late 1990s, domestic cotton prices in China moved below the equivalent international reference cotton price (A-index). This was indicative of a taxing policy rather than a

[13] The geographical basis of these quotations is the Far Eastern markets, with only two African Franc Zone origins featuring in the calculation, countries are added or withdrawn from the selection on the provision of notice of intentions as cotton quality and availability change (CottonOutlook, 2022).
[14] This method is a used as a means to identify growths which are most competitive and thus likely to be traded in larger volumes (CottonOutlook, 2022).

subsidizing policy for growers. Post the 1990s, China implemented price support measures in the cotton sector. A soft approach towards this policy commenced shortly after China acceded to the World Trade Organisation (December 2001). In 2011, a more formal policy approach was implemented by including designated minimum prices that are publicly backed by a guarantee of public stock acquisition (MacDonald, et al., 2015).

According to Johnson et al. (2015), the price support policy kept domestic prices at artificially high levels between 2011 and 2013, which also triggered a spike in the global price (Johnson, et al., 2015). Although it provided a protection mechanism for Chinese cotton producers against the volatile international market, this policy created many uncertainties for the rest of the world (MacDonald, et al., 2015). In China, farmer support increased significantly, resulting in more than expected cotton textile fibre production and thus higher stocks than normal. In addition, cotton production increased elsewhere, in response to higher international prices (between 2011 and 2013), resulting in higher than expected cotton fibre stock levels in the world (Mac Donald et al, 2015; Johnson, et al., 2015). As a result, China withdrew price supports to induce a reduction in international prices and dispose of surplus stocks. These movements in cotton stocks, relative to cotton prices are presented in Figure 2.2.

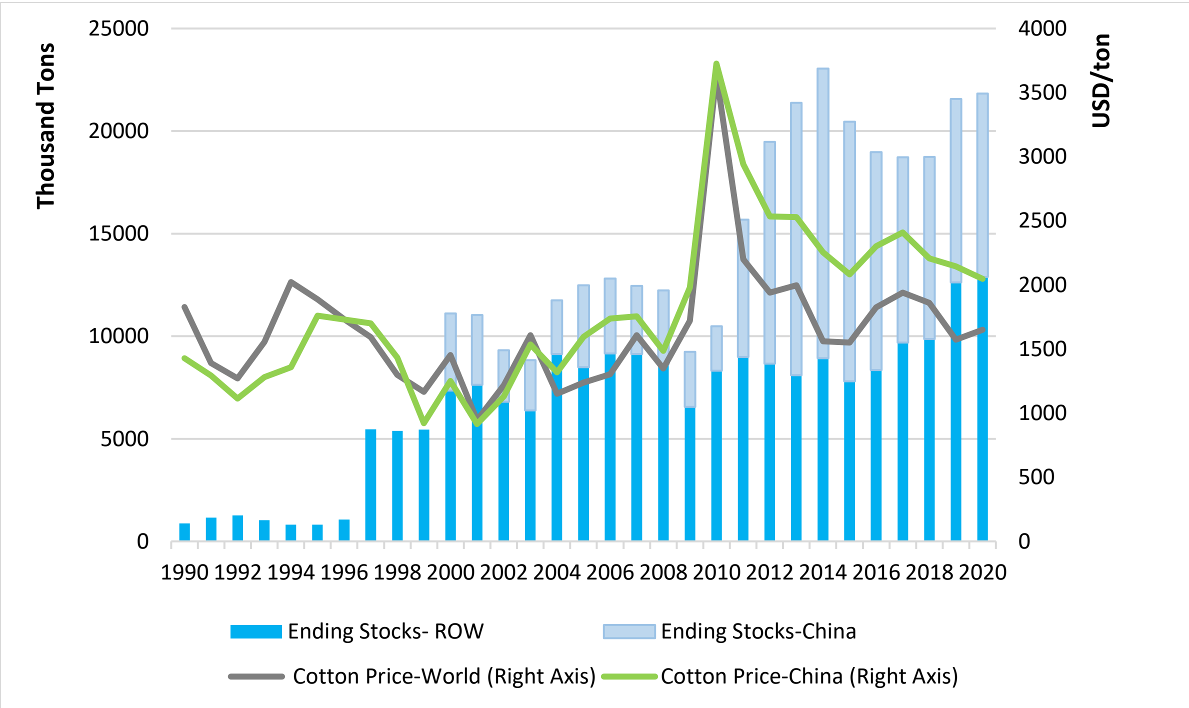

Figure 2.2: Rest of world (ROW), China cotton stocks and price movements over time

Source: OECD FAO Outlook, 2020

A Period of Revival in Global Prices

In recent years (post-2014 and until 2018), the international cotton price (A-Index) has shown some improvements. According to Cotton SA (2018), part of the observed improvements in the international price resulted from a decline in cotton subsidies[15]. According to the ICAC (2020), governments that provide support for domestic cotton sectors include China, the USA, India, Turkey, the EU[16], Colombia, and some countries in West Africa [17]. Direct assistance in cotton production reduced to 47% in 2017/18 (production year) from 75% in 2015/16, which supported higher international cotton prices. This is due to the negative correlation between subsidies and cotton prices. A consistent relationship observed in the past few seasons has shown that in years when prices are high, subsidies seem to decrease and when prices are low, subsidies tend to be higher. This is the case given minimum support price programs in main producing countries, which are triggered when market prices are below government intervention prices (ICAC, 2020).

The rise in cotton prices in 2018 in comparison to 2017 resulted from various occurrences in the international market. Although high cotton prices traditionally influenced the decision to plant, environmental conditions along with water availability were the main influencing factors. Speculative buying and steady international demand for quality cotton influenced prices in early 2018. By March (2018), prices spiked due to unfavourable environmental conditions and pest infestation in main cotton-producing countries. The largest global producer, India, reported the biggest loss after experiencing yield losses following pink bollworm infestations. Over the same period, drought and the shortage in irrigation water suppressed production in America and Australia (CottonSA, 2019).

Towards the end of the first 6 months of 2018, cotton stocks held in China declined while stocks elsewhere increased. Despite the growth in stocks outside China, the cotton A-Index was well above the long-term average of 70 US c/lb (86 US c/lb). The spike in cotton prices mainly resulted from global cotton stocks being well below than initially estimated by USDA levels in addition to production challenges in the US and China, driving the international market to new highs (CottonSA, 2019).

In the second half of 2018, global trade policy issues, through sanctions between the US, as the largest cotton exporter and China, as the largest consumer of cotton lint posed risks on the global cotton sector. Expectations of increased tariffs implemented by China, on various commodities, including cotton, combined with production declines in major producing countries worked against the growing demand for cotton in Asia and South Asia. The uncertainty in global trade policies had the potential to disrupt the stability of world economic growth and trade. Tight cotton supplies coupled with a growing demand helped in maintaining rising prices (CottonSA, 2019).

Trade tensions at the beginning of July caused a downward movement in cotton prices, however, the demand for cotton continued to grow, supported by the demand for cotton textiles in China and the narrowing gap between cotton and polyester prices. Although international cotton prices were moving downwards, polyester prices were increasing, narrowing the gap between the two commodities to 17 US c/lb by August 2018, compared to 35 US c/lb in July

[15] Including subsidies for inputs, storage, transportation, grading and marketing costs; boarder protection; crop insurance and minimum price support measures
[16] Greece and Spain as main cotton producers
[17] Burkina Faso, Côte d'Ivoire, Mali and Senegal

(CottonSA, 2019). Global cotton consumption was above cotton production for the fourth consecutive year, supported by global economic growth, import demand and spinning capacity, driven by Asia and South Asian economies, which account for two-thirds of global cotton imports. Between March and August 2018, China had already used 2 million tons from its state cotton reserves, leading to the lowest stock levels in the country since 2011/12 (CottonSA, 2019). This decline in stocks in China and the increase in import demand supported cotton prices.

Contrary to the earlier months of 2018, lower prices persisted towards the end of the year. The trade war between the US, China and Turkey intensified in September 2018, leading to the lowest international cotton price levels in 8 months. Cotton prices continued to decline into November and December 2018, ascribed to large arrivals of the season's crop; however, higher prices were tested as weather conditions restricted the availability of high-quality premium cotton from the US (CottonSA, 2019). Although the world cotton market was characterised by lower cotton prices towards year-end (2018), higher cotton prices persisted through the most of 2018, in comparison to 2017, ascribed to tight cotton supplies as a result of production difficulties through unfavourable weather conditions in combination with pest infestations supporting a growing demand given low stock levels.

The Cotton A-Index was lower by 16% in 2019, compared to 2018 due to unsettled trade negotiations between the U.S and China (OECD-FAO, 2021; USDA, 2019). Considering the period amid the global COVID-19 pandemic (2020), the world cotton price fell sharply between January and April, from 1726.22 USD/ton to 1330.05 USD/ton (USDA, 2020). Average monthly prices have since recovered and exceeded pre-COVID-19 levels, supported by the recovery in global mill use activities and in combination with other factors such as tightening supplies of the old US cotton crop (2019) and concerns with the availability of the new crop (2020). This recovery is also indicated on the graph (Figure 2.2) by the growth in the A-Index (by 5%) to 1650.47 USD/ton in 2020, from 1571.79 USD/ton in 2019 (OECD-FAO, 2021; USDA, 2019; USDA, 2020).

On the other hand, cotton production in 2019 was unaffected by the COVID-19 pandemic as harvesting was complete in most of the Northern Hemisphere countries and crops were well developed elsewhere at the onset of the pandemic. In addition, the pandemic had little impact on plantings in 2020, with lower production in Pakistan, the U.S, Greece, Mali and Turkey largely driven by pest and weather concerns. Although production was unaffected by the COVID-19 pandemic in the past two years (2019 and 2020), global mill use reduced significantly as operations were disrupted by lockdown restrictions at the onset of the pandemic. However, the length and extent of the impact of the temporary shutdown of spinning mills differ per country. With global production unaffected and the reduction (by 13%) in cotton utilisation by spinning mills in 2019, ending stocks were forecast higher (by 15%) compared to 2018 levels (Figure 2.2).

2.2.3 Cotton in Africa

A total of 37 African countries produce cotton, but Africa is a relatively small producer, contributing only about 7% to global cotton production (Amanet, et al., 2019). There are six cotton basins in Africa, consisting of 12 leading producers, the largest one, West Africa accounts for two-thirds of the continent's total production. This region extends from Senegambia in the west, to South-Eastern Chad to the east and ends in the heart of the Central African Republic (OECD, 2006). Eight of the twelve leading cotton-producing countries are in West Africa while the remaining four are distributed from the Nile Valley to SA (OECD, 2006).

Figure 2.3 shows African cotton production, along with its share in global production. Production showed a sharp decline in the aftermath of the world financial crisis but also increased by 16% between 2007 and 2011. The expansion in production was driven by increases in the area devoted to cotton. Higher cotton prices paid to growers between 2009 and 2010 combined with government subsidies for production inputs (fertilisers and pesticides) supported the expansion in the cotton area.

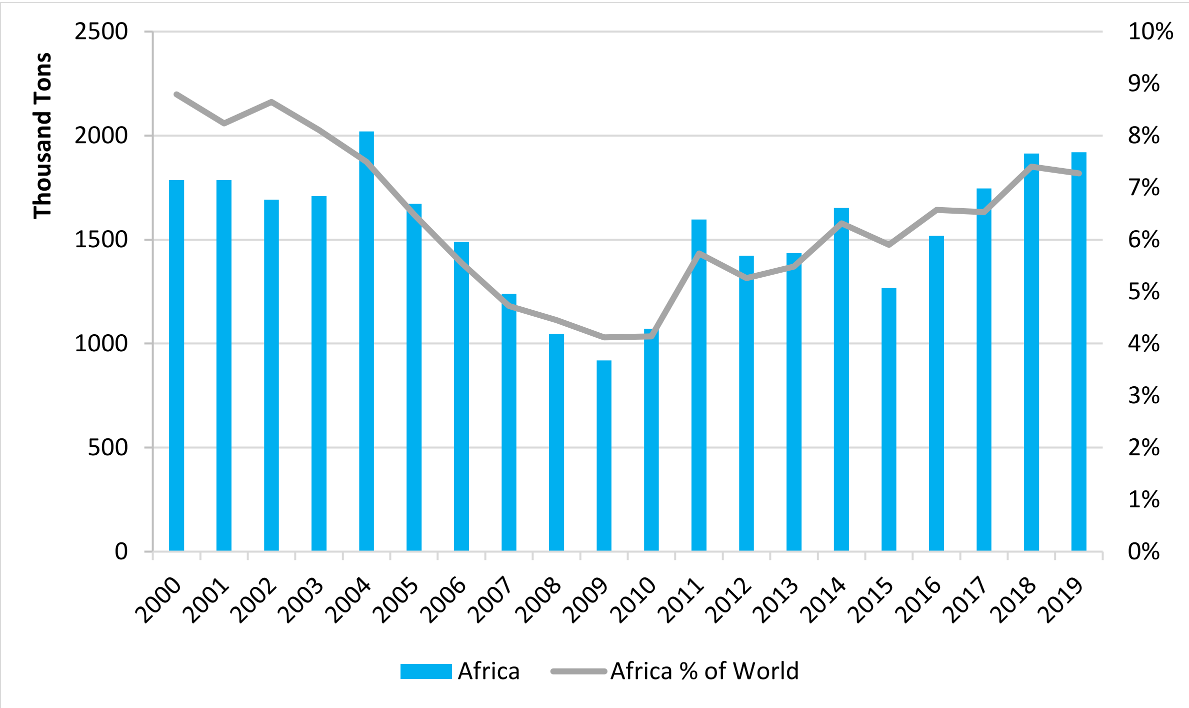

Figure 2.3: Africa cotton production and share in global production

Source: OECD-FAO Outlook 2019

A large portion of the cotton produced in Africa is destined for the export market – as can be seen in Figure 2.4. Cotton trade (imports and exports) was lowest around the period of the global financial crisis (2006-2010) due to low demand in the global market (ITC, 2013). Regional utilisation followed a declining trend before 2010 but shrunk the most (65%) between 2007 and 2010. Even so, Africa is a marginal player in cotton processing thus importing minimal quantities and exporting most of its production. For example, in 2011, cotton processing in Africa represented about 2% of the global mill consumption, which was still the case in 2019. Although Africa represents only a small portion of the global mill consumption, continental utilisation showed growth between 2010 and 2019 (3%). This growth (starting in mid-2010), was supported by the growing demand for apparel (Sub-Saharan Africa) procurement by EU and US retailers given rising production costs in China due to higher wages in comparison to Sub-Saharan Africa (largest textile and apparel industries in Africa) (Bennet & Greenberg, 2011).

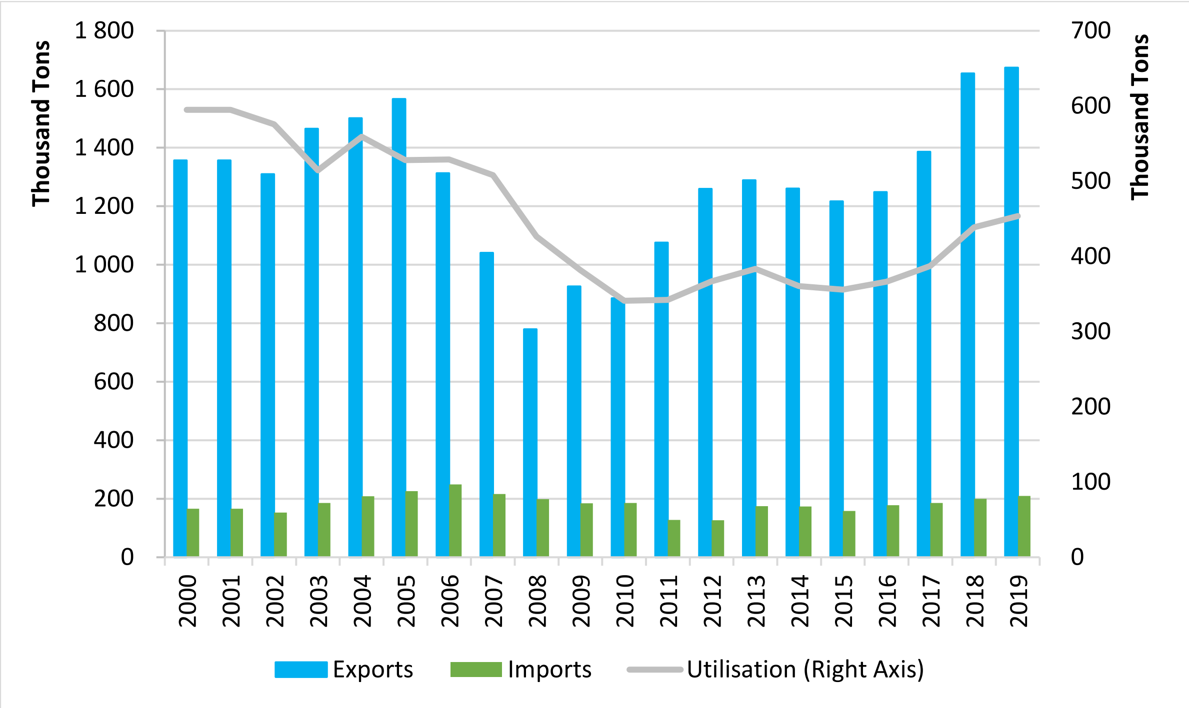

Figure 2.4: Africa cotton trade, production and utilisation

Source: OECD-FAO Outlook 2019

2.3 Domestic Cotton Situation - SA

Cotton's share in the SA fibre market has shrunk over time, declining from 70% in the 1980s to only about 19% of the total fibre consumption in 2018. Figure 2.5 illustrates the relative share of fibres in the local textile industry. The increased competition from imported cotton textiles, in combination with lower prices for synthetic fibres strengthened the synthetic market as the price for cotton, became relatively higher than that of synthetics (Bruwer, 2019).

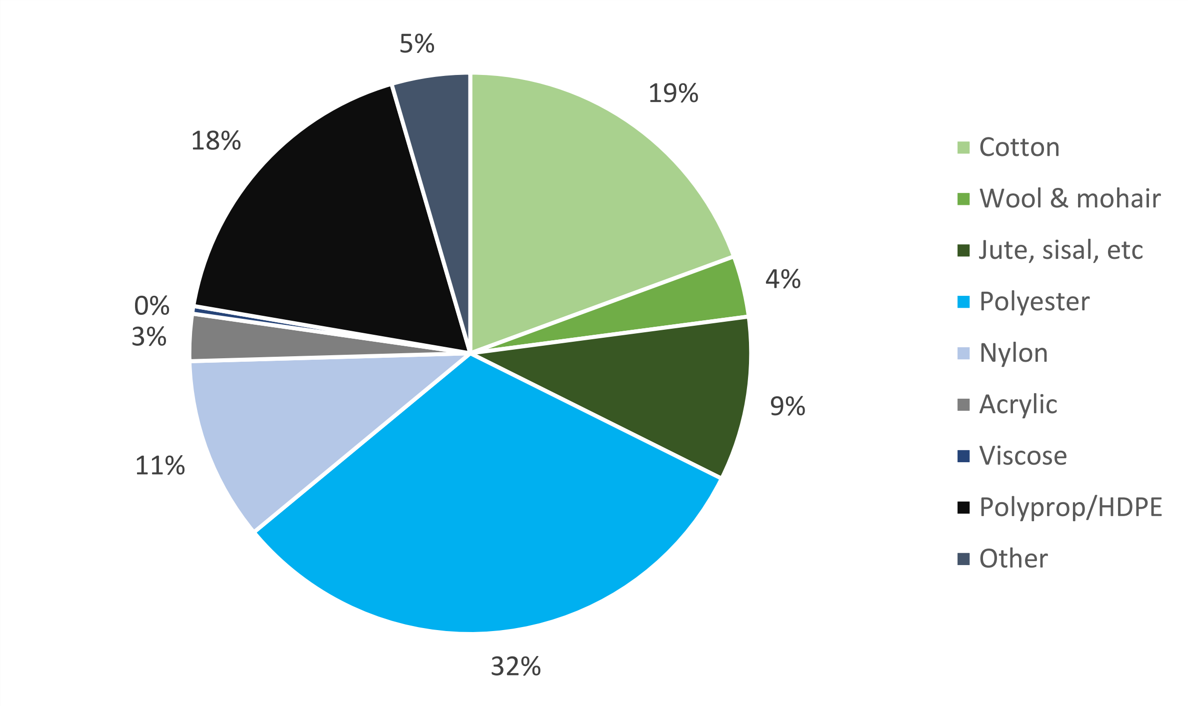

Figure 2.5: SA fibre consumption shares by type (2018)

Source: Cotton SA, 2019

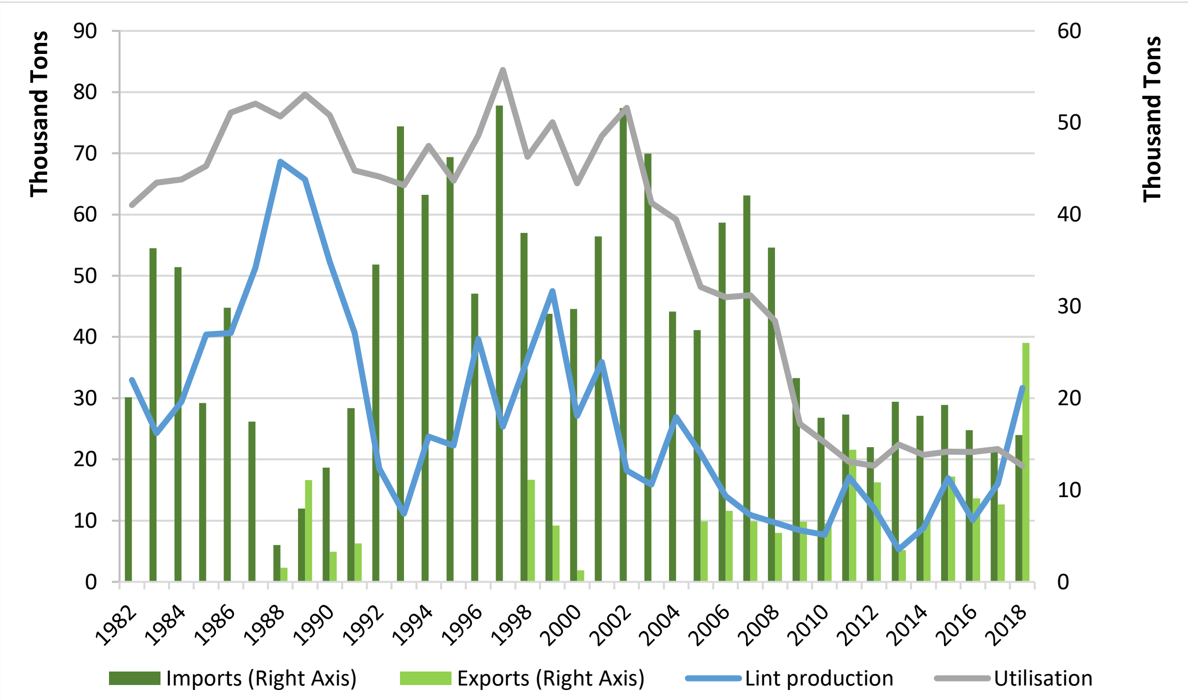

Figure 2.6: SA cotton production, imports, utilisation, and exports

Source: Cotton SA, 2019

Figure 2.6 above provides an overview of SA's cotton production, utilisation, imports and exports over time. As in the global scenario, local cotton demand is driven by the textile industry which uses cotton in the manufacturing of fabrics for clothing and textile apparel. Cotton utilisation entails the processing of cotton lint at spinning mills into yarn. Local mill use is reported as a total of local production and imports. A breakdown of cotton utilisation reported as consumption from Cotton SA statistics indicates that this is inclusive of locally produced cotton lint received from ginners, as well as cotton lint imports. The domestic utilisation of cotton has varied over time, showing the steepest decline between 2008 and 2010 (19%).

Although there is an existing demand for cotton locally (advocated by import levels), certain factors, both global and local have dampened demand (processing at textile mills) in the past. The textile industry expanded markedly after the Second World War, with major expansions taking place between 1950 and 1960. Textile activities primarily involved the manufacturing of blankets, rugs and sheeting but by 1960, the industry had expanded towards knitted fabrics (19 establishments); as well as, cotton-based yarns and fabrics (produced in 46 mills) (CottonSA, 2019).

The growth of the local textile industry gained momentum between the 1960s and 1970s but was only moderately sustained in the 1980s. With the escalation of imported textiles from 1988, imported fabrics represented 46% of the local fibre consumption. As a result, the local use of cotton fibre decreased between 1988 and the early 1990s, along with cotton production. During this period (1988 and 1993), the growth of the local textile industry through new investments in technology (upgrades) was hindered by the surcharge in textile imports (CottonSA, 2019). From an industry with several spinners, weavers and knitters in operation previously, many of these operations were closed given the increased competition from low-cost fabric, clothing and other finished goods. With a total of twenty-two operational spinning mills previously, only four spinners remained in the aftermath of the global financial crisis (between 2008 and 2010) and given increased competition from cotton fabrics (Claassens, 2017; Bruwer, 2019).

South Africa trades (imports and exports) cotton as part of bilateral trade agreements, such as the Southern African Community (SADC) Free Trade Protocol which was concluded in August 2000. Trade partnerships have also been extended beyond Africa, for example, the economic partnership agreement between SA and the EU, as well as with the USA through AGOA (Africa Growth and Opportunity Act) (2000). Preferential tariff treatment received through these international partnerships was limited to clothing - not inclusive of yarns, fabric and domestic textiles (CottonSA, 2019). AGOA apparel provisions were enacted in 2000, set to run for eight years but legislative revisions in 2007 and 2012 extended the provisions to 2015. Having completed the initial 15-year period, the legislation was extended further by 10 years, to 2025 on the 29th June 2015 (Tralac, 2015). Apparel provisions allowed for duty-free clothing exports to the US on stipulations that the products imported from SA were manufactured from raw materials originating from SADC countries. According to Bennet and Greenberg (2011), SA was considered by the US to be a developed economy therefore its apparel producers did not enjoy the privilege of duty-free nor quota-free access to U.S markets for apparel produced by fabric from anywhere else in the world through the "third country fabric" provision[18]. With the preferential treatment received under AGOA, SA clothing exports to the US grew (increase in cotton utilisation between 2000 and 2002; Figure 2.6), with SA occupying the highest share of exports in 2001 (25.7%) (Moodley, 2003).

The ascension of Southern African countries and SA to free trade agreements, especially within the region, for example, the SADC free trade area, as well as at an international level, such as AGOA supported the trade for cotton lint. Cotton imports and exports presented in Figure 2.6 are inclusive of processed cotton lint, primarily through the ginning process. While South African cotton exports occur at the ginning level, imports are recorded at the spinning level. SA was previously a net importer of lint but has moved to a net export position in 2018. The trend in exports from Figure 2.6 indicates that exports were only sustained from 2005 onwards. Cotton exports from SA are destined for various regions of the world, including Africa, the Americas, Asia, Europe, and Oceania (DAFF, 2011). The main factor driving exports to other African countries is the issue of obsolete ginning machinery in some of these countries, which damages the fibre in the ginning process (Bennet & Greenberg, 2011). Cotton imports have declined in the decade between 2008 and 2018. Imports are received from the SADC region, mainly from Zambia, Zimbabwe and Eswatini.

Although FTAs have supported the trade in cotton lint and apparel between SA and the world, the removal of import duties on clothing to facilitate these agreements in 2002, led to issues with illegal and under-valued clothing imports thus contributing to the closure of several clothing manufacturing companies between 2003 and 2008 due to low productivity (CottonSA, 2019). The effect of clothing imports on productivity at the mill level and the resulting closure of companies is indicated by a dip in utilisation between 2003 and 2010 (Figure 2.6). Additional closings of some manufacturing entities followed during the height of the global economic crisis (2008 to 2010), further contributing to the contraction of the textile industry (CottonSA, 2019).

To counteract the competition faced by the local cotton industry as a result of textile and clothing imports, the Department of Trade and Industry (DTI) within the South African government, instigated a tariff control in combination with assistance programmes to stimulate growth in the SA industry. These programmes were initially introduced in 1989, and are mostly export-orientated. These included the Structural Adjustment Programme (SAP) and the General Export Incentive Scheme (GEIS) (CottonSA, 2019).

Having resulted in fraud and due to inadequate customs control under the SAP causing destruction within the domestic textile and clothing industries, this programme was replaced by the Duty Credit Certificate Scheme (DCCS) in 1994[19], which offered a customs duty credit as an attempt to encourage and reward export performance (CottonSA, 2019).

[18] The third country fabric provision was used by other Sub-Saharan countries including Lesotho, Swaziland, Mauritius and Madagascar, supporting significant growth in their pparel manufacturing industries (Bennet & Greenberg, 2011).
[19] The DCCS ended in April 2005 (CottonSA, 2019).

The DSCCS was followed by the Long-Term Strategy for the textile pipeline in 1995, a phase-down tariff implementation plan over eight years. The goal of the long-term strategy was to remodel the textile and clothing industries to increase efficiency and competitiveness. This plan was executed through calls for capital investments, which were made after 1995, resulting in improved financial performance in some of the major companies in the industry (CottonSA, 2019).

Even with the attempts to regrow the local textile and clothing industry, clothing imports still posed a risk to domestic fabric and clothing production. The biggest disruptor of the domestic textile and clothing industries was low-priced clothing imports and household textiles from China. In response to requests for safeguards against these imports by the local textile and clothing industry, the DTI introduced import quotas on certain clothing and fabric from China, starting in January 2007. The quota restrictions only benefited the knitting sector, with limited benefits for the rest of the industry due to changes in sourcing patterns for clothing imports in 2007 and 2008, as imports from China were replaced by imports from other low-cost exporting countries. Also, fabric imports increased to about 65% in 2011 (CottonSA, 2019).

2.3.1 Overview of the SA Cotton Value Chain

This section provides an overview of the cotton value chain from production to processing and consumption (final goods), the actors (buyers and sellers) involved in the exchange of the product at each value chain node, as well as the agreements of exchange. Figure 2.7 includes a summary of the domestic value chain structure, along with the various stakeholders. Marketing conditions as set by industry stakeholders determine the flow and the ownership of raw materials through different stages of the value chain. Pre-1996, the Cotton Marketing Agreement (1975) stipulated the marketing conditions for lint and seedcotton. However, free-market principles have been applied post-1996, in consideration of the Marketing of Agricultural Products Act 47 of 1996. The marketing of cotton and cotton products is discussed in more detail in section 2.5.

Figure 2.7 below provides an overview of the domestic value chain structure. The cotton industry is divided into different segments that represent the cotton supply chain. Each level is connected to the next, to ensure supply continuity and consistent quality (CottonSA, n.d.). The different role players hierarchically are:

- Input suppliers- seeds, fertiliser, machinery etc
- Growers
- Ginners
- Spinners
- Oil pressers

Seedcotton is the raw product grown and harvested in the fields by farmers. The average cotton yield recorded by Cotton SA for the 2018/19 production year was 3.08 tons per hectare. From the farmlands, cotton undergoes a step-by-step transformation through an exchange from one value chain role player to the other.

Seedcotton is processed into lint and cotton seed through the ginning process. Typically, one metric ton of seedcotton yields between 350 and 400 kilograms (kg) of cotton lint and between 600 and 650 kg of cotton seed (Baffes, 2010; Bennet & Greenberg, 2011). Cotton lint makes up about 75 to 80 per cent of the value of seedcotton, while cotton seed makes up the remaining 20 to 25 per cent (Bennet & Greenberg, 2011). Further, the cotton oil extraction ratio is 17%, while the outturn ratio for cotton meal is 47%.

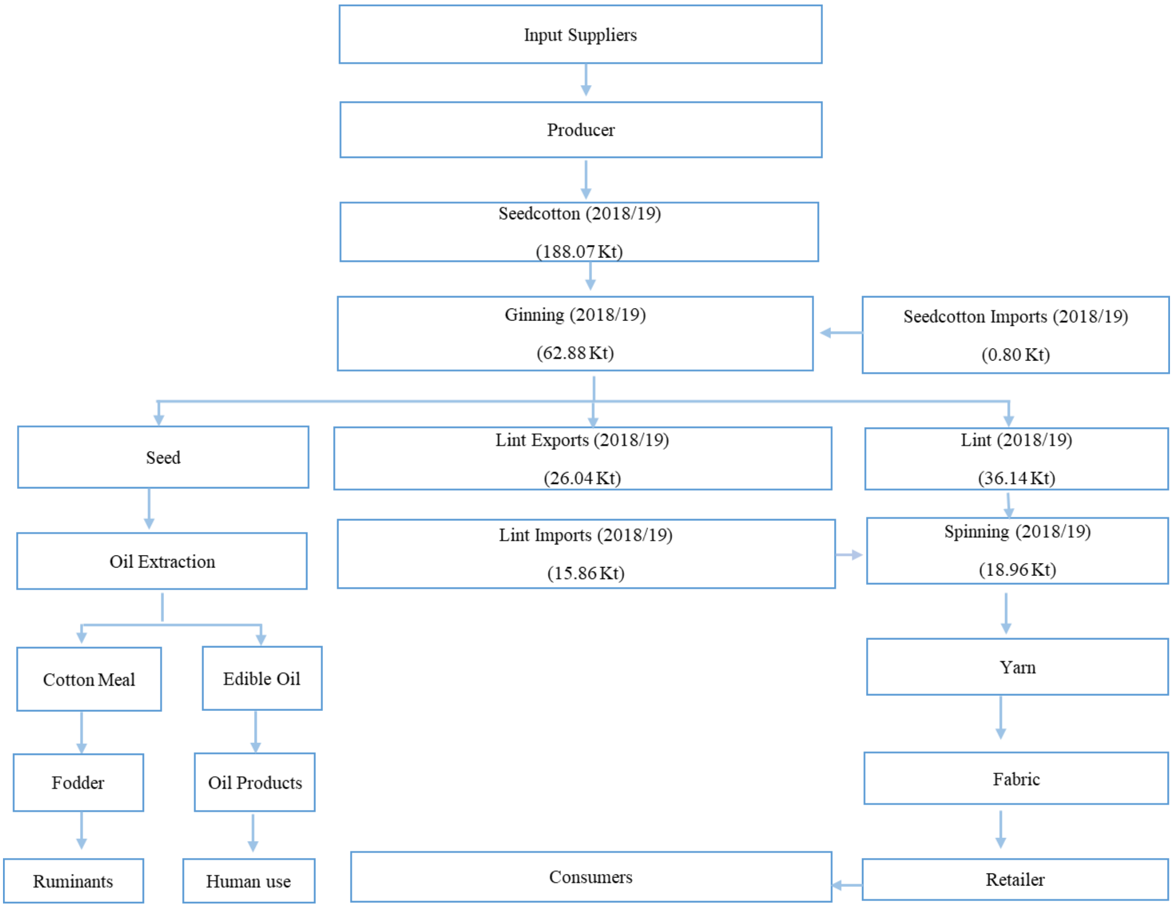

Figure 2.7: SA cotton value chain structure

Source: Cotton SA, 2018

Only government-certified cultivars can be grown in SA. Common cultivars grown in SA include DP1541 B2RF, DP1240 B2RF, DP 1531 B2Rf, CANDIA BGRF, PM 3225 B2RF, Delta 18 RF[20] (CottonSA, 2021) which are preferred in terms of yield, fibre length, strength, and macronaire; as well as, hardiness (DAFF, 2016). The statutory measure requires for

[20] DP1541 B2RF, DP1240 B2RF, DP 1531 B2Rf, CANDIA BGRF Cultivars are recommended for all production regions in South Africa
PM 3225 B2RF is recommended only Limpopo, Mpumalanga and KwaZulu-Natal for handpicking purposes
Delta 18 RF is a non-Bt cultivar, recommended for refugia areas (CottonSA, 2021)

registrations with Cotton SA by industry stakeholders to be done in terms of Government Notice No.199 of 28 March 2014.

As is the case with all other industries, the cotton value chain is governed by laws and organisations. Despite the facilitation of registrations for different role players in the cotton value chain, Cotton SA also plays an essential role as a representative of all role players within the cotton value chain. This non-profit company was created after the dissolution of the Cotton Board in 1997, under the Marketing of Agricultural Products Act of 1996 (CottonSA, 2019).

Essential functions performed by Cotton SA include (CottonSA, 2019):

- Dissemination of industry statistics and insight
- Promoting the production and utilisation of cotton
- Provision of research, training and implementation of quality standards to improve the market value of SA cotton
- Intermediary for the cotton industry
- Administering statutory measures in respect of the Marketing Act
- Smallholder cotton farmer development
- Governance of the SCC

In terms of Government Notice No.198 of March 2014, all industry participants (as listed above) are required to report monthly returns to Cotton SA.

Cotton SA collaborates with industry experts to provide cultivar recommendations on (CottonSA, n.d.):

- Cultivars with acceptable performance
- Planting dates
- Optimal plant populations per cultivar

2.3.2 Value chain nodes and processes

Value chain processes include production, ginning and spinning. The dynamics at consecutive levels of the value chain are discussed in detail.

2.3.2.1 Primary cotton production

Cotton production is mainly concentrated in five provinces, Limpopo, Northern Cape, North West, KwaZulu Natal and Mpumalanga. Although provincial production varies over time, it is mainly concentrated in Limpopo, with Mpumalanga contributing the least to total production. Production percentage shares for the respective provinces are illustrated in Figure 2.8. Cotton SA provincial production estimates from the 2017/18 production year indicate that the highest production occurred in Limpopo (47%), followed by the Northern Cape (41%) and North West (7%). The relative production shares in these top three provinces have since changed over the past two seasons (2018/19 and 2019/20), with increases in production in Limpopo and the

North West provinces, while the Northern Cape has shown a decline[21]. These changes in cotton production are attributed to weather conditions (too much or too little rain), hailstorms and pests. Moreover, in recent seasons, prices also played a role in the farmers' decision to plant cotton or to switch to food crops (i.e maize). The different production regions in each province are listed below.

- Limpopo (Loskop, Thabazimbi, Weipe, Springbok Flats)
- Northern Cape (Hopetown/Douglas, Lower Orange River, Vaalharts, Marydale/Prieska)
- North West (Taung, Stella/Setlagole)
- KwaZulu Natal (Makhathini Flats/Jozini)
- Mpumalanga (Tonga/Nkomazi)

Cotton is grown on both dry and irrigated land, except in the Northern Cape (only irrigation) and Mpumalanga (only dryland). The average domestic yields achieved in 2018/19 for the respective areas were 967 kg/ha and 4506 kg/ha. Most cotton growers practice machine picking; however, 1% of the total growers still practice handpicking, specifically in KwaZulu Natal and Mpumalanga areas (Bennet, et al., 2019). Once harvested, seedcotton is stacked into bales of 150 to 200 kg or collected in mass bins and subsequently transported to ginners.

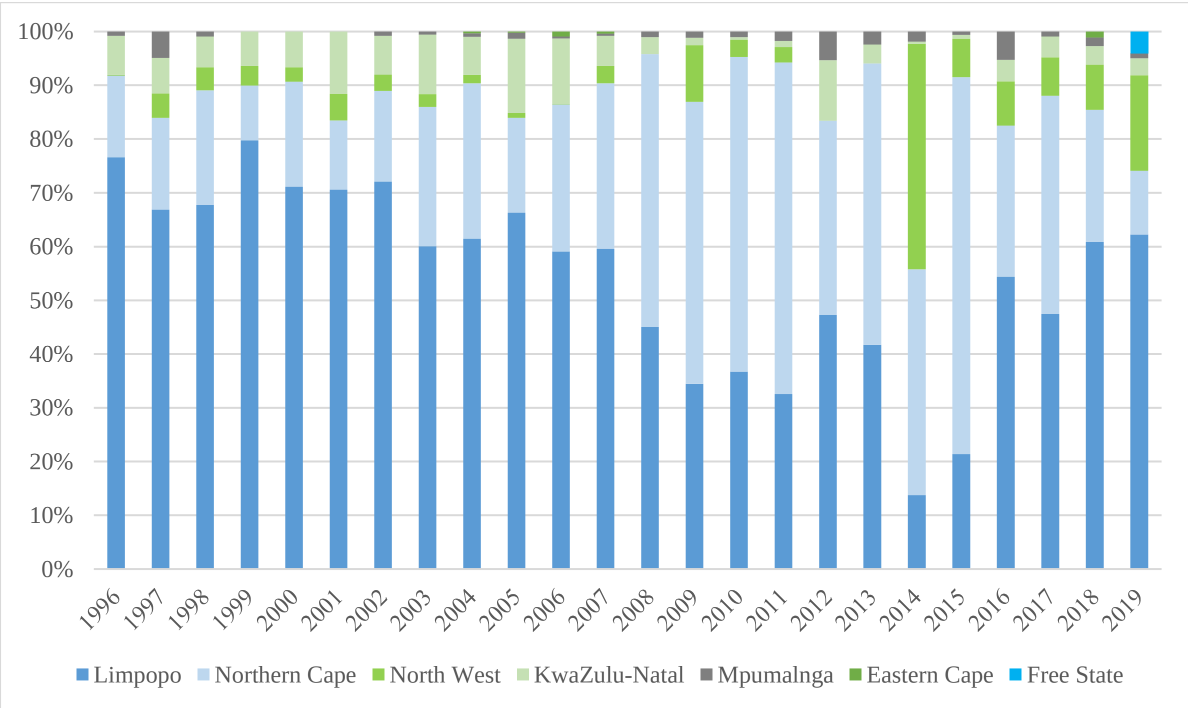

Figure 2.8: SA cotton production share per region

Source: Cotton SA, 2020

[21] The production shares for the 2019/20 production season are estimated as, Limpopo (62%), North West (18%) and Northern Cape (12%).

Total cotton production and the relative share per province largely fluctuates in response to changes in market factors such as the cotton price. When the local agricultural marketing policy moved from a state-regulated to a market or self-regulated system post-1996, domestic producers were faced with a different marketing environment as they were exposed to the dynamics of the international markets. The effects of the abolishment of the Cotton Board, coupled with decreases in tariff and non-tariff barriers, created an environment where domestic producers had to compete in a global market and commodity prices were influenced by international prices and the volatile local currency.

The extent of the influence of the international price on the local cotton market will be empirically tested in Chapter 3, but to illustrate how local producers respond to fluctuations in the global market through changes in the total area planted, we consider the trends in the domestic cotton area between 2004 and 2010 shown in Figure 1.1. The decline in the cotton area during this period was resultant from the switch by local producers to other crops given higher prices especially due to the commodity supercycle. The commodity supercycle marked a period of higher commodity prices globally, fuelled by the growth in China's domestic infrastructure and manufacturing (industrialisation) and the demand for industrial raw material commodities (Farooki, 2009). During this time, international prices for grains were moving well above cotton prices. Although cotton prices were also moving on a growth path, an increase in cotton prices only followed after a sustained increase in grain prices, 5 years later (MacDonald, et al., 2015). Figure 2.9 shows the movements in global grain prices in comparison to cotton. Wheat and maize prices were moving on an increasing trend from 2004 until 2008, supporting the switch by South African producers, from cotton to grains and oilseeds in combination with the decline in demand for local cotton fibre. The trend lines for wheat, maize, and soybeans in Figure 2.9, are steeper than that of cotton, suggesting a larger growth in grain prices compared to cotton.

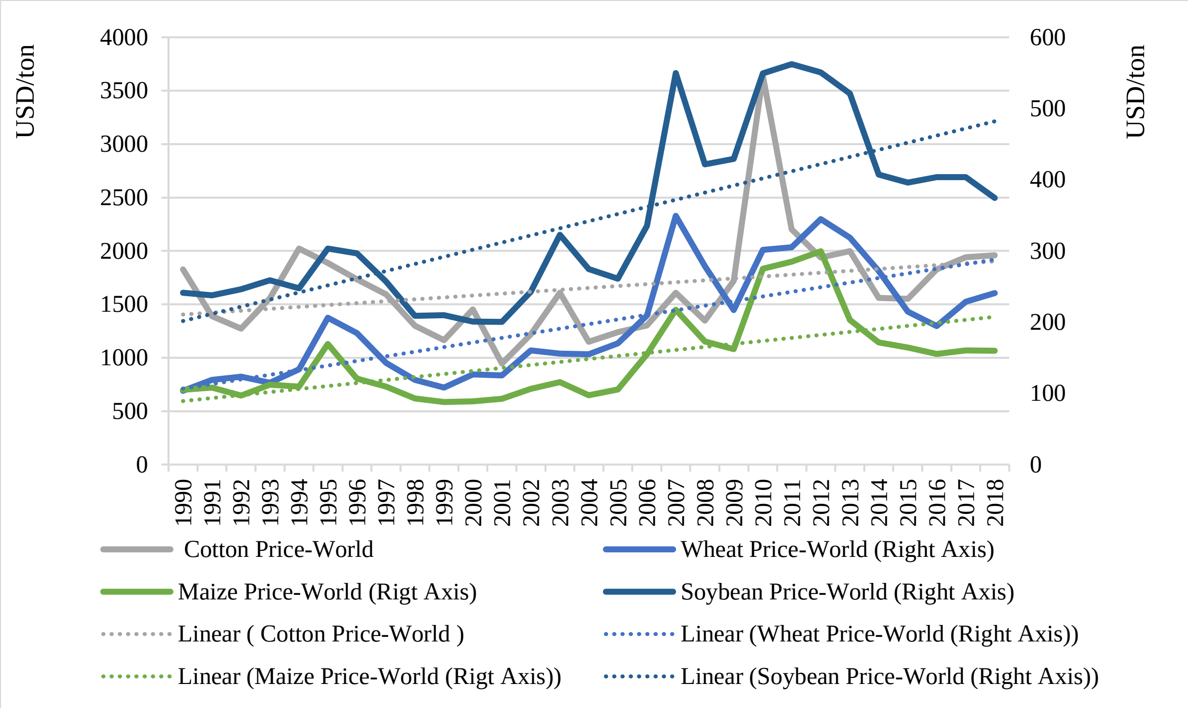

Figure 2.9: Global cotton and grain price movements over time

Source: OECD FAO Outlook, 2019

2.3.2.2 Cotton Ginning

Ginning is the mechanical separation of the harvested cotton boll, into fibre and seed. The seedcotton consists of 37% fibre and about 61% seed in mass. The separated parts of the boll undergo different processes to manufacture a variety of products. The products of the ginning process are consumed by the textile (lint) and seed processing industries.

In the 1980s, SA had six ginning[22] companies, differentiated as cooperative or non-cooperative. The companies were (Randela, 2005):

- Clark Cotton
- Tongaat Cotton Limited
- Eastern Transvaal Co-operative
- Orange Co-operative Limited
- Noordelike Sentrale Katoen (NSK)
- Central Cotton Co-operative

With the decline in seedcotton production, ginning companies reduced to only three in the 1990s. Clark Cotton, NSK and Orange Co-operative remained under operation, the largest

[22] Previously, a small ginning facility was built on the Rustenburg experimental site in 1922, followed by two more gins in Germiston and Barberton. The Natal and Upington ginneries went into production in 1924 and 1953, respectively (Randela, 2005).

being Clark Cotton, ginning 60% of the local crop. Two new entrants joined in the late 1990s, namely Limpopo Cotton and Makhathini Cotton (Randela, 2005).

Currently, SA has seven operational gins:

- Loskop Cotton (Limpopo - Marble Hall)
- Vaalhart's Gin (Northern Cape - Hartswater)
- Northern Cape Cotton Gin (Northern Cape - Marydale)
- GWK Cotton (Northern Cape - Modder River)
- Makhathini Cotton Gin (KwaZulu-Natal - Jozini)
- Weipe Cotton Gin (Limpopo- Messina)
- Koedoeskop Cotton Gin (Limpopo - Thabazimbi)

Figure 2.10 shows the share in gin production (lint) for the 2019/20 marketing year, which indicates that the highest level of seedcotton processing occurred in Koedoeskop, Loskop and GWK gins. Minimal, if any ginning activities take place in the Makhathini gin, where processing capacity (estimated to be operating at only 20% of potential capacity) is limited by old ginning machinery (the oldest in the country) (Bruwer, 2019). Cotton SA (2020) crop estimates for the 2019/20 production year indicate that only 157 tons of lint bales were produced by the Makhathini Flats region, of which the seedcotton produced was ginned in Loskop (Limpopo) (DRDLR, 2015).

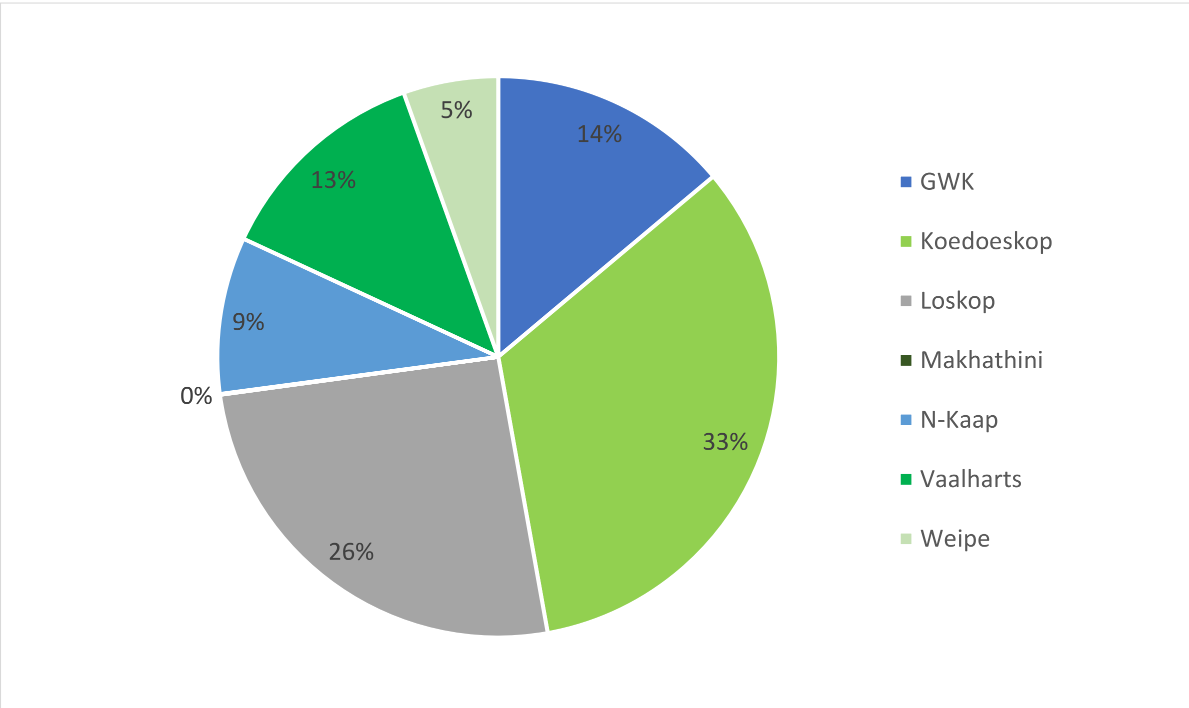

Figure 2.10: SA lint bale production by gin

Source: Coton SA, 2020

Seedcotton processed at the ginning level is sourced from local production and through imports from neighbouring countries (SADC). In the same way, local cotton lint production is also exported to both regional and international markets. SA has exported about 79% of its cotton lint production, on average in the decade between 2010 and 2019. Exports are mainly destined to SADC members but there is also an existing demand from Asian (Bangladesh, India and China) markets. The growing demand by SADC countries for SA exports is dominated by Mauritius, Lesotho and Swaziland which have shown the largest growth in textile and apparel industries since the enaction of AGOA provisions. The growth in textile industries of these countries is supported by the fact that they were allowed third country fabric provisions as part of AGOA. Also, capital investments in these countries, from Asian investors (Taiwan, Hongkong and Japan) did not only enable the expansion in manufacturing capacity but opened export market opportunities for apparel as investors had connections to international buyers (Bennet & Greenberg, 2011). Of all SADC countries, Lesotho occupied the lion's share of SA lint exports between 2010 and 2019 based on ITC TradeMap trade statistics (2019).

Figure 2.11 shows the pattern in lint exports over time along with the percentage of lint production being exported. The factors which determine the movements in exports are global demand for cotton, but this only applies on provision that production meets global quality standards, the international cotton price; as well as, the rand-dollar exchange rate. During the 11 years shown on the graph, cotton exports were lowest in 2013/14. Although the rand was weak against the dollar, local production was low during this year (Figure 2.6).

In the period between 2009 and 2019, lint exports grew by 13% but the biggest growth occurred between 2018 and 2019 (32%). This growth was backed by a combination of factors, including strong production, good quality cotton, from the efforts of the Better Cotton Initiative (BCI) and the benefits of a weak local currency given higher prices in the global market. Cotton exports in 2009/10 and 2010/11 were also weak given a decrease in production and the strength of the rand to the dollar, which effectively reduces the price received in the international market.

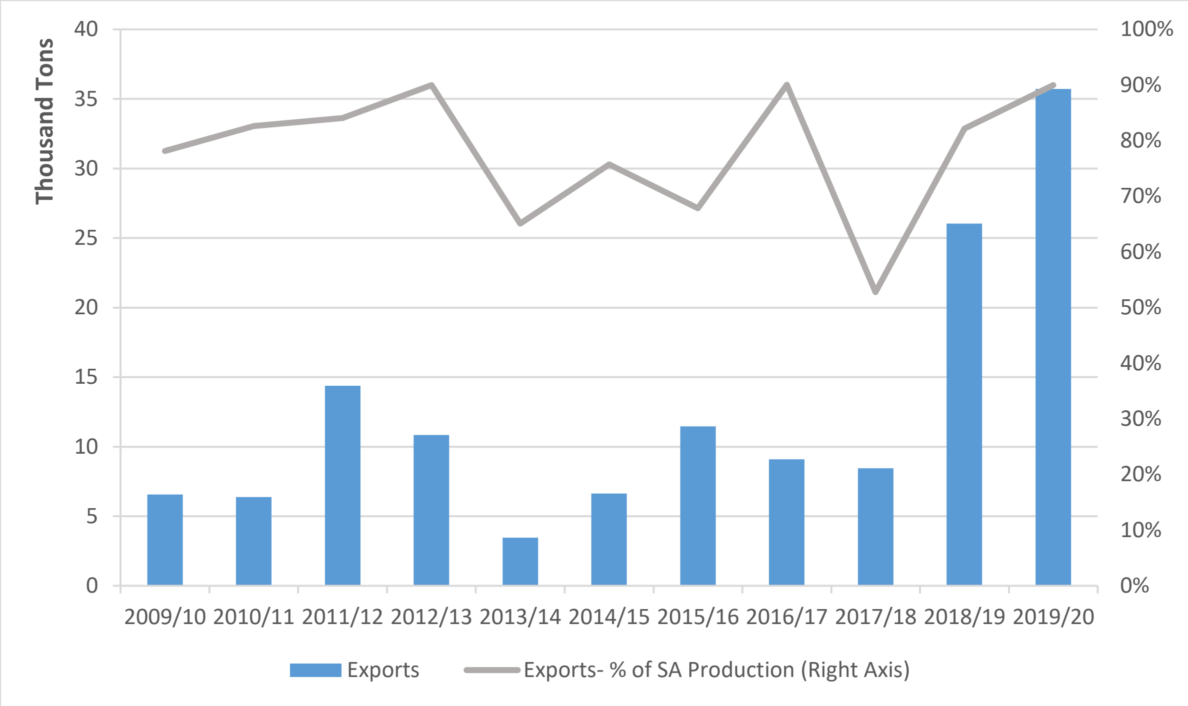

Figure 2.11: SA lint exports and export percentage share of total production

Source: Cotton SA, 2020

The output from the ginning process is cotton fibre, also referred to as lint, which is the most important cotton product commercially and seed (CottonSA, 2019). The seeds can be sold to oil pressers for pressing into crude oil, which can be refined into edible oil. The oil cake which is the output from the oil pressing process is then used in the animal feed industry. The oil cake consists of albumen (45%), fat (6%), fibre (10%), carbohydrate (24%), minerals (5%) and liquid (10%) (CottonSA, 2019). Although cotton seed by-products are economically valuable, the local cotton industry had no beneficiation for these products in the past (CottonSA, 2016). Discussions with the CEO of CottonSA, Hennie Bruwer (2020) indicated that only one commercial crushing plant is under operation in SA, which is based in the Loskop production region, crushing both cotton and sunflower seeds. According to Schoeman (2019), cotton by-products are in the pipeline for potential future projects. The projected local production for cotton oil cake was 4307 tons in 2018/19 and 9921 tons for full-fat cotton seeds (Bennet, et al., 2019).

Once ginned, cotton lint is wrapped up into 200 kg bales and delivered to spinners. Cotton lint is graded, classified and coded according to grading and regulation standards stipulated by the industry and marketing agreement (CottonSA, n.d.).

2.3.2.3 Cotton Spinning

Once collected following ginning, the compressed lint bales proceed to spinners for spinning into yarn. The spun yarn can be processed into fabric by knitting, weaving or towel making. Different spinning mills produce different products according to customer specifications (for example, retailers). As highlighted in section 2.4, there are currently only four spinning mills[23] remaining in SA, the largest of these (SA and Southern Africa) is Prilla Mills, situated in Pietermaritzburg (CottonSA, n.d.).

The local demand for cotton by spinning mills is met through production and from import pools under free trade agreements. According to Bennet and Greenberg (2011), spinners procure cotton lint of mixed quality as they specialize in certain yarn counts and yarn twists that require a blended range of fibre lengths, strengths and price in the laying up process before spinning. Therefore spinners maintain this diversity by also sourcing outside local markets.

With reference to Figure 2.6, cotton lint imports spiked between 1988 and 1993 (50%), owing to the growing demand by the developing textile and apparel industry but has followed a declining trend since the early 2000s with the demise of the spinning mills and textile and apparel companies. However, a distinct decline in cotton imports is visible between 2008 and 2018. During this period, imports were less by 4%, with the largest decline in the aftermath of the global economic crisis (2008-2012). The 2013/14 production year was marked by relatively low production levels, increasing imports.

Figure 2.12 shows the total share of local lint production that is processed by spinners. The share of SA lint production spun locally has shown some growth (17%) between 2014/15 and 2017/18, while lint imports declined (5%). In the same period, exports remained steady indicating the demand for lint by the local market (Figure 2.11). On the contrary, 2018/19 was marked by a significantly lower share of local cotton utilised by spinners, while production (Figure 2.6) and export demand (Figure 2.11) was higher.

[23] While primary production dates back as early as the 20th century, local processing through spinning and weaving commenced in 1946 in Paarl, the first textile factory was established in 1952 in Ladysmith (Randela, 2005).

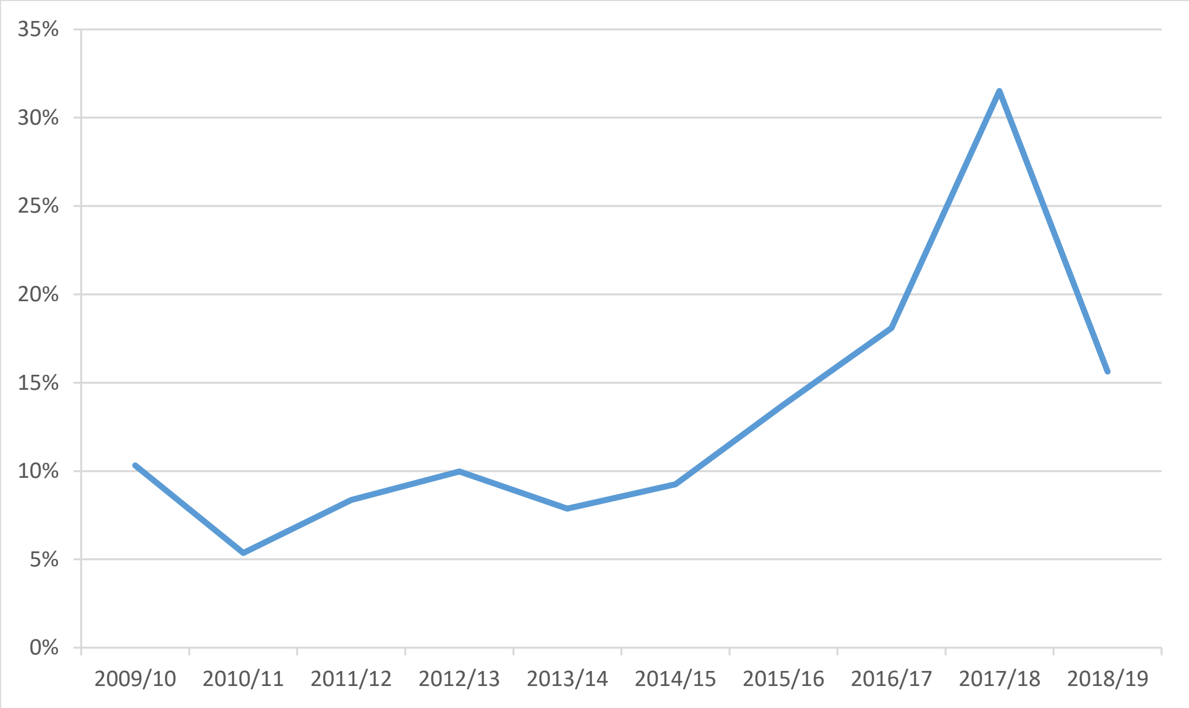

Figure 2.12: SA share of lint production processed locally

Source: Cotton SA, 2019

Cotton yarn, as well as woven fabrics, are exported to international markets but SADC countries hold the major share of these exports. Based on ITC TradeMap trade statistics (2019), 99% of woven fabric exports are sourced by SADC countries (Lesotho, Botswana and Zambia), while the market for cotton yarn is dominated by Mauritius under the same reasons mentioned for SA cotton lint demand (by Mauritius), followed by Zimbabwe, Zambia and Botswana. SA cotton yarn exports to Mauritius were strongest between 2001 and 2007 but only minimal quantities are exported currently as a result of the contraction in the local textile and apparel industry.

2.3.3 Cotton Marketing

The marketing of cotton in two different periods, pre-1996 (regulation by the Cotton Board) and post-1996 (deregulation of the Cotton Board) is outlined in this section.

2.3.1 Cotton marketing pre-1996

Historically, the cotton industry in SA operated on a consensus basis on which sectors within the industry crafted the Cotton Marketing Agreement in 1975, which stipulated marketing rules for cotton lint. The signatories of the agreement included ginners, spinners, and the Cotton Board, as representatives of the cotton producers (Randela, 2005).

The Cotton Marketing Agreement bestowed the formation of a regulatory body, the marketing committee, responsible for implementing regulatory measures and making decisions on marketing arrangements (Randela, 2005). Signatories agreed on an annual basis on the quantity of cotton to be supplied by ginners and processed by spinners. The spinner commitments and the manner of the acquisition were determined by the Cotton Board, in consultation with the South African Cotton and Textile Manufacturers' Association (SACTMA), together with the

Department of Trade and Industry (DTI). Although allocations were set by the board, it was the spinner's consumption (lint) for the previous marketing year which determined the utilisation for the subsequent year. Spinners received their allocations monthly, in even quantities, irrespective of the lint grades (quality) available in the market (Classen, 2003a).

The Cotton Board also determined allocations to ginners but utilisation (seedcotton) in this case was not specified to be equally distributed. In this case, the supply allocations were arranged based on the seedcotton received in the previous marketing year; as well as, in the marketing year concerned. The former determined the first supply allocation and the latter determined the second, or even the third delivery allocation (Randela, 2005). Under the Cotton Marketing Agreement (1975), ginners were not allowed to carry over seedcotton and/ or lint stocks between consecutive marketing years, without authorisation from the committee. In a situation where a surplus of cotton lint occurs, it was offered to the cotton Board under the same conditions (price) that would have been enforced on the sale between spinners and ginners (Randela, 2005).

Producers delivered seedcotton to the closest ginnery to them for ginning into lint and seed. The lint was marketed to spinning companies and cotton seed to oil processors and farm feed manufacturers. Two kinds of ginners existed during this period, cooperative and commercial ginners (non-cooperative). Six ginners operated in the 1980s but decreased to only three in the 1990s, namely Clark Cotton, NSK, and Oranje. Limpopo Cotton joined the three ginners in the late 1990s (De Klerk, 2002).

Lint prices were determined by the international lint price, the Cotlook A index. The cotton marketing committee, in annual price negotiations, decided upon a fixed lint price for the next marketing season. A maximum and a minimum price were determined for lint, while the seedcotton prices received by farmers were derived from fixed lint prices. The role of the Cotton Board in this instance was to act as an arbitrator on the occurrence of a dispute and to monitor orders and deliveries (Bruwer, 2003).

Cotton exports (seedcotton, lint, and seed) were regulated under proclamation R.30 and R.31 of 03 March 1978 which required authorisation of exports through the issuance of permits by the Minister of agriculture (CottonBoard, 1992/1993). The approved export quantity in a certain period could however be restricted after consultation by the Minister with the Cotton Board and the National Agricultural Marketing Council (NAMC). The importation of cotton had no restrictions, except that a tariff of R1.60/kg was imposed in 1992. Given SA's inability to meet domestic cotton demand, a rebate of 100% of the duty was implemented on lint imports within the SADC origin. This was done by way of a permit system directed by the Department of Agriculture (Randela, 2005).

2.3.2 Cotton marketing post-1996

When the local agricultural marketing policy moved from a state-regulated to a market or self-regulated system post-1996, domestic producers were faced with a different marketing environment as they were exposed to the dynamics of the international markets. The effects of the abolishment of the Cotton Board, coupled with decreases in tariff and non-tariff barriers, created an environment where domestic producers had to compete in a global market and commodity prices could be influenced by international prices. The extent of such influence on the local cotton market will be tested in Chapter 3. Competitive market forces created threats to the survival of the domestic industry, one of the critical issues being production subsidies in major cotton-producing countries (Randela, 2004). According to Randela (2004), cotton production subsidies can distort world markets by boosting production in the implemented country and depressing producer prices in the rest of the world, thus, affecting the profitability of cotton producers.

Since 1996, and currently, cotton is marketed on an open market guided by the Marketing of Agricultural Products Act 47 of 1996. In the current system, prices are determined by the market and no interventions take place in the buying or selling of cotton products (DAFF, 2011).

Growers can sell their cotton in various ways:

- Transfer of ownership

Through the sale of the seedcotton by the grower entirely to the ginner, for ginning and subsequent marketing of the lint to spinners, directly or by using an agent.

- Contract ginning- retained ownership

The producer does not sell the seedcotton to the ginner but engages in a contract with the ginner, to gin the seedcotton in exchange for payment (ginning fee). The farmer retains full ownership of the cotton and can either market it himself, through the ginnery or an agent.

Cotton marketing arrangements pre-1996 are similar to arrangements under the Marketing of Agricultural Products Act no. 47 of 1996.

Similarities between the two marketing environments (Randela, 2005):

- Marketing approach based on consensus.
- Industry stakeholders meet yearly before a new season begins to draft informal voluntary agreements used in estimating the domestic shortfall for the following season, which may signal the need for import rebate permits.
- Issuance of permits for import rebates by the Department of Agriculture.
- Joint commitment by spinners to process a specified share of the domestic crop.

Under the current marketing conditions, no restrictions exist on importing cotton but the duty of R1.60/Kg is still imposed on cotton originating outside the SADC region. A free trade agreement (FTA) between SADC countries has been in force since 2000. A duty of R0.60 was enforced on SADC countries in 2002 but has reduced over the years and discontinued in 2004. As a result, the bulk of the cotton utilised in SA is imported from SADC countries at a lower per unit cost. Changes in regional trade regimes threaten local producers, particularly smaller growers (Randela, 2005).

2.4 Recent Interventions of the SA Cotton and Textile Industry

The South African Textile industry has implemented several initiatives directed at the protection and development of the domestic textile value chain. Of recent, value chain interventions have been pinned down to specific input products of the textile industry, for example, cotton interventions through the SCC.

2.4.1 Introduction of industry initiatives

Various programmes aimed at the development of the local textile and clothing industries have been announced over the years, but these were generally focused on value chains of all fibre types (cotton, mohair, wool etc). These included initiatives such as the Textile and Clothing Industry Development Programme (TCIDP) of 2002, the Enterprise Investment Programme (EIP) and the Preferential Procurement Programme of 2011. Minimal, if any changes were visible in cotton production following the introduction of these initiatives (CottonSA, 2019).

In 2013, a national cluster, the Southern African Sustainable Textile and Apparel Cluster (SASTAC) was established, under a five-year plan funded by the DTI. Contrary to previous programmes, this initiative is strictly a cotton programme with the main objective of building, improving and growing the capacity for sustainable textiles and apparel in the cotton industry and value chain and supplying local and international markets with fully traceable and sustainable cotton products (CottonSA, 2019). Through this initiative, the cotton industry, led by Cotton SA, formed the SCC. Elements of the SCC are discussed below.

Besides the SCC, the retail – clothing, textile, footwear, and leather (R-CTFL) value chain master plan was established in 2019 with the call to revitalise the domestic clothing, textiles, footwear, and leather (CTFL) value chain, which feeds into SA's major CTFL retailers (DTIC, 2019). According to the Minister of Trade and Industry Ebrahim Patel (2019), the R-CTFL master plan represents the first commitment from a broad array of retailers to buy local, driving local manufacturing and employment. According to the DTIC (2019), the objectives of the textile master plan include:

- Growing R-CTFL employment by at least 121 thousand and upstream formal manufacturing employment by 70-160 thousand
- Enhancing value chain costs, processes and product competitiveness
- Adopting new technologies to shorten the lead time in the value chain
- Improving financial returns to enhance investments and by implication expanded economic activity and job creation throughout the value chain
- Building advanced management, technical and operator skills to promote the use of advanced technologies and to improve competitiveness
- Transforming the value chain by developing and promoting black and female senior management, advancing worker ownership, attracting black industrialist investment and advancing the inclusion of black-owned SMME's (small, medium and micro enterprises) in the CTFL manufacturing eco-system
- Reshaping the local textile industry to be recognised as ethical and environmentally responsible

The first phase of the master plan will run through to 2030, based on seven core action commitments. These include (DTIC, 2019; DTIC, 2020):

- Growing the domestic market for locally produced CTFL products
- Increasing domestic procurement for CTFL products
- Stemming the flow of illegal imports by employing strategic tariff and rebate measures
- Incentive programme extensions
- Aligning production capacity to sales cycles
- Transforming the value chain

2.4.2 The Sustainable Cotton Cluster

The most recent cotton specific value chain intervention is the SCC, which was implemented for five years ending in 2019. The SCC was a holistic supply chain approach, connecting all participants in the cotton value chain. The approach was introduced mainly to revive the local industry by addressing fundamental issues within the cotton value chain and establishing stronger relationships throughout the value chain to promote local beneficiation (Slabbert, 2017).

Interactions on the interventions of the cotton cluster with the CEO of Cotton SA, Hennie Bruwer (2019), indicated that the South African cotton market is not producing enough to meet the domestic demand for cotton products, which is therefore partly met through imports. With the local demand estimated at 300 000 tons, the goal of the cluster was to build local competitiveness by increasing the production of major garments produced from cotton, including jeans, chinos, towels and underwear. Replacing at least 50% of the imports for these products can help meet 100 000 tons of the local consumption needs while creating employment in the value chain.

To develop the production and utilisation of local cotton (CottonSA, n.d.), and the ultimate goal of economic growth, as well as job creation (CottonSA, 2016), the main interventions of the cotton cluster, included technology demonstrations, access to finance for equipment, and achieving a sustainable value chain through responsible cotton production while implementing global standards, and skills development (Slabbert, 2017).

The SCC facilitated the demonstration of new striper harvester technology to dryland cotton producers, in the effort to improve their production yields and revive the industry to previous production levels. These advanced pickers cost between R9 and R11 million each, harvest between 15 and 20 hectares a day, and significantly improve the ease and management of cotton harvesting, but requires significant capital investments. While cotton could be more profitable than other dryland crops, cotton input costs are higher (Aucamp, 2019) and harvesting of cotton is cumbersome and requires substantial capital investment. For crops like maize, harvesting machinery is generally accessible and lower financial investment is required for operating and maintaining machinery, but cotton machinery tends to be cotton specific and a challenge of accessibility and capacity exists in most regions as only a few farmers own harvesting machinery and the remaining farmers resort to hiring at harvest time.

With the cluster focussing on facilitating an inclusive environment for all participants in the cotton supply chain and skills development, efforts were also directed at stimulating small-scale production (production on 1 ha plots). The inclusion of small-scale farmer participation was based on the notion that cotton has great potential as a cash crop for small-scale farmers due to its drought resistance and the ability to fixate nitrogen in crop rotation. When wheat and maize crops are preceded by cotton in commercial production, yields can increase by 10% (Slabbert, 2017).

Additional interventions included business process innovations to insure continuous industry competitiveness; implementation of product traceability measures through the introduction of a cloud-based IT programme, as well as the development of financing and insurance products. All interventions were contracted with clearly defined key performance indicators. The Industrial Development Corporation (IDC) managed the financing of cluster interventions on behalf of the DTI (Slabbert, 2017).

As part of the SCC, the local cotton industry subscribed to the Better Cotton Initiative (BCI) in 2014, with the first harvest of Better Cotton taking place in 2016/17 (BCI, 2020). The BCI is an international initiative that promotes responsible cotton production to improve the quality of production by producers while protecting the environment and ensuring that it remains sustainable for the sector's future (Aucamp, 2019).

BCI core indicators include standards for crop protection and pesticide use, soil health and structure, water management, decent work ethics, biodiversity enhancement and land use, fibre quality, record keeping and training (CottonSA, 2018). BCI cotton production amounted to a share of 22% of total cotton production in the 2018/19 marketing year. Total BCI cotton production in the world was 5.6 million tons in 2018/19. SA produced 18 000 tons of BCI cotton in the same period, an increase from 11 000 tons in 2017/18 (TextileExchange, 2020). According to Cotton SA, about 40% of South African cotton growers were BCI licensed in 2019.

In 2018, BCI reported global sales growth by 45%, in their respective standard complaint cotton, which was primarily driven by increased demand from retailers and brand members (Voora, et al., 2020). In 2017, Nike's sustainable cotton consumption was estimated at around 54% (Voora, et al., 2020), while an increasing number of retail companies such as H&M are moving towards sustainably sourced cotton (including BCI) (Brannsten, 2021).

Overall, the SCC approach, which commenced in 2014 and ended in 2019 (awaiting renewal), operated under a local beneficiation model, which grew cotton fibre production by 42% in 2017, compared to a share of 7% upon its inception in 2014. The model stretched throughout the entire supply chain spectrum, to benefit farmers (including both small-scale and commercial) and retailers (Slabbert, 2017). The local beneficiation model is discussed further in the section below.

2.4.3 Local Beneficiation Approach of the SCC

The local beneficiation approach of the cluster was focused on developing relationships mainly between actors at extreme points of the value chain, including farmers, at the production level and retailers, at the consumption and distribution level. In a traditional cotton marketing system, contract farming occurs between the farmer and the ginner, however, the cluster took contracting a step further by establishing contracts between the farmer and the retailer.

The cluster achieved success in obtaining the legal commitment from retailers to acquire cotton fibre in advance (12 to 18 months). Retailer commitments contract the entire supply chain to the farmer, who secures a buyer for his product beforehand. The commitment by retailers to obtain cotton from farmers unlocked financing alternatives, especially for small-scale farmers who often do not have ownership of the land on which they farm (Slabbert, 2017).

The arrangement was set up in a way that following planting in October/November, the retailer issues a promissory note to the farmer, which stands as the legal commitment to purchase the final product and stipulates the agreed quantity. Once harvesting has taken place in April, ginning proceeds in May and spinning occurs between June and July, to complete the knitting and/or weaving processes. The final product is then manufactured between August and September and should be delivered to retailer distribution centres in October (Slabbert, 2017).

The cluster concluded 11 integrated supply chain programmes by 2017 and each programme was ring-fenced to ensure retailer confidentiality. The contracting retailers included the Mr Price Group, Ackermans, Woolworths and the Edcon group, while the product range included sleepwear, general knitwear (t-shirts, towels, jeans and chinos) and underwear (Slabbert, 2017).

The cluster also facilitated the financing of investments in additional ginning capacity to accommodate increasing harvests (Bruwer, 2019). However, the four remaining spinning mills, (decreased from 22 in 2000) were operating at almost full capacity and represented the biggest bottleneck in the industry during the period of the cluster. The eighteen mills that have shut down cannot easily be repaired or upgraded to increase spinning capacity as most of the equipment was sold and exported. The investments in ginning capacity were thus misaligned with the limitations in spinning capacity, but construction of new spinning infrastructure is not economically justified or viable due to high capital investments (estimated between R700million to R1billion) (Bruwer, 2019).

Although funding for the first phase of the Cluster ended in March 2019, indications exist that it could be extended for an additional five years (Slabbert, 2017). Industry interventions introduced by the cluster are still running, for example, small-scale farmer projects which have been established through cluster funding are still in place (such as the Nkomazi project). Also, the DTI has announced the commitment by major retailers in the sector, to increase procurement of locally produced goods over the next 10 years (starting 2019). To achieve the goal of producing goods from locally produced cotton, one of the biggest retailer groups in SA, the Mr Price Group has invested R30 million to support small-scale cotton farmers, in addition to the 250 growers the retailer is already supporting. The approach for this new investment is directed towards 1) improved cash flow between growers and ginners, 2) timeous delivery by farmers to ginners (CottonSA, 2019).

The performance of small-holder farmers and their access to formal markets and financial services given small, variable quantities produced has been one of the issues hindering growth in the local industry. As such, the SCC initiative included investments in small-holder cotton projects to promote production at this level. The performance of these small-holder projects prior and following the discontinuation of the cluster is discussed in detail below.

Table 2.1 presents total cotton production for small-holder cotton projects during the final year of the cluster. Additional projects occurred in Free State (Hoopstad) and North West in the 2019/20 and 2020/21 production years, respectfully. The current estimates (2020/21) indicate that the number of small-holder farmers and the total area planted to cotton under small-holder projects has declined after the discontinuation of the cluster. A total of 388 small-holder farmers were recorded for the 2020/21 season, from 1010 in 2019/20. The total area is estimated at 1015 hectares (from 2929 ha in 2019/20) on dryland and 91 (from 436 ha in 2019/20) hectares on irrigation.

Small-holder farmer projects are coordinated under co-operative structures, which assist in marketing and provide centralised service units (machinery such as trailers and tractors). Marketing under co-operative structures is similar to the general marketing system described in section 2.6.2, in terms of delivery and payment terms, but given that these farmers plant on small plots, thus producing small volumes, co-operatives offer the advantage of pool marketing. The marketing structure is designed in a way that farmers engage in off-take agreements with the gin. Once harvested, the seedcotton is transported to co-operative assembly points for weighing and subsequent delivery to ginneries. Since the seedcotton is delivered in mixed bundles, farmers are allocated specific barcodes which differentiates the lots in the grading system. Cotton SA's agriculture development and transformation manager Tertius Schoeman (2021), indicated that although small-holder farmer projects assist in developing marketing channels for the farmers, the biggest challenges faced in sustaining these projects are the continuation of funds, climatic conditions and profitability, impacted by the prevailing market price and costs at the farm and processing level (gin).

The main factors that put pressure on small-holder farm economics are transportation costs to the gin as cotton is a bulky crop (transported in bales) and extra handling costs passed on from the gin to the farmers. Baling is currently done in wool packs, limited to the lack of machinery for round bailing given the huge investment costs in acquiring module builders which is unjustifiable given the scale of production. Wool packs offer a cost-efficient alternative to round bales and can be repaired for re-use at the most for three seasons. Although these packs can be re-used, there are extra costs for repairs, when torn and handling fees required to process the cotton into round bales using a module builder at the gin level. Processing into round bales requires the unpacking of the deliveries and loading the cotton onto the module builder which is a labour-intensive process, thus extra costs for baling are passed onto the farmer.

Table 2.1: Smallholder cotton production 2018/19 production year

Region		No. of farmers	Dryland Area (Hectares)	Irrigation Area (Hectares)	Production Actual 200 kg lint bales
Mpumalanga	Nkomazi	906	1770	0	3552
	Nokaneng	188	610	0	226
Limpopo	Matlelerekeng	3	60	10	18
	Dichoeng	11	10	100	523
North West	Taung	20	0	230	1193
	Batshweneng	6	0	106	245
KwaZulu Natal	Makhathini	1247	2200	200	2672
Total		2381	4650	646	8429

Source: CottonSA Statistics, 2021

The trends in imports and exports during the period of the cluster are shown in Figure 2.13 and Figure 2.14. Figure 2.13 shows the total cotton-specific exports and imports before and during the period of the cluster. Total exports declined between 2012 and 2014 but gained momentum in 2015, increasing by 7 thousand tons between 2015 and 2018 and reaching a high of 22 thousand tons in 2019. The growth in exports was mainly driven by lint exports (neither carded nor combed), with around 80% of local production being exported (de Bruyn, 2020). Imports remained stable throughout the cluster, showing a marginal decline (5%) supported by lower lint imports.

As the goal of the cluster was to replace imports of certain clothing and apparel products, specifically chinos, t-shirts, underwear, and towelling, Figure 2.14 shows the trends in imports for some of these products throughout the cluster period. Consultations with the South African Textile Federation (Texfed) and the Apparel Manufacturers of South Africa (AMSA) indicated that production data for these products is limited and is not broken down into different fibre types. For this reason, import and export data is used to gather a general understanding of the impact of the cluster on these products. From Figure 2.14, underwear imports dwindled between 2015 and 2017, remaining stable until 2019 after a significant increase in 2013 and 2014. Towel imports on the other hand rose between 2014 and 2019.

South Africa's lint production (tied to cotton area) still falls short of meeting local consumption and replacing lint imports; however, it seems from the story of the cotton cluster that the industry has somewhat shown a renewed interest in cotton production. Some improvements occurred in the industry, through production, processing, and exports throughout the cluster but certain challenges also prevailed which may have limited overall performance. Value chain challenges that occurred before and amid the period of the cluster are discussed below.

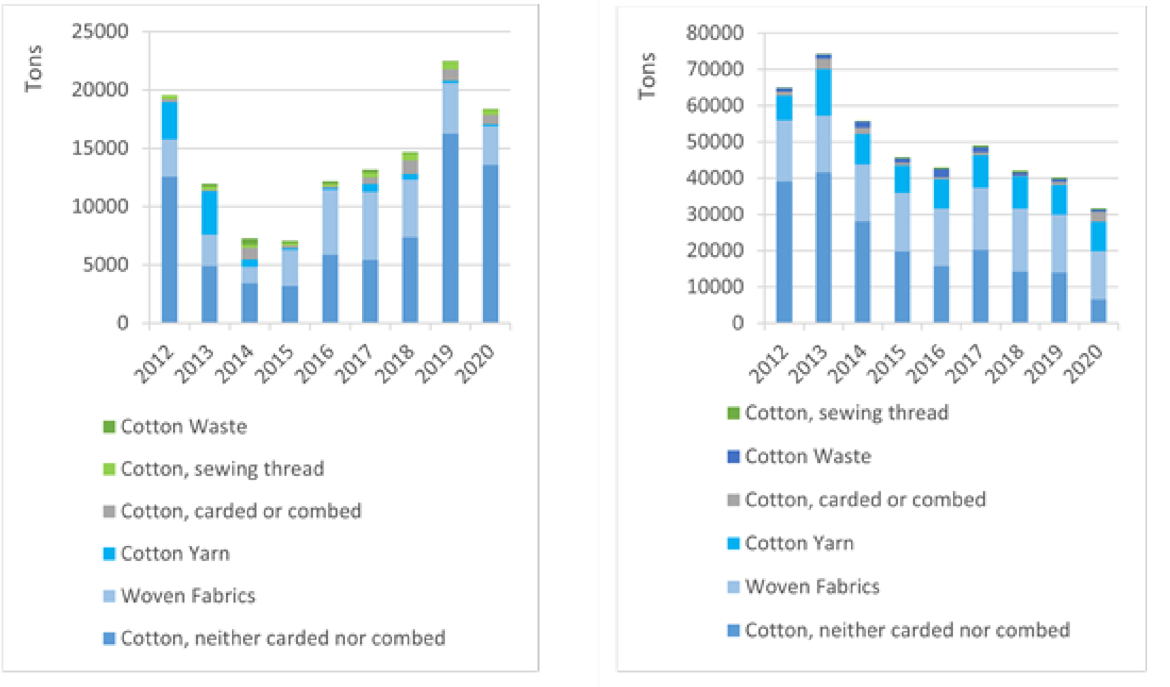

Figure 2.13: Total cotton exports (left) and imports (right)

Source: Trade Map, 2021

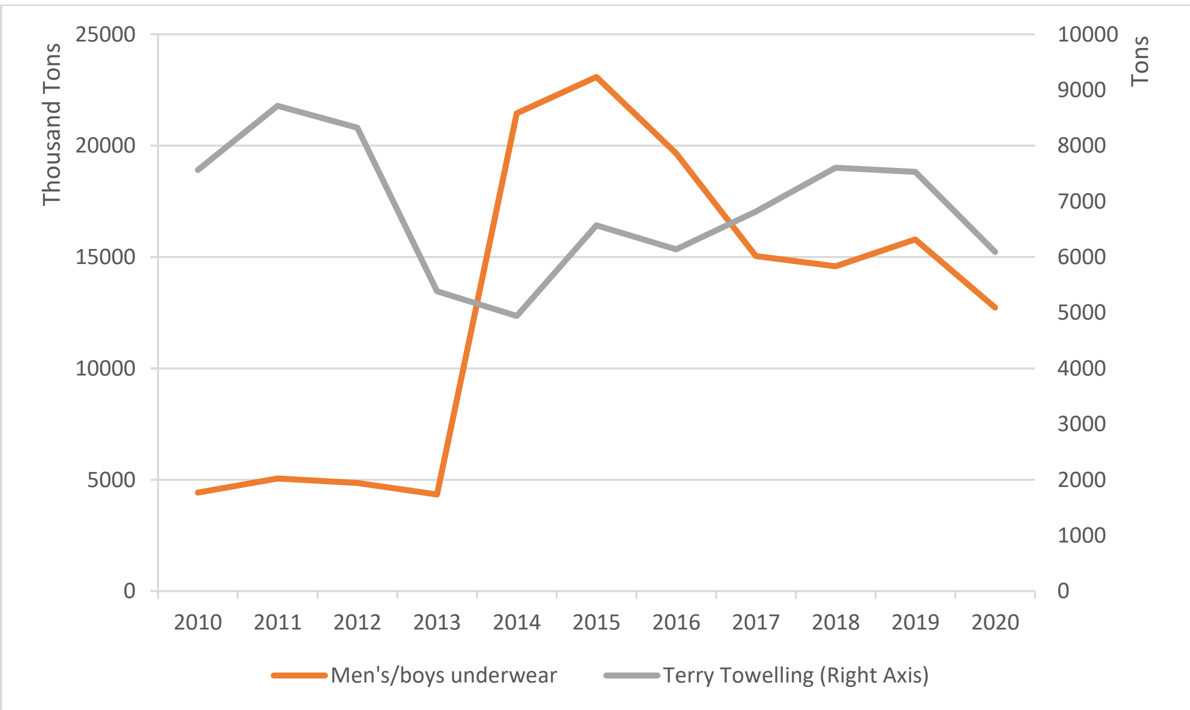

Figure 2.14: SA imports of SCC specific products

Source: TradeMap, 2021

2.4.4 Economic Challenges Prior and Amid the SCC Approach

Stakeholders in the cotton value chain have always been faced with challenges, especially at the primary production level. Although cotton cluster interventions were aimed at improving the sector's performance by addressing issues that contribute towards value chain inefficiencies, some of these pre-existing problems remained and have continued with the discontinuation of the SCC.

Most of these challenges are faced by producers at the production level and farmers respond through changes in area or by completely moving out of cotton production. Since farmers are providers of the raw material, any changes which occur at the production level are directly reflected at higher levels of the value chain. For example, as producers are the source of raw cotton (seedcotton), changes in the area planted by farmers are reflected in lint production from seed cotton processing at the gin level. Thus a decline (increase) in cotton area directly causes a decline (increase) in lint production and processing (share of local cotton vs imports) at the higher levels of the value chain.

The main factor which contributes towards the decision by a farmer to remain or move out of cotton production is profitability. The factors which affect the profitability of farmers were listed by Randela (2004) as, the costs of production, the technology available to them and the producer price as influenced by the quality of seedcotton produced. South Africa produces some of the best quality cotton in the world, thus selling at a premium price in export markets therefore quality[24] is not an issue (Bennet & Greenberg, 2011). However, farmers are operating in an environment characterised by increasing costs and these costs are more pronounced in situations where farmers do not have the access to machinery, as is the case for most small-holder farmers. According to Malinga (2019), the majority of small-holder cotton farmers in SA use handpicking thus profits are limited by increasing picking costs (minimum wage set by the SA Government). Given that yield is also an important element in the profit equation, and with increasing input costs, small-holder cotton farmers find it progressively difficult to absorb increasing costs, without concurrent improvements in the seedcotton price (Randela, 2005).

According to Malinga (2020), expensive cotton industry technology and high costs of cotton picking are barriers to cotton farming. This argument can be better explained by discussing the different harvesting mechanisms and the difficulties faced in the respective systems. Also, by unpacking the issue of harvesting machinery where mechanical cotton picking is of relevance.

Techniques used for harvesting cotton in SA is handpicking and machine harvesting. Only 1% of domestic cotton production is handpicked and the balance is machine picked (Bennet, et al., 2019). The adoption of GM cotton has helped in improving cotton yields while enabling farmers to save on pesticide costs (Nkechi, 2020). Gouse (2006) highlighted that small-scale farmers save on pesticide costs by using Bt cotton but the increase in yields results in higher

[24]SA's cotton quality is high given the focus on marketing high quality lint. However, quality is sometimes an issue when farmers want to sell under circumstance where the cotton is of inferior quality (Bennet & Greenberg, 2011).

harvesting costs. In addition, there is a possible increase in input costs for GM cotton through higher seed costs and an additional technology fee, levied by the Bt gene owner.

Combine harvesters were introduced to the local market as one of the interventions of the Cotton Cluster. The machinery is imported and is associated with high maintenance costs. The efficiency of the pickers is also dependent on the characteristics of the cotton plant. For example, stripper harvesters work best with small plants thus resulting in inefficiencies (more plant waste) where plants reach heights higher than those acceptable for harvesting by a stripper picker (Schroeder & Schwippl, 2016). Two types of pickers are available in the market, spindle pickers and stripper pickers. The differences in the machinery lie in system (irrigation or dryland) efficiencies, harvesting (including maintenance) and ginning costs as well as fibre quality. Spindle pickers are perceived to pick cleaner cotton and maintain better fibre quality. Stripper pickers are designed for lower yields in dryland conditions, therefore, offering an alternative to spindle stripper from a cost perspective. Advantages of stripper pickers compared to spindle pickers include significantly lower costs of acquisition, less fuel and maintenance costs, attributed to their design (fewer moving parts in row units). Strippers also pick more cotton from the plant but normally include more immature cotton bolls, increasing the possibility of lower micronaire (cotton quality indicator) values (Schroeder & Schwippl, 2016).

Consultation with the agricultural development and transformation manager of Cotton SA on the impact of the machinery on small-holder cotton producers indicated that the introduction of the harvesters in the local industry was directed towards stimulating production for large-scale producers. To afford the purchase and maintenance of these machines, farmers need economies of scale. Small-holder farmers are unlikely to have the scale to justify the investment in harvesting machinery. These farmers produce on small distanced plots, which implies that the machinery will not run continuously. Also, these farmers rely on communal land for farming and they lack the collateral to qualify for loans from formal financial service providers, which limits the affordability of the harvesters.

Cash flow problems between the farmers and the ginners in the past two to three years is another issue that has prevailed in the industry during the period of the cluster. The flow of payments from the ginner to the farmer is determined by the ginning process. This means that the efficiency of the processing of the seedcotton at the ginner determines how quickly the farmer can get paid. Once the farmer's cotton is ginned, the lint is graded and thus the quality from the grading system determines the price realised by the cotton, which is what will be paid to the farmer.

According to Bruwer (2020), the typical ginning period globally is a hundred days. Ideally, the ginner would process all the cotton over a hundred days and make payments thereafter. With this being stated, it implies that gins do not operate throughout the year which reduces costs and minimises disputes on late payments to the farmers. However, this has not been the case in SA in recent years.

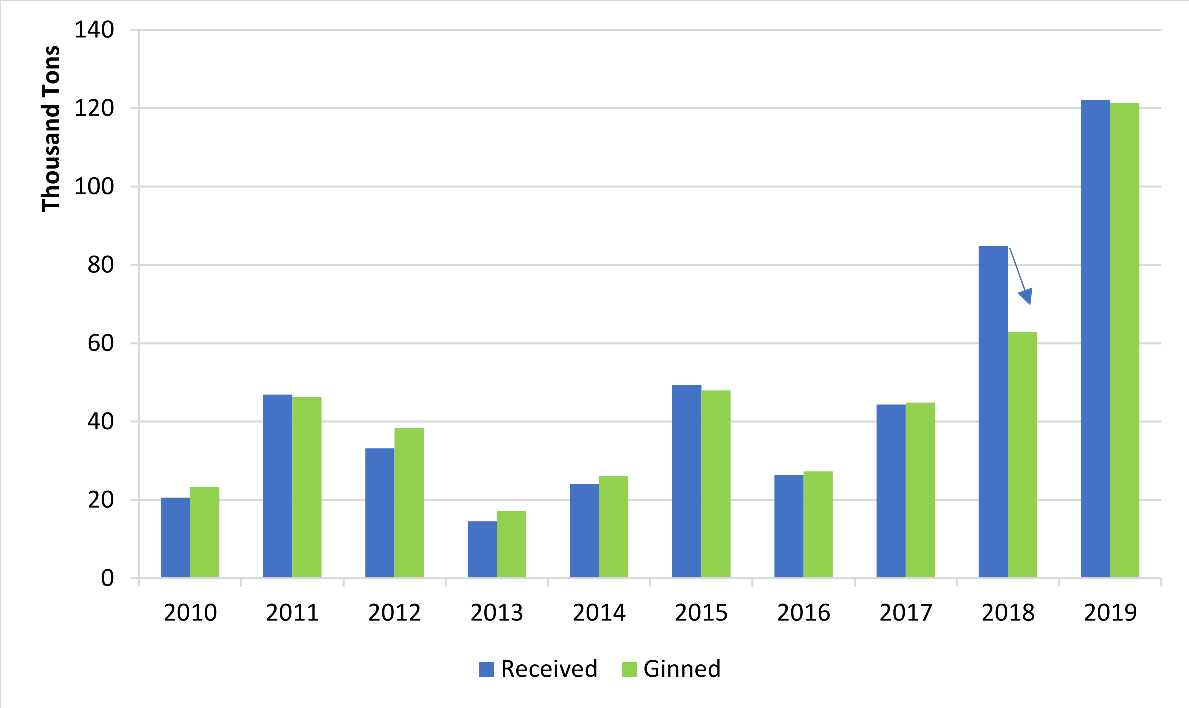

Figure 2.15: Seedcotton deliveries and processing at the gin level

Source: Cotton SA, 2020

Figure 2.15 shows the patterns in seedcotton deliveries received by ginners and the amount of seedcotton processed (ginned) between 2010 and 2019. Ginners have been able to process deliveries in most years, with the exceptions in 2015 and 2018. In addition, more cotton was planted in 2018, compared to 2017, with good harvests but consumption further in the pipeline did not increase as much. In years where the processing does not occur in the relevant marketing season, stocks are kept to be processed in the following season. This implies that grading is delayed, thus delaying final payments to the farmer. Delayed payments have also been noted as a contributing factor to farmers moving away from cotton production as they fail to meet financial obligations and are unable to reinvest in inputs for the following season.

2.4.5 Climatic Challenges Prior and Amid the SCC Approach

In as much as inefficiencies remain in the pipeline, production is also often dampened by environmental attributes such as rainfall. The topic of a changing climate and its impact on cotton production is also an existing challenge of the industry. Production is being made easier through technology and improvised systems, but the world's climate is becoming more volatile and weather conditions are changing in traditional cotton growing regions, putting more stress on dryland cotton production. According to Gouse (2006), large-scale irrigation cotton farmers can substitute or rotate cotton with other crops (mainly maize, vegetables or groundnuts). Similarly, dry-land farmers with sunflower or maize given less severe climatic conditions. However, small-scale dryland farmers only rely on cotton due to low, irregular rainfall and the lack of production credit for other crops. Although cotton is a hardy crop, making it less susceptible to drought, the plant requires a specific amount of water at different stages of its development; therefore, droughts can pose a risk on yields depending on the severity at critical stages of the plant's growth.

According to Theron (2015), the normal growing period for cotton is 200 days and the needs of the plant (temperature, moisture, and sunlight) vary depending on the stage of the plant's development. A cotton plant uses the highest amount of water between the first flowers and first boll burst, starting at 70 days and ending at 120 days. The global average moisture needed for an average crop varies between 500mm and 1250mm. However, in SA, given erratic rainfall conditions, the average amount of summer rainfall required to achieve reasonable and consistent production is a minimum of 600mm (Theron, 2015). The challenges of irregular climate conditions, especially the shifts in seasons and rainfall call for better management and distribution of crops, as well as more sustainable cultivation methods.

To analyse the effects of changing rainfall patterns on cotton production, BFAP's long-term trend in early summer rainfall was used to determine whether rainfall requirements are met in three different dryland production areas, Limpopo, Mpumalanga and the North West provinces. Although cotton offers the advantage of late planting (November), it is of importance to understand the implications of a season that is seemingly shifting later, for a crop that is recommended to be planted early (October).

The trends in rainfall observed for the three provinces show that although weather patterns are changing over time, rainfall has been consistent. Of all three provinces, Mpumalanga receives the most rainfall, thus meeting the 600mm threshold more often than others do. The North West province receives the lowest amount of rainfall. It is important to note that a significant amount of summer rainfall is received between November and January, which is the time when cotton requires water the most. At least 50% and at most 80% of total summer rainfall is received between November and January. Moreover, there has been an increase in the amount of rainfall received over this period post-2000, with the exception of drought years.

According to Maybank et al. (1995), drought is one of the most harmful extreme conditions globally, although its detriment occurs slowly over time in comparison to other natural disasters. One of these events occurred in 2015 when Southern Africa experienced an intense drought resulting from an El Niño event. The aftermath of the El Niño was delayed October/November rains, which did not fall in time and were recorded to be insignificantly below normal when they did fall (Van Zyl, 2016). The 2015/16 drought was the worst in the past 100 years, resulting in an approximately 70% decrease in the total area planted under dryland conditions (CottonSA, 2016).

According to Tyson and Pretson-Whyte (2000), all droughts, regardless of scale (days, seasons or years), have been linked to predominant anticyclone conditions, which greatly control weather and climate conditions of Southern Africa. In addition, droughts are different in their characteristics, namely, intensity, duration, frequency and area coverage. Thus, four major categories of droughts exist, agricultural, meteorological, hydrological and socio-economic drought (Wilhite & Glantz, 1985). Meteorological parameters, for example, evaporation, precipitation, humidity, snow wind and temperature may intensify the severity of and effects of a drought (Philander, 2008).

The general increase in rain received (as a percentage of summer rainfall) between November and January post-2000, is indicative of shifting rainfall patterns. Although this still falls within the critical time (in terms of precipitation) for cotton production, it remains a critical issue given a constantly changing climate. This may imply that shifting planting dates (for example, from October to November) may compromise cotton yields. Given these shifts in rainfall the access to equipment, including irrigation systems could turn out to be an even bigger contributor to the decision to plant in dryland areas. A graphical representation of the results from the long-term rainfall trend is shown in Figure 2.16, Figure 2.17 and Figure 2.18, where the horizontal lines represent a ten-year average.

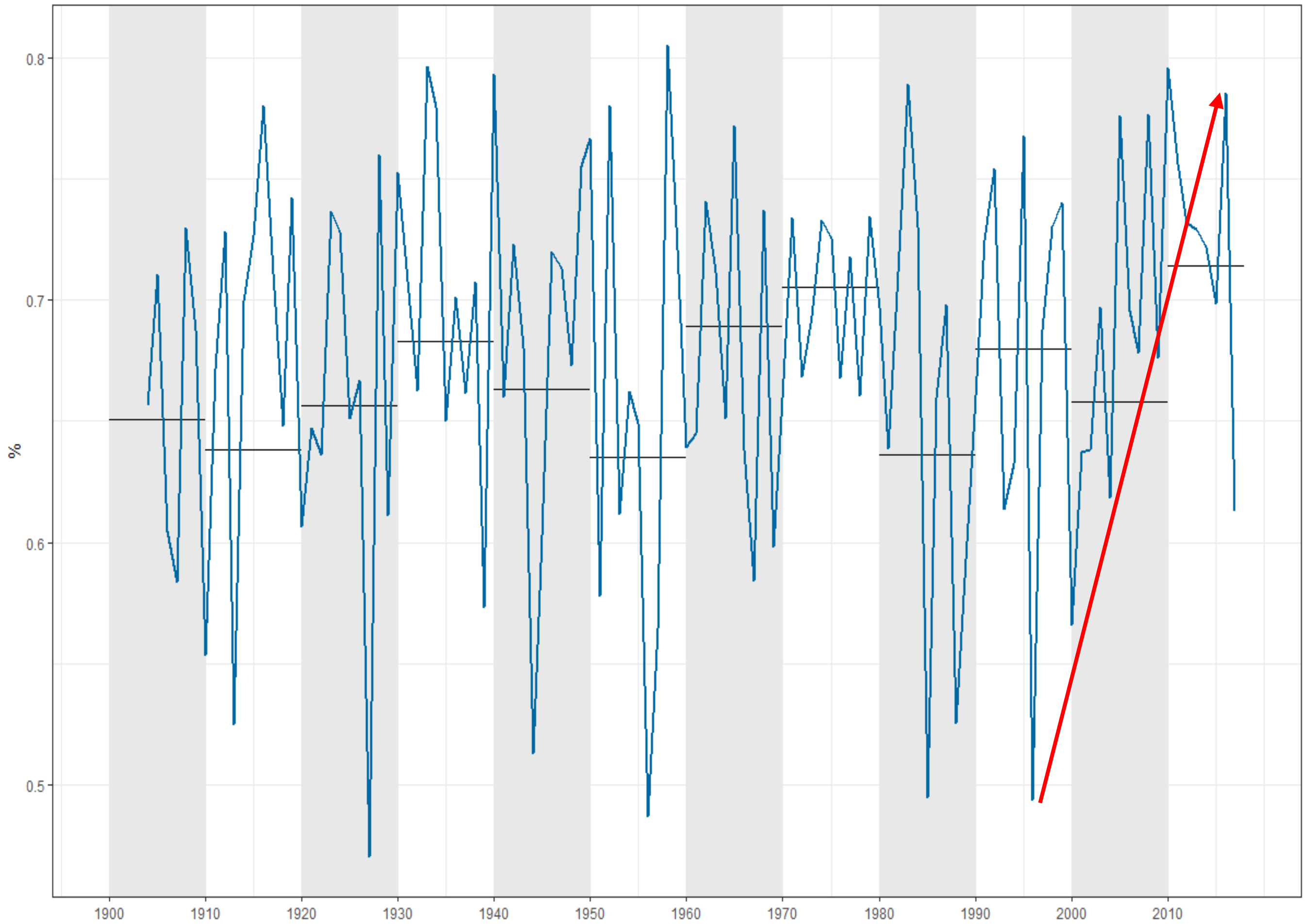

Figure 2.16: November to January rainfall as a percentage of total summer rainfall - Mpumalanga

Source: BFAP & SAWS, 2020

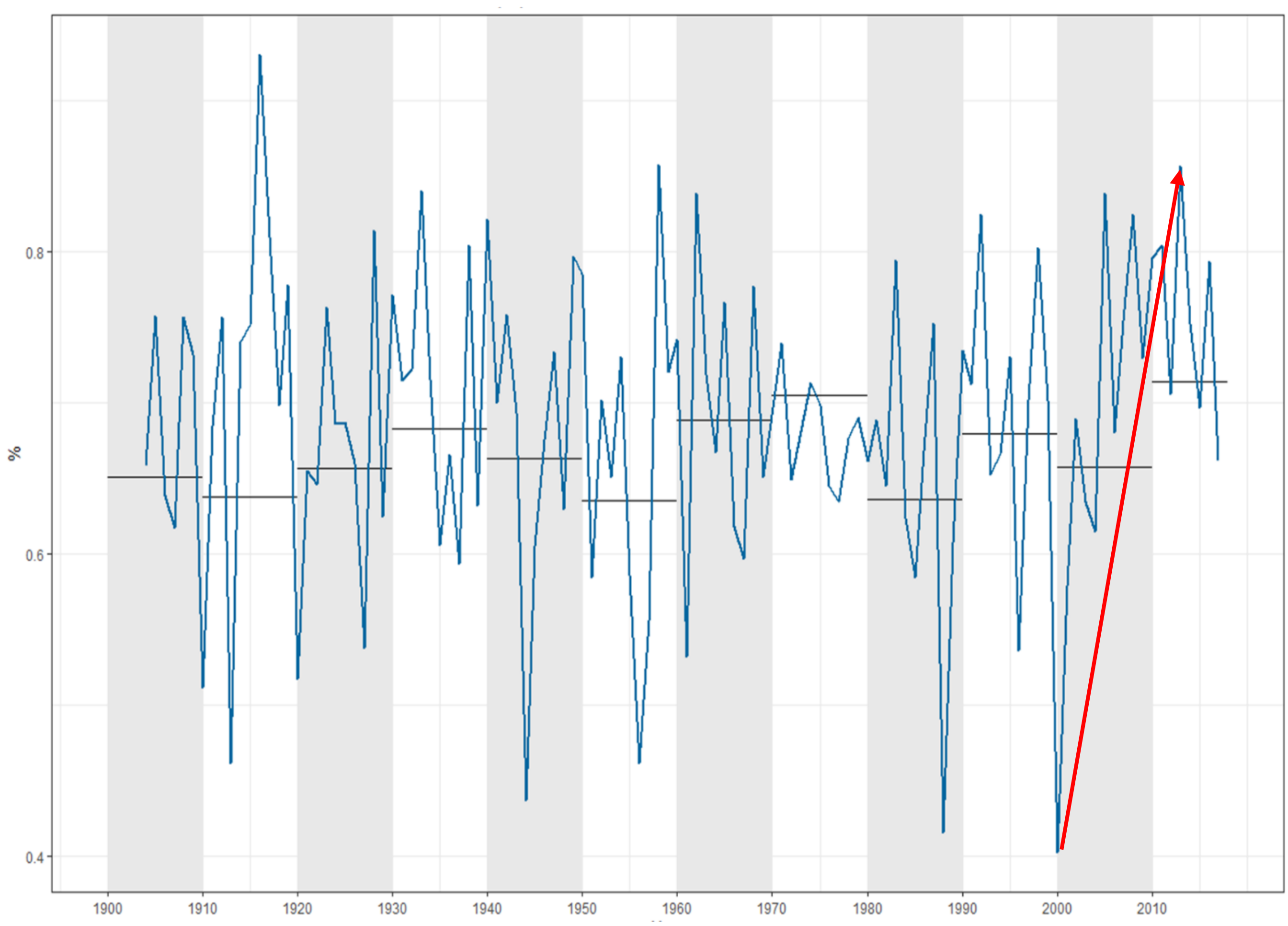

Figure 2.17: November to January rainfall as a percentage of total summer rainfall - Limpopo

Source: BFAP & SAWS, 2020

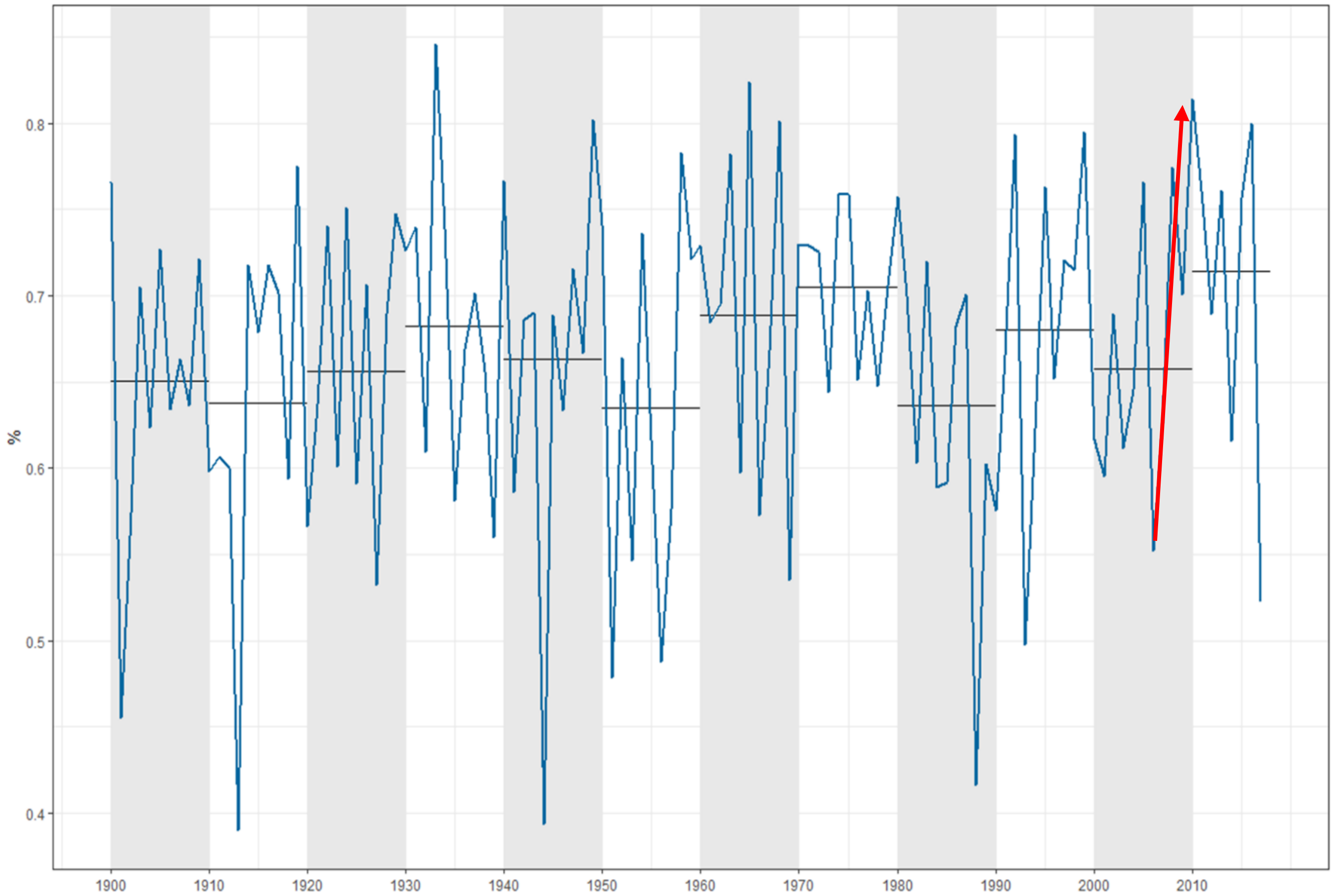

Figure 2.18: November to January rainfall as a percentage of total summer rainfall – North West

Source: BFAP & SAWS, 2020

It is important to note that although the cotton cluster was introduced as an attempt to revive cotton production and the industry at large, some factors which affect area cannot be controlled (such as shifting rainfall patterns in the cases of dryland area). Some challenges remain in the sector (old and new) even after the introduction of the SCC, thus the extent to which these factors impacted the area planted is quantified econometrically in Chapter 4.

2.5 Conclusion

This chapter provided a basic understanding of the global, regional and local cotton demand and supply from reviewing literature and in consultation with industry representatives. It also provided an overview of the changes in the local marketing environment along with a breakdown of how these changes have contributed towards the re-shaping of the SA cotton industry. Conclusions that can be drawn from the chapter are that the demand for cotton globally and from a regional perspective is driven by textile and apparel industries for the manufacturing of clothing and other products. Also, cotton production inevitably varies in response to demand but other factors such as environmental constraints, along with economic and political uncertainties can cause major fluctuations in supply.

Global stock levels have also contributed to the dynamics in cotton demand and supply, through price effects. The price of cotton in SA has shown similar trends as in the global space, therefore it is important to test the relationship between these two markets to determine whether global price movements were transmitted to SA.

CHAPTER 3

EVALUATING COTTON PRICE DYNAMICS IN SOUTH AFRICA

This chapter considers the determinants of South African cotton prices through an evaluation of price transmission between the international and South African cotton markets. This is achieved first by reviewing the literature related to factors that determine prices in the global and domestic markets. Secondly, by providing a background on the methodologies applied to analyse price transmission in cotton markets. Lastly, quantifying the extent of price transmission between SA and the world cotton market from the results of econometric cointegration models. In addition to lint prices, producer price relationships for seed cotton are also analysed, considering both the global cotton price and the local lint price as explanatory variables.

The concept of price transmission between the local and global markets is tested as a precursor to analysing the relationship between total area planted and price which speaks to the objective of identifying the relevant drivers of cotton area and its resultant sustainability going forward.

3.1 Literature Review

Economic theory states that a market price is the equilibrium point where buyers (demand) and sellers (supply) meet in the market. Besides, various economic and non-economic factors can alter the supply and/or demand of a commodity, thus leading to a new equilibrium price. Where a commodity is actively traded and competes with other crops for land, prices shift in response to demand and supply changes. In the same way, new market information can cause changes in supply and demand, resulting in a price shift (CRS, 2006).

In a study conducted on the South African textile industry, Moodley (2003) stressed global cotton demand for utilisation in textile industries as the main driver of cotton prices. Cotton demand supports global prices, which in turn, drives supply. Also, although cotton demand is the main driver of price, the quality of cotton plays an important role in price determination (Mahofa, 2007). In a case where a country forms part of the global market through export contributions, the domestic price (producer price) is expected to be related to the international price (Mahofa, 2007), due to the law of one price. Changes in currency exchange rates between trading nations also affect international trade (global demand) and price. Currency depreciation in a specific exporting country against other exporting countries lead to the same effects as a lowering of its export price thus making products from this country more competitive in the market. In contrast, the depreciation of currency for an importing country will lower import demand, as products from exporters are more expensive (CRS, 2006).

A study conducted on the major factors affecting cotton world price behaviour also supported the concept of cotton demand (for spinning and clothes) as the main driver of the global cotton price but highlighted that demand is subject to the global economic situation. The change in world incomes affects the change in cotton demand more, in comparison to other agricultural products (food). For example, when incomes are low (during global economic crises), consumers cut back on clothing purchases and purchase again when their incomes improve (NCC, 2005). Additional factors listed in this study include shifts in trade and stock policies in large producing countries, the increased efficiency in production, and subsidized yarn prices. Subsidised yarn production causes downward pressure on raw cotton prices, in the same way, improvements in production efficiency for major producers have lowered cotton production costs and pressured prices (NCC, 2005).

The world cotton market is subject to distortions as a result of agriculture and trade policies in large producing and exporting countries. Agricultural policies which contribute towards these distortions include government support programmes in the form of subsidies on cotton production and state reserve policies. Subsidies encourage surplus production thus resulting in flooding in the world market and this has seen global prices falling. Using the early 1990s as an example, a period characterised by low international prices, it was estimated subsidisation policies for cotton production were implemented in more than two-thirds of the cotton-producing countries globally (Mahofa, 2007). In addition, cotton sector support by major producing countries in 2002 amounted to more than a quarter of the global value of cotton production (Baffes, 2005). The US was in the lead, with production support amounting to USD$ 3.6 billion, followed by China US$ 1.2 billion and the EU US$ 1 billion (Mahofa, 2007).

The Chinese stock reserve policy has also been a contributing factor to price distortions in the global market. This is a price regulation mechanism dedicated to protecting cotton producers from price volatility by controlling supply and demand. Regulation responses occur under two possible scenarios, the state reserve absorbs surplus domestic production to keep prices from falling too low and supplies the domestic market if prices and supplies outside of China are such that domestic prices are high relative to the international price. The global trend for import demand in cotton spinning countries suggests that imports are driven by the gap between production and consumption; however, this is not the case in China as state reserves are sometimes sourced through imports, thus impacting import demand. China is the main importer and second-largest producer of cotton in the world, thus any changes in supply (production) or demand (consumption/imports) are reflected in the global cotton price (USDA, 2020).

According to the USDA (2020), China has sold nearly 200 million cotton bales since its accession into the WTO in 2001 and state reserve holdings have changed by an estimated 20 million bales in a single year. Between 1960/61 and 2010/11, the cotton stock-to-use ratio was between 30% and 60% but this has recently increased to 65% and above post-2011/12, moving to levels above 90% in the past two years. China remains at the top of global cotton stocks as a result of the stock reserve policy. The huge build-up in reserves began after the global price shock in 2010 but began reducing in 2014/15 and continued until 2018/19. The reduction in import demand for state reserves in 2014/15 lowered the global price, which led to lower production in 2015/16 and prevented stocks from rising outside China (USDA, 2020).

The global price is strongly correlated with shifts in the Chinese cotton trade. In the period 1977-2002, the correlation between the world price and China's net imports was estimated at

62%. China moved from a closed economy at the beginning of this period, and while it has opened substantially, reliable information on the availability of cotton, particularly stocks remain scarce. Therefore, the unavailability of reliable information on China's stock levels, makes it difficult for the rest of the world to predict China's demand for cotton (NCC, 2005).

The global cotton price is responsive to the factors listed above and these price changes are in some instances (depending on agricultural policy) transmitted to domestic markets as should be the case given the law of one price (Steinwender, 2014). Price transmission analysis is a method largely applied to analyse the links between global and domestic markets in the world, measuring the efficiency with which prices adjust in response to global market changes. This is also the case for cotton specific analyses.

Mahofa (2007) applied an econometric approach (Spearman correlation coefficient) to analyse the relationship between the international lint price and the Zimbabwean cotton price. Interpretation of the results indicated a positive relationship between the world price (Cotlook A Index) and Zimbabwean producer price, therefore an increase in the global price will cause an increase in the price in Zimbabwe. Toosi (2013) conducted a study on the price linkages between the Iranian and world cotton market by applying the Engle-Granger cointegration process and Error Correction Model. The analysis was applied to monthly prices between 2006 and 2010. The results of the study showed that the world cotton price precedes and causes the cotton price in Iran therefore there is no two-way causality between these prices. Furthermore, any price shock induced by the global cotton market causes disequilibrium in the domestic price, which takes more than approximately three months to eliminate. Also, support policies in cotton trade cause the most significant shocks. Moghaddasi et al. (2011) also applied the Error Correction Model and Engle-Granger Method to investigate price transmission between the global and Iranian barley, rice and cotton markets between 1991 and 2008. The study proved that there were long-run relationships between domestic (Iran) and world prices for barley and rice, but no relationship was found for cotton.

The differences in the results of the Iranian price transmission studies were attributed to changing trade patterns. The increase in textile demand coupled with low domestic production supported the surge in cotton imports from other countries (Toossi, 2013). Therefore, the non-existing linkage between domestic and world cotton prices changed to a weak relationship.

In the remainder of this chapter, the theories relating to price transmission as suggested from literature are tested in the South African context, using Engle-Granger cointegration procedures.

3.2 Cointegration between the world and SA cotton price

This section provides the empirical results from analysing price relationships between the global and local cotton markets.

3.2.1 Data

Table 3.1 presents the summary statistics of the data series; as well as the relevant source. Secondary yearly price data from Cotton SA is used to quantify short-run and long-run price relationships between the two markets. The price series contain 37 yearly observations, from 1982 until 2018.

Table 3.1: Summary statistics for cotton production and prices, 1982-2018

	$AIndex$ (c/kg)	$LintSAP_t$ (c/kg)	$SeedCotP_t$ (c/kg)	Seedcotton Production (tons)
Mean	863811.40	939.67	320.67	75979.18
Median	49261.40	795.00	243.00	67737.00
Maximum	3539714.00	2400.00	900.00	196051.00
Minimum	18834.63	167.19	53.500	14069.00
Std. Dev.	999816.60	622.58	242.81	47450.40
Skewness	1.49	0.89	1.02	0.80
Kurtosis	4.32	2.96	3.01	2.89
Jarque-Bera	16.57	4.94	6.42	3.98
Probability	0.00	0.08	0.04	0.13
Observations	37	37	37	37
Source	Cotton SA	Cotton SA	Cotton SA	DAFF
Period	1982-2018	1982-2018	1982-2018	1982-2018

From the descriptive statistics, we can conclude that none of the series is normally distributed, indicated by skewness values that are greater than zero. Positive skewness values indicate positive skewness of the series. In contrast, the kurtosis values indicate that only the domestic lint price and seedcotton production are normally distributed. A series is normally distributed given a kurtosis value of 3 or less.

The Jarque-Bera statistics are considered for further insight on the normality of the series, which indicate normality test results at 1%, 5% and 10%. The results show that the test is significant at all levels for the international cotton price, while the local lint and seedcotton prices are significant at 10%. We, therefore, reject the null hypothesis of normality for the international cotton price. The null hypothesis of a normal distribution is rejected at 5% for the seedcotton price and 10% for the local lint price. We fail to reject the null hypothesis of a normal distribution for seedcotton production. This implies that the series for the local lint price and seedcotton production are normally distributed. In addition, the international cotton price and the domestic seedcotton price series are not normally distributed.

All the series were transformed into log-linear format before conducting the analysis and consequently also the unit root tests. This is done to be able to interpret coefficients as elasticities. Secondly, the use of log-linear formats dampens exponential trends in explosive series (Chimaliro, 2018).

3.2.2 Graphical analysis - domestic price movements relative to the international price

Figure 3.1 gives a representation of the domestic and global cotton prices, as represented by the Cotton A-Index. The seedcotton price is the price received by the producer, while the lint price is relevant at the gin level. Domestic cotton prices have been showing some growth in recent years, particularly between 2011 and 2018, with the highest price recorded in 2017.

From the graphical representation, it appears that a positive correlation exists between domestic and world cotton prices. The growth in domestic prices between 2014/15 and 2018/19 is explained by increases in the A-index due to the continued decline in Chinese stocks which supported a higher price internationally (CottonSA, 2018). Another important factor that contributed to the higher price locally is a stronger exchange rate (Rand/Dollar). To illustrate the effect of the exchange rate on domestic prices even further, the A-index (in dollar terms) increased between 2015 and 2017, resulting in an amplified local price given a weak currency. Interpretations of price relationships (domestic and global) and domestic price movements over time are based on industry discussions and industry reports, an empirical analysis on these prices is included in section 3.2.4.

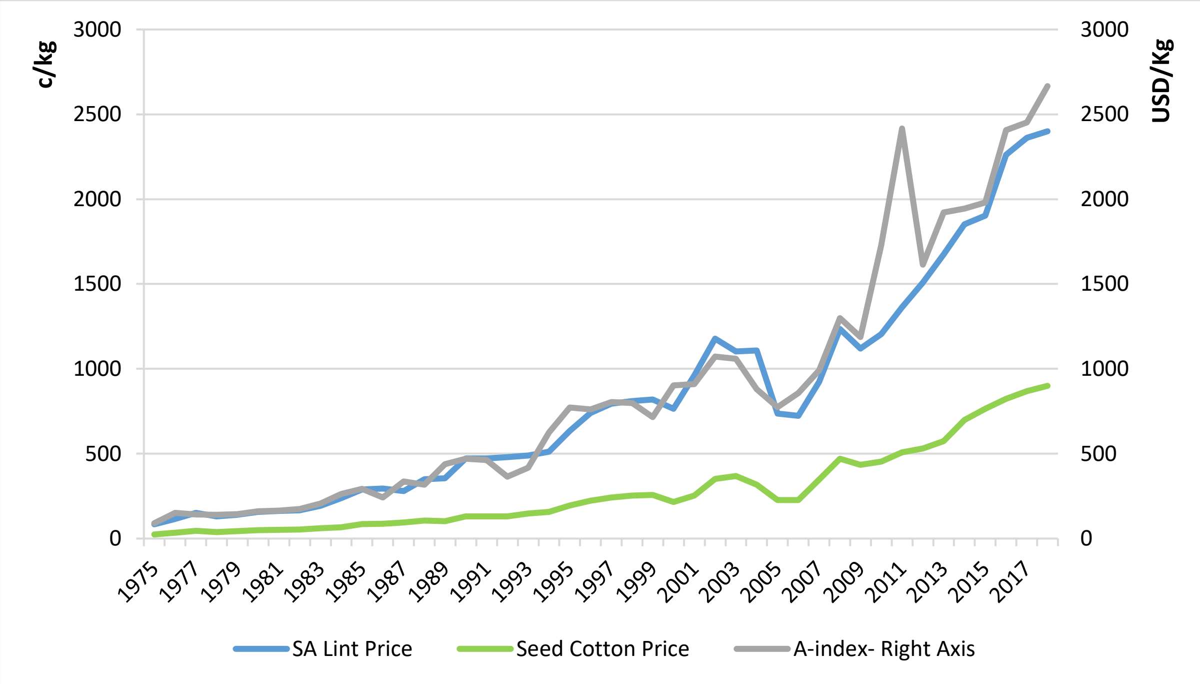

Figure 3.1: Shifts in SA cotton prices relative to the world price

Source: CottonSA, 2019

The difference in the volatility of local prices over time, owing to the changes in marketing regime, specifically pre and post-1996 is also worth noting (Figure 3.1). These changes in the local marketing structure are discussed in detail in Chapter 2. Table 3.2 provides a summary of the price derivation for seedcotton and lint under the two marketing regimes.

Table 3.2: Summary of cotton price formation pre and post-1996

Pre-1996: State Regulated	Post-1996: Open Market - Competition
1. Seedcotton price derived from fixed lint prices 2. Lint prices were derived from the A-index, with minimum and maximum levels set by the marketing board	1. Seed cotton: 2-Step Process - Advanced payment on expected global price - Final payment on the grading of lint 2. Lint prices derived from the A-index on global supply and demand

3.2.2 Methodology

Cointegration models are the most widely used method to analyse price transmission given their benefits of providing both short-run and long-run price dynamics and their ability to provide reliable results where only price data is available (Davids, et al., 2016).

This study employs the residual-based Engle-Granger (1987) methodology to quantify long and short-run dynamics but unit root tests must be conducted first to test core properties of the data. Unit roots are confirmed using the Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) tests. The Augmented Dickey-Fuller (1979) test is based on an autoregressive model and is commonly used in literature to test the null hypothesis of stationarity. Although the ADF test features are inclusive of a deterministic constant, a trend; as well as, a unit root stochastic process, the constant and trend are poorly estimated in the least squares method given the presence of a unit root. This results from the failure of the least squares procedure to separate the stochastic process from the deterministic part. The solution to the weaknesses of the ADF test is using a unit root test with a higher power, such as the PP test, which controls for serial correlation as proposed by Phillip and Perron (1988) (Chimaliro, 2018). The ADF and PP tests are similar in that they test for the null hypothesis of a unit root thus giving assurance of the presence or absence of a unit root when the tests provide the same results (Davids, et al., 2016).

The Engle-Granger procedure consists of two steps. First is the estimation of long-run relationships between global and SA prices, followed by unit root tests on the residual series. According to Davids et al. (2016), a linear combination of two non-stationary series, integrated of the same order and having a long-run relationship is stationary even if they diverge in the short-run. A cointegration relationship among the price series allows for the estimation of short-run dynamics using the Error Correction Model (ECM).

3.2.3 Stationarity Test

The results of formal unit root tests (ADF and PP tests) are presented in Table 3.2. The transformed variables were tested for unit roots at level and at first difference, observing all specifications of unit root testing (intercept, intercept and trend, no trend and intercept).

Table 3.3: ADF and PP test results at level

Variable	Model	ADF		PP	
		Lags	ADF	Bandwidth	PP
$LnLintP_t$	Intercept	0	-1.3957	32	-2.1063
	Trend and Intercept	0	-3.2249*	9	-2.7411
	None	0	3.1053	22	4.5666
$LnAINDX$	Intercept	0	-1.6516	11	-2.2499
	Trend and Intercept	0	-2.8702	5	-2.7804
	None	0	3.4433	7	3.9831
$LnSeedCotP_t$	Intercept	2	-0.7859	21	-1.0939
	Trend and Intercept	1	-4.4911***	32	-2.9188
	None	2	3.2857	22	5.9863
$LnSdCotProd$	Intercept	0	-2.0154	2	-1.9651
	Trend and Intercept	0	-2.2402	2	-2.2897
	None	0	0.1016	0	0.7086

*Asterisks ***, **, * denote statistical significance at 1%,5% and 10% levels respectively*

Table 3.4: ADF and PP test results at first difference

Variable	Model	ADF		PP	
		Lags	ADF	Bandwidth	PP
$\Delta LnLintSAP_t$	Intercept	0	-5.3526***	34	-7.2030***
	Trend and Intercept	0	-5.3231***	34	-8.2803***
	None	0	-4.4072***	4	-4.3283***
$\Delta LnAINDX$	Intercept	0	-5.5199***	11	-5.8091***
	Trend and Intercept	0	-5.5985***	13	-6.6395***
	None	0	-4.2899***	4	-4.2897***
$\Delta LnSeedCotP_t$	Intercept	1	-6.1377***	17	-6.0504***
	Trend and Intercept	1	-6.0612***	17	-5.9739***
	None	1	-4.3272***	11	-4.0922***
$\Delta SdCotPrd$	Intercept	1	-5.2741***	0	-6.1866***
	Trend and Intercept	1	-5.2989***	0	-6.1688***

	None	1	-5.3592***	0	-6.2753***

*Asterisks ***, **, * denote statistical significance at 1% ,5% and 10% levels respectively;* Δ *denotes the first differenced operator*

The unit root test results show that all variables are non-stationary at level (Table 3.2) but became stationary after differencing once (Table 3.3). This implies that variables are integrated of order one (*I* (1)). ADF and PP statistics are significant at 1% for all first differenced variables therefore we reject the null hypothesis of a unit root.

Econometric theory suggests that a cointegration relationship may be present between two variables that are integrated of the same order. As unit root test results show that the variables are non-stationary but become stationary after being differenced once (*I* (1)), cointegration relationships can be estimated between the price series.

3.2.4 Engle-Granger cointegration procedures

The value chain diagram in chapter 2 (Figure 2.7) provided an overview of cotton at different stages of the value chain. The flow of the product from production to processing implies that different prices apply to it depending on the level in the supply chain. Therefore, seedcotton and processed cotton (lint) are priced differently. The similarity in price formation across the value chain is that there is no government intervention, which means that prices are negotiated between buyers and sellers and the agreed price is dependent on market forces.

It is expected that the SA price for lint is determined by the international price and the exchange rate at that time, given trade patterns (previously net importer of lint but now exporter); however, this assumption will be tested using cointegration procedures. The literature review in section 3.1 listed the various factors which contribute towards price formation in the global market. Changes in these factors contribute towards price volatility in the world market. These include quality, global cotton demand, production, and stock levels. If global cotton market prices are linked to domestic prices, this would imply that the resulting changes in the international price would also be reflected in the domestic market.

Producer prices for seed cotton are also analysed for cointegration relationships. Discussions with Bruwer (2020), a representative from Cotton SA suggests that the price of seedcotton is negotiated between the seller (farmer) and the buyer (gin), on a contract basis. This institutional marketing arrangement is widely used to reduce transaction costs. Contract farming offers mutual benefits to both the grower and the ginners. To the producer, the main benefit is a guaranteed market, while ginners have a reliable and guaranteed supply. These annual contracts enable ginners to increase seedcotton supply to use ginning capacity more fully. In addition, the ginner and grower agree on quality principles (determined by production procedure) since quality is an important aspect when the ginner sells to the spinners.

According to Bruwer (2020), the seedcotton price is determined in a two-step process; first, the farmer will receive an advanced payment from the ginner, which is derived from the expected international lint price. Consecutively, once the lint extracted from the seedcotton is sold, the farmer receives a final price based on the quality, grade and realisation of the pool price (Bruwer, 2020). Market price differences also depend on local supply and demand conditions.

Cotton prices are lowest in production zones and highest around processing centres (CRS, 2006).

The contract between the ginner and the farmer is renewed on an annual basis and it includes specifications on the quantity exchanged and the quality of the seedcotton. The ginner sources seedcotton based on ginning capacity and may contract with different farmers. However, the seedcotton quality also plays an important role in pricing as different grades receive different prices. Cotton grades are important in the agreement between the ginner and the spinner. A spinner requires cotton lint of specific length and strength (determined by quality) to produce different products. For example, the production of yarn would require a certain length or strength which might differ in the manufacturing of thread. Thus, the price of seedcotton is relevant between the farmer and the ginner and the lint price between the ginner and the spinner.

As there is a possible link between the domestic cotton market and the international market, long-run cointegration tests are performed to test the relationship between the world cotton price and the domestic lint price; as well as the local producer price. In addition, because the seedcotton quality determines the quality of the lint produced, the relationship between the seedcotton price and the local lint price is also tested. The expectation is that the seedcotton price is linked to both the international cotton price and the local lint price given discussions with industry representatives and the theories from literature.

3.2.4.1 Cointegration test

The appropriate number of lags for the analysis are determined prior to performing the cointegration tests. A large number of lags leads to loss of degrees of freedom which may cause issues of multicollinearity, serial correlation and misspecification of error terms. The determination of the appropriate number of lags is an empirical process that is achieved by running a diagnostic test on the unrestricted Vector Auto Regressive (VAR) model (Chimaliro, 2018).

Table 3.5: Lag selection results for cotton prices

Variables	Lags	LogL	LR	FPE	AIC	SC	HQ
$\boldsymbol{LnSALintP_t}$	1	33.0554	10.3534*	0.0010*	-1.7680*	-1.6333*	-1.7220*
$\boldsymbol{LnSeedCotP_t}$	2	31.3041	6.6067*	0.0118*	-1.6061*	-1.4266*	-1.5449*
$\boldsymbol{LnSeedCotP_t}$	2	38.8782	3.0075	0.0075*	-2.0517*	-1.8721	-1.9904*

Asterisks (*) denotes lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Table 3.4 shows the results of the diagnostic test based on the LR, FPE, AIC, SC and HQ criteria. The number of lags is selected based on the lowest value in each criterion, as indicated by the asterisk (*).

The second step of the Engle-Granger cointegration procedure is to estimate long-run relationships and to test for stationarity of the residual series. The cointegration test is based on the following hypothesis:

Ho: No long-run relationship exists between variables

H1: Long-run relationship exists between variables

The following cointegration equations are used to estimate long-run relationships between prices:

$$LnLintP_t = \alpha_0 + \beta_i \, LnAINDX + \varepsilon_t \quad (1)$$

Where

$LnLintP_t$ is the natural log of the SA lint price

β_i is the long-run price transmission elasticity

LnAINDX is the natural log of the world cotton price

ε_t is the error term

$$LnSeedCotP_t = \alpha_0 + \beta_i \, LnAINDX + \varepsilon_t \quad (2)$$

Where

$LnSeedCotP_t$ is the natural log of the producer price in SA

βi is the long-run price transmission elasticity

LnAINDX is the natural log of the world cotton price

εt is the error term

$$LnSeedCotP_t = \alpha_0 + \beta_i LnLintP_t + \varepsilon_t \quad (3)$$

Where

$LnSeedCotP_t$ is the natural log of the producer price in SA

βi is the long-run price transmission elasticity

$LnLintP_t$ is the natural log of the SA lint price

εt is the error term

The tables below represent the results of the specified cointegration equations.

Table 3.6: Cointegration equation - SA lint price

Variable	Coefficient & Elasticity	Test statistic
Ln world cotton price	0.49	39.96***
Intercept (c)	0.31	1.97*

*Asterisks ***,**, * denote statistical significance at 1%, 5% and 10% levels respectively*

Table 3.7: Cointegration equation - seedcotton price (A-index)

Variable	Coefficient	Test statistic
Ln world cotton price	0.54	34.39***
Intercept (c)	-1.46	-7.20***

*Asterisks ***, **, * denote statistical significance at 1%, 5% and 10% levels respectively*

Table 3.8: Cointegration equation - seedcotton price (SA lint price)

Variable	Coefficient	Test statistic
Ln SA lint price	1.10	50.50***
Intercept (c)	-1.78	-12.33***

*Asterisks ***, **, * denote statistical significance at 1%, 5% and 10% levels respectively*

The results in the tables (Table 3.5, Table 3.6 and Table 3.7) indicate economic significance as the coefficients are in line with priori expectations. Explanatory variables are also statistically significant while the F-statistics (1596, 1182 and 2552, respectively) render the models significant. A comparison of the seedcotton cointegration equations suggests that the model where the local lint price is used as an explanatory variable performs better, as shown by the higher F-statistic of 2552.

Given that the variables were determined as non-stationary, no statistical inference can be drawn from the results, but we can interpret long-run elasticities from the coefficients as the variables were specified in the log-linear form. Elasticities are interpreted once long-run relationships are verified.

Since OLS equations have been estimated, the next step is to verify long-run relationships by performing unit root tests on the residuals. Table 3.8 presents the results of the cointegration tests.

Table 3.9: Results of the Engle-Granger cointegration procedures for cotton prices

Dependent	Independent	Lag	β1	Engle-Granger Procedure		Conclusion
				ADF	PP	
South Africa (lint)	**World (lint)**	1	0.4896***	-4.7039***	-4.6121***	Co-integrated
South Africa (seedcotton)	**World (lint)**	2	0.5394***	-3.7885***	-3.8446***	Co-integrated
South Africa (seedcotton)	**South Africa (lint)**	2	1.0984***	-2.9139*	-2.9161*	Co-integrated

*Asterisks ***, **, * denote statistical significance at 1%, 5% and 10% levels respectively*

The statistics from the Engle-Granger cointegration test indicates that we reject the null hypothesis of no presence of a long-run relationship for all the pairs.

For the co-integrated series, β_1 is the price transmission elasticity which indicates the percentage change in the price of the dependent market given a 1% change in the price of the independent market (Davids, et al., 2016). The results of the cointegration estimations indicate that a 10% change in the world cotton price will cause a 4.9% change in local lint prices. Also, a 10% change in the world cotton price will result in a 5.4% increase in the local producer price. The long-run price transmission coefficients are significant for both the co-integrated series pairs. A 10% increase in the domestic lint price will induce an increase of 11% in the producer price.

3.2.4.2 Estimation of Error Correction Models

Since long-run relationships have been assessed and the presence of cointegration relationships are indicated, the next step is the estimation of ECM models, to quantify short-run price effects around the long-run equilibrium relationship. In an ECM, variables are used in the first differenced form to render them stationary.

The generic representation of the models are specified as follows:

$$\Delta LnLintSAP_t = \alpha_0 + \Delta LnAINDX_{t-i} + \alpha_1 EC_{\mathrm{t-1}} + \varepsilon_t \qquad (4)$$

Where

$\Delta LnLintSAP_t$ is the natural log of the local lint price in the first difference form

$\Delta LnAINDX_t$ is the natural log of the world cotton price in first difference form

EC_{t-1} is the error correction term

ε_t is the associated error term

$$\Delta LnSeedCotP_t = \alpha_0 + \Delta LnAINDX_{t-i} + \alpha_1 EC_{\mathrm{t-1}} + \varepsilon_t \qquad (5)$$

Where

$\Delta LnSeedCotP_t$ is the natural log of the local producer price in first difference form

$\Delta LnAINDX_t$ is the natural log of the world cotton price in first difference form

EC_{t-1} is the error correction term

ε_t is the associated error term

$$\Delta LnSeedCotP_t = \alpha_0 + \Delta LnLintSAP_{t-i} + \alpha_1 EC_{t-1} + \varepsilon_t \quad (6)$$

$\Delta LnSeedCotP_t$ is the natural log of the local producer price in first difference form

$\Delta LnLintSAP_t$ is the natural log of the local lint price in the first difference form

EC_{t-1} is the error correction term

ε_t is the associated error term

Table 3.10: Short-run equation (ECM) - lint price

Variable	Coefficient	T-Statistic
D(world cotton price)	0.2496	3.8228***
EC(-1)	-0.7881	-5.4294***
Intercept (c)	0.0358	2.0029

*Asterisks ***, **, * denote statistical significance at 1%, 5% and 10% levels respectively*

Table 3.11: Short-run (ECM) equation - seed cotton price (A-index)

Variable	Coefficient	T-Statistic
D(world cotton price)	0.2867	3.5354***
EC(-1)	-0.5284	-3.7368***
Intercept (c)	0.0347	1.5769

*Asterisks ***, **, * denote statistical significance at 1%, 5% and 10% levels respectively*

Table 3.12: Short-run equation (ECM) - seedcotton price (SA lint price)

Variable	Coefficient	T-Statistic
D (Ln SA lint price)	0.9688	10.7549***
EC (-1)	-0.3118	-2.4169***
Intercept (c)	0.0064	0.4827

*Asterisks ***, **, * denote statistical significance at 1%, 5% and 10% levels respectively*

The estimation results are presented in Table 3.9, Table 3.10 and Table 3.11 above. The adjustment coefficient is significant, with the expected sign (negative) for all ECM equations. The coefficient of the error correction term that is negative and between 0 and 1, is an indication that it is mean reverting and therefore that the system will converge to equilibrium over time if a disequilibrium is introduced. This variable indicates the amount of disequilibrium that will be corrected in a certain period, t or the time it will take for the system to move back to equilibrium. A positive value implies that no convergence back to equilibrium can take place.

The adjustment coefficient where the local lint price is the independent variable (-0.78) indicates that 78% of any price shock induced by the world market causing disequilibrium in the domestic lint market will be corrected in period t.

Comparing the two equations for seedcotton prices (Table 3.10 and Table 3.11), 52% of the disequilibrium is corrected in period t given a shock in the world price suggesting that correction is faster, compared to the 31% correction resulting from a shock in the local lint price.

The results of the Engle-Granger cointegration procedure show that price effectiveness in the long-run is more than in the short-run. The results are also in line with priori expectations that the domestic lint price is linked to the world price given the presence of trade. Comparisons with the study by Toosi (2013) suggest that SA is more strongly tied to the world market.

The output from the cointegration test also verified that producer prices are linked to both the world price and the local lint price. This was expected as the seedcotton quality is determinant of the lint quality, which influences the lint price. In turn, the lint price is also influenced by the world price. From the results, it can be concluded that South African cotton markets are well integrated into the global market, as was expected given the nature of trade.

3.2.4.3 Diagnostic tests on ECM

Once an ECM is estimated, it is important to conduct diagnostic tests to establish the validity of the results obtained. A series of diagnostic tests are performed on the ECM estimation to test for violations in the assumptions of classical normal linear regression models which include normality, heteroscedasticity, autocorrelation and misspecification. The ECM is accepted if none of the assumptions tested is violated. The diagnostic tests conducted on the models are presented below (Table 3.12, Table 3.13 and Table 3. 14).

Table 3.13: ECM diagnostic tests - SA lint price

Test	H_0	Test Statistic	*p*-Value	Conclusion
Jarque-Bera	Residuals are normally distributed	**JB (2)** = 6.47	0.03**	Residuals are not normally distributed
Ramsey RESET	No misspecification	**LR (2)** = 1.29	0.2	No misspecification
Ljung-Box Q	No serial correlation up to 6th order	**LB_Q (6)** = 5.31	0.5	No serial correlation up to 6th order
Breusch-Godfrey LM	No serial correlation up to second order	**$nR^2(2)$** = 3.94	0.14	We fail to reject the null hypothesis of no serial correlation
ARCH LM	No ARCH (autoregressive conditional heteroscedasticity)	**$nR^2(2)$** = 2.80	0.10	No ARCH (autoregressive conditional heteroscedasticity)
White	No heteroscedasticity of general form	**nR^2(no CT)** = 9.68	0.08*	Presence of heteroscedasticity

(*) [**] (***) Statistically significant at 10%, 5%, 1%

According to the results in Table 3.12, although there is no misspecification and there is no presence of serial correlation or heteroscedasticity (ARCH LM), the null hypothesis normal distribution of residuals is rejected at a 5% level. The model is accepted as the OLS assumptions of normality, misspecification, serial correlation and heteroskedasticity are not violated at the most extreme level of significance (1%).

Table 3.14: ECM diagnostic tests - seedcotton price (A-index)

Test	H_0	Test Statistic	*p*-Value	Conclusion
Jarque-Bera	Residuals are normally distributed	**JB (2)** = 10.58	0.01**	Residuals are not normally distributed
Ramsey RESET	No misspecification	**LR (2)** = 0.91	0.37	No misspecification
Ljung-Box Q	No serial correlation up to 6th order	**LB_Q (6)** = 10.79	0.10	No serial correlation up to 6th order
Breusch-Godfrey LM	No serial correlation up to second order	**$nR^2(2)$** = 5.46	0.06*	Reject the null hypothesis of no serial correlation at 10%
ARCH LM	No ARCH (autoregressive conditional heteroscedasticity)	**$nR^2(2)$** = 1.07	0.30	No ARCH (autoregressive conditional heteroscedasticity)
White	No heteroscedasticity of general form	**nR^2(no CT)** = 1.30	0.94	No heteroscedasticity

(*) [**] (***) Statistically significant at 10%, 5%, 1%

Results from Table 3.13 show that residuals are not normally distributed, in addition, we reject the null hypothesis of no serial correlation up the second order at a 10% level of significance.

Table 3.15: ECM diagnostic tests - seedcotton price (SA lint price)

Test	H_0	Test Statistic	*p*-Value	Conclusion
Jarque-Bera	Residuals are normally distributed	**JB (2) =** 0.54	0.76	Residuals are normally distributed
Ramsey RESET	No misspecification	**LR (2) =** 0.36	0.72	No misspecification
Ljung-Box Q	No serial correlation up to 6th order	LB_Q **(6) =** 4.38	0.63	No serial correlation up to 6th order
Breusch-Godfrey LM	No serial correlation up to second order	$nR^2(2)$ **=** 0.66	0.72	We fail to reject the null hypothesis of no serial correlation
ARCH LM	No ARCH (autoregressive conditional heteroscedasticity)	$nR^2(2)$ **=** 1.21	0.54	No ARCH (autoregressive conditional heteroscedasticity)
White	No heteroscedasticity of general form	nR^2**(no CT) =** 3.55	0.62	No heteroscedasticity

(*) [**] (***) Statistically significant at 10%, 5%, 1%

Table 3.14 gives the results of the diagnostic tests on the seedcotton ECM where the local lint price was the independent variable. From the results, we accept this model given that none of the OLS assumptions was violated at 5%, compared to the model in Table 3.13 .

3.3 Determining different factors that drive producer prices

Since producer prices are determined by both the international cotton price and the cotton grade realisation process, section 3.2.4 analysed cointegration relationships in this respect. From the empirical results, it was shown that a cointegration relationship is present between both the local cotton prices and international cotton lint prices (Table 3.8). However, a stronger long-run relationship exists between the producer price and the domestic lint price, indicating that lint quality could play a more important role in the price determination process. Therefore, this section focuses on determining the impact of both quality and supply on producer prices. The local lint price is used as a measure of lint quality, while seedcotton production is used as a measure of seedcotton supply.

Engle-Granger cointegration procedures discussed in section 3.2 are employed to evaluate the relationship between the producer price and possible explanatory variables. Given that summary statistics (section 3.2.2) and stationarity testing (section 3.2.3) are included in section 3.2, the next step is to conduct the cointegration test to quantify long-run relationships, followed by the estimation of an ECM to quantify short term variation around the long-run relationships.

3.3.2 Cointegration test

The cointegration equation can be conceptualised as follows:

$$LnSeedCotP_t = a + \beta_1 LnLintSAP_t + \beta_2 LnSdCotProd + \varepsilon_t \quad (7)$$

Where

$LnSeedCotP_t$ is the natural log of the producer price

$LnLintSAP_t$ is the natural log of the SA lint price

LnSdCotProd is the natural log of domestic seedcotton production

ε_t is the error term

Estimation of an OLS (ordinary least squares) regression, where the dependent variable was the natural log of the cotton producer price in SA yields the results summarised in Table 3.15. From the estimated results, we note that explanatory variables are significant, while the F-statistic of 1497 renders the model significant. The signs of the coefficients are in line with priori expectations.

The results of the cointegration equation only provide an initial guide in terms of the relevance of the chosen variable, but no statistical inference can be drawn from them given that variables are non-stationary (Van Eyden & Inglesi-Lotz, 2018).

Table 3.16: Engle-Granger cointegration equation for local producer prices

Variable	Coefficient	T-Statistic
Ln SA lint price	0.6076	5.0528***
Ln SeedCotton production	-0.0575	-2.4080**
Intercept (c)	3.1985	

*Asterisks ***, **, * denote statistical significance at 1%, 5% and 10% levels respectively*

Given that the model was specified in the log-linear form, elasticities can be interpreted directly from the coefficients of the explanatory variables. An elasticity of 0.61 on the domestic lint price suggests that a 10% increase in the lint price will result in an increase of 6.1% in the producer price. Similarly, an increase of 10% in seedcotton production reduces producer prices by 0.5%. This implies that producer prices are more responsive to changes in the lint price in comparison to shifts in production.

Table 3.16 presents the results of the cointegration test performed on the residual of the OLS equation. According to Van Eyden & Inglesi-Lotz (2018), the Engle-Granger cointegration test is essentially an application of the ADF test for non-stationarity on the residuals of a suspected co-integrating equation. Based on the ADF test results, it is concluded that the residual series is stationary; therefore a long-run co-integrating relationship exists between the dependent and independent variables.

Table 3.17: Results of the Engle-Granger cointegration test

Unit root test	Results		Null hypothesis	Conclusion
ADF	Intercept	-1.9812	Residual series has a unit root- no cointegration	Residual series does not have a unit root and therefore cointegrated
	Intercept and trend	-4.4148***		
	None	-2.0937**		

*Asterisks ***, **, * denote statistical significance at 1%, 5% and 10% levels respectively*

3.3.3 Estimation of Error Correction Model

As a long-run co-integrating relationship has been established, an error correction model is estimated to account for short-run variation using the long-run relationship. Seedcotton production was found to be insignificant in the ECM and thus excluded in the estimation. The ECM equation is represented as follows:

$$\Delta LnSeedCotP_t = \alpha_0 + \beta_1 \Delta LintSAP_{t-i} + EC_{\mathrm{t-1}} + \varepsilon_t \quad (8)$$

Where

$\Delta LnSeedCotP_t$ is the natural log of the producer price in first difference form

$\Delta LintSAP_{t-i}$ is the natural log of the world cotton price in first difference form

EC_{t-1} is the error correction term

ε_t is the associated error term

Table 3.18: ECM estimation results

Variable	Coefficient	T-Statistic
D (Ln SA lint price)	0.8263	12.2960***
EC (-1)	-0.3761	-3.1077***

*Asterisks ***, **, * denote statistical significance at 1%, 5% and 10% levels respectively*

The estimated results of the specified model are summarised in Table 3.17 above. The negative sign of the coefficient on the error correction term indicates that the system converges back to equilibrium upon an external shock. The magnitude of the coefficient (0.37) suggests that 37% of the error will be corrected in time t.

The coefficients for lint price is in line with priori expectations. Test-statistics of the short-run model are also significant, while the F-statistic (82.62) indicates that the model is significant as a whole. The model is a good fit, with an adjusted R^2 value of 0.82.

The adjusted R^2 from the estimation of the ECM yields a low value in comparison to the cointegration equation (0.98). Davids (2013), indicates that differencing variables often reduces the goodness of fit in agricultural models. Further, graphical examination of the estimated function is an important consideration when evaluating a model economically. A graphical representation of the ECM model allows for a comparison between the actual and fitted values of the ECM.

Figure 3.2 provides a graphical representation of the ECM. The graphical illustration shows that the turning points of the estimated function are represented well.

Figure 3.2: Comparison of actual and fitted values from the ECM

3.3.4 Diagnostic tests

The same tests conducted in section 3.2.4.2 were used to test the producer price ECM (7). The results of the diagnostic tests are included in Table 3.18.

Table 3.19: ECM diagnostic tests

Test	H_0	Test Statistic	*p*-Value	Conclusion
Jarque-Bera	Residuals are normally distributed	**JB (2) =** 0.82	0.66	Residuals are normally distributed
Ramsey RESET	No misspecification	**LR (2) =** 0.34	0.57	No misspecification
Ljung-Box Q	No serial correlation up to 6th order	**LB_Q (6) =** 5.61	0.47	No serial correlation up to 6th order
Breusch-Godfrey LM	No serial correlation up to second order	**nR^2(2) =** 1.86	0.39	We fail to reject the null hypothesis of no serial correlation
ARCH LM	No ARCH (autoregressive conditional heteroscedasticity)	**nR^2(2) =** 0.52	0.47	No ARCH (autoregressive conditional heteroscedasticity)
White	No heteroscedasticity of general form	**nR^2(no CT) =** 1.36	0.93	No heteroscedasticity

(*) [**] (***) Statistically significant at 10%, 5%, 1%

From the diagnostic test results, there is no misspecification in the model, the white test also indicates no heteroscedasticity. The results also show that the residuals are normally distributed; therefore, we can accept the model as none of the tests was violated at 5%.

When comparing the two sets of estimations for seedcotton price, the model that is purely derived from lint prices (Table 3.7), as a measure of lint quality performs better, with a higher F-statistic (2552) compared to the second model (Table 3.15) which includes quality and seedcotton production as explanatory variables (F-statistic = 13). It is also evident that the domestic lint price is the most important factor determining seed cotton prices considering the relative elasticities in the respective equations.

The quality of the lint extracted from seedcotton in a particular consignment is vital across all levels of the value chain. The benefit of good quality seedcotton to the farmer is a boost in the price of the lint extracted, thus improving the price received by the producer. For the ginner, good quality lint is beneficial as this determines the price realised from sales to spinners and how it is marketed internationally as lint of specific grades attracts higher (premium) prices. Although cotton quality needs are different depending on the final product, quality differences affect the price; as well as, the value that manufacturers can get from the cotton (Estur, 2008).

3.4 Conclusion

This chapter applied a well-established methodology of Engle-Granger cointegration to test certain relationships between cotton lint and seed cotton prices, and a range of explanatory variables. Empirical analysis showed that both the domestic lint prices; as well as the seedcotton prices are linked to the global cotton market. Literature on studies conducted on cointegration relationships between Iranian and world cotton prices suggests that these price relationships are reinforced by the increase in trade. This implies that the more a country is linked to the global market through imports, the more likely a cointegration relationship will exist. SA was historically a net importer of cotton lint (except for 2018), which explains the positive elasticity of 0.5 (SA lint - world cotton) obtained from the results.

The goal for applying Engle-Granger procedures on domestic producer prices was to first determine whether these prices are determined by domestic lint prices or the world cotton price. Empirical results verified both instances, but the local lint price performed better when included in the cointegration equation, in comparison to the world cotton price. Also, the price transmission elasticity was higher using the domestic lint price and an exogenous variable. Discussions with industry representatives indicated that producer prices to some extent are determined by the grading system which considers the quality of the lint. Given that lint prices are determined by the world cotton price, it seems relevant that the seedcotton price is also linked to the international price for cotton.

As the ECM for the producer price, where the domestic lint price was used as an explanatory variable was accepted, price determination at the producer level was further analysed by introducing a supply variable. Seedcotton production levels were used as an explanatory variable in addition to the lint price and the equation was tested for cointegration. A cointegration relationship was also verified in this case. In addition, of all the factors analysed empirically as determinants of the seedcotton price, the cotton lint price is the most important factor, indicating the significance of quality in the cotton grading system.

CHAPTER 4

QUANTITATIVE EVALUATION OF THE SHIFTS IN SA COTTON PRODUCTION

This chapter evaluates the changes which have occurred in domestic cotton production as a result of the introduction of some industry interventions whilst accounting for international price dynamics, which were shown in the previous chapter to transmit into South African markets. The South African cotton industry had been experiencing a downturn for some time, indicated in the decline in the area planted to cotton over the past two decades. The challenges faced by the industry initiated some sector-specific interventions, and the most recent commenced in 2014. Although there have been other interventions before, the efforts of recent initiatives, specifically the SCC are believed to have led to more noticeable changes or improvements in the industry. However, this initiative was introduced over a period also marked by higher cotton prices globally. Therefore, this chapter aims to test the hypothesis that the introduction of the SCC initiative has supported the growth in cotton production. As the SCC occurred over a period where cotton prices increased, relative effects of both these factors are analysed empirically, through cointegration analysis.

The chapter first provides a literature review on research previously conducted on the economic analysis of cotton production, followed by a representation and discussion of empirical results.

4.1 Literature Review

Extensive research has been conducted on the determinants of cotton production in several African countries from which lessons can be drawn in analysing the factors which influence cotton production in SA. Gillson et al. (2004) analysed the long-term determinants of cotton production in several African countries between 1960 and 2002. The results of the study show that area planted and seedcotton production are correlated to current and past season's seedcotton price in the period 1990-2001.

Mahofa (2007), studied the determinants of cotton production in Zimbabwe (1965-2006). The results of the study show that both price and non-price factors affect production. OLS regression techniques were applied to analyse the relationship between area and factors including the lagged cotton area, lagged producer prices (real), the lagged maize producer price (real), inflation (lagged), real expenditure on research and extension, real agricultural credit, a dummy for structural adjustment programmes, rainfall, and the world cotton price. Empirical results reveal that the major factors were government expenditure on research and short-term credit extended to farmers. Low supply response elasticities were documented for the own price and that of substitute products (maize).

Several cointegration techniques are employed for empirical analyses in agricultural studies, Davids et al. (2017) have applied the ARDL cointegration procedure in analysing price transmission between various maize markets in Southern Africa, including SA, Zambia and Zimbabwe. The ARDL technique was applied given inconclusive unit root test results on the underlying variables at levels but confirmed stationarity at first difference. Abbas et al. (2019) employed the ARDL procedure to analyse the effect of price support and wheat production in Pakistan.

Sisal et al. (2007) applied the Johansen cointegration and ECM technique to analyse cotton supply response on price and non-price variables. This method was used for testing cointegration given non-stationarity (I (1)) in the series. In contrast to the cointegration techniques employed in the studies mentioned above, Mahofa (2007) used the Ordinary Least Squares (OLS) method to determine the relationship between cotton supply and major factors affecting cotton production. The OLS technique is based on the assumption of stationarity of the underlying time series or at least around a deterministic trend.

It is worth noting that the applicability of econometric techniques is dependent on unit root characteristics. While conventional methods assume stationarity, constant mean and variance, recent econometric developments acknowledge that time series may not always display these features. As a result, cointegration procedures are increasingly applied in econometric analysis (Nkoro & Uko, 2016).

The study by Mahofa (2007) provides a basic guideline on the explanatory variables to consider in estimating cotton area, while the empirical approach applied by Davids et al. (2017) and Abbas et al. (2019) support the choice of econometric analysis for this study.

While there have not been any econometric studies published on the determinants of cotton production in South Africa, the study by Davids et al. (2017) also provides an example of the application of a cointegration approach to a domestic agricultural commodity market.

4.2 Graphical analysis - area and local cotton demand

This section provides an analysis of the trends in cotton area and explanatory variables which are used in the estimations. The selection of variables was based on industry information from discussions with representatives as well as the literature review on the determinants of cotton supply.

Figure 4.1 is a representation of cotton area and local procurement. Local procurement refers to the amount of lint processed locally[25] which is attributed to domestically produced lint[26]. Total lint utilisation is recorded as the sum of lint produced locally, which is absorbed in the local value chain and lint procured through imports, therefore local procurement is calculated as the difference between total processing (local) and lint imports. That is:

$$\text{Local Procurement } = \text{Total Lint Processing}_{(\text{mill})} - \text{Lint Imports}$$

Local procurement is used as a proxy for the SCC (which introduced domestic procurement initiatives), to measure its impact on local supply. Specifically, to analyse empirically whether the drive towards domestic procurement resulted in an area response from producers. As mentioned earlier, it is of importance to note that local procurement is an imperfect representation of the SCC, but the best we have given data availability. From the graph, we can

[25] Processing at the mill level into yarn and other cotton products
[26] Lint extracted from SA produced seedcotton after ginning

see that local procurement increased in the period 2014 to 2017, reaching a peak in 2017 and declining again in 2018, attributed to the decline in seedcotton production and thus processing in the pipeline, as indicated in Figure 2.15.

The total cotton area has decreased significantly over time, owing to a variety of economic factors. Cotton area has declined from levels of over 200 thousand hectares in the 1980s to a low of about five thousand hectares in 2009. The most important of the factors which dampened area is identified as lower productivity as a result of lower prices and high input costs, relative to substitute crops. Pricing dynamics were discussed in chapter 3, while a comparison of global cotton and grain prices is included in chapter 2 (Figure 2.9).

Empirical results from analysing price relationships showed that the seedcotton price is tied to both the local lint price and the world cotton price. In addition, it was confirmed that the strongest link is with the local lint price, which is also influenced by international lint prices. However, as the planting seasons in the northern hemisphere precedes that of the southern hemisphere, cotton producers in the southern hemisphere can make decisions on area (increases or reductions) based on market information that was not available to their northern hemisphere counterparts (NCC, 2005).

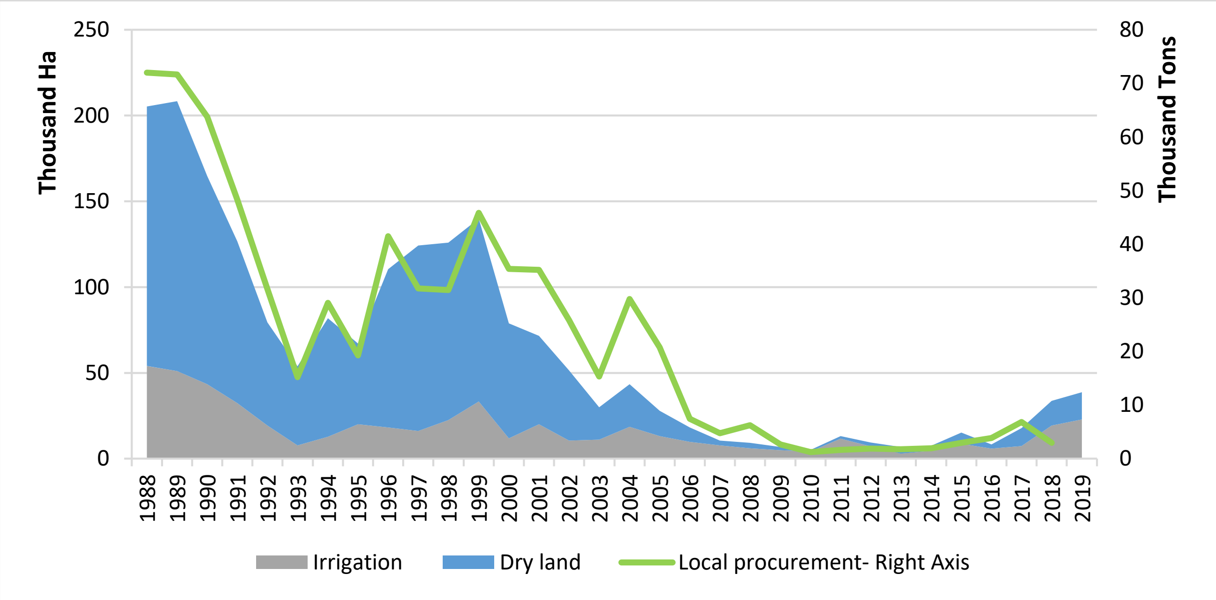

Figure 4.1: Cotton area and local procurement over time

Source: Cotton SA, 2020

Figure 4.1 also shows that cotton area has shown a turnaround in the 5 years between 2014 and 2018, with dryland area improving to be above the irrigation area after being almost non-existent. The increase is thought to have resulted from better cotton prices, the demand for locally produced cotton and a renewed interest in cotton (Malinga, 2019).

4.3 Analysing growth rates

A simple growth rate analysis is done to draw some inference on the relative growth in area, prices and local procurement over the past decade. Table 4.1 provides a representation of the growth rates over two periods, over the 10 years between 2009-2018, and during the period of the cotton cluster (2014-2018).

Table 4.1: 10-year and 5-year growth rates for commodity prices, yields and cotton area

	2009-2018				**2014-2018**		
	Absolute change	Percentage p.a	Average	Actual - 2018	Absolute change	Percentage p.a	Average
Seedcotton price c/kg	465.00	9%	655.60	900.00	202.00	6%	810.80
DryLand yields (t/ha)	0.25	5%	0.80	0.96	-0.16	0%	0.93
Irrigation yields (t/ha)	-0.39	1%	4.50	4.51	0.44	-2%	4.60
White maize price R/ton	487.92	7%	1960.26	1789.67	-370.65	-1%	2484.97
White maize yields (t/ha)	-0.29	1%	4.35	4.27	0.99	10%	4.41
Sunflower price (R/ton)	1370.47	5%	4243.24	4225.05	-210.42	-1%	4729.59
Sunflower yields (t/ha)	0.09	1%	1.25	1.32	0.17	6%	1.26
World Price c/kg	1478.90	6%	2031.77	2666.09	721.89	8%	2289.74
Dryland area '000 ha	15.83	30%	6.14	16.02	10.16	35%	10.01
Rainfall mm	-38.84	-4%	314.81	276.09	-63.95	-2%	278.20
Irrigation area '000 ha	20.77	14%	9.43	22.76	16.33	31%	13.19
Local procurement '000 tons	0.30	11%	2.77	2.97	1.04	17%	3.70

The absolute change is a calculation of the difference in the value at the end and beginning of the period. From the table, the actual 2018 values for the seedcotton price, the world cotton price and area were higher than the average over 10 years. Actual 2018 yields are also higher than the average, except for irrigation cotton and white maize. In comparison to cotton prices, the actual price of competitive crops (2018) was lower than the average for the decade. The rainfall received for the 2018 planting season was also below average.

Prices for maize and sunflower showed the least growth per annum compared to cotton prices for the 10 years while showing a contraction between 2014 and 2015. Cotton area and local procurement grew the most in the 5 years of the cotton cluster.

Yields for competitive crops, sunflower and maize increased marginally between 2009 and 2018, showing the most growth between 2014 and 2018. Cotton yields increased only in the 10 years, especially in the case of dryland cotton, with no growth in the period of the cluster. This is however also sensitive to weather impacts and 2014 to 2018 did not have ideal weather conditions for crop production.

An empirical analysis is conducted in the next section to study the relative contributions of the factors identified as possible drivers of cotton area changes (profitability, rainfall and demand). Prices are used in real terms to eliminate the effect of inflation. The impact of price on area is analysed using a combination variable revenue, a component of profitability, which was listed as one of the main factors producers consider in making area decisions. Revenue is calculated as the product of prices and yields.

4.4 Empirical analysis: area estimations

The relationship between cotton area planted and the different factors which cause variations in cotton acreage and are believed to have contributed towards the recent turnaround is analysed using economic cointegration models. The choice of explanatory variables is supported by the literature review as well as discussions with industry representatives.

4.4.1 Methodology

In this section, the Autoregressive-Distributed Lag (ARDL) cointegration approach is applied, as proposed by Pesaran et al. (2001). According to Natalya (2009), the ARDL procedure is adopted for various reasons. It allows for the estimation of cointegration relationships using the OLS technique, once the lag order of the model has been identified, and allows for the derivation of a dynamic ECM from the ARDL model (Banerjee, et al., 1993).

The ARDL method is applicable where regressors are integrated of the same or different orders, this implies that series can be stationary $I(0)$, non-stationary $I(1)$ or mutually co-integrated (Pesaran, et al., 2001). In comparison to the Engel and Granger (1987) technique, the ARDL procedure has better small sample size properties, although limited to $I(0)$ and $I(1)$ series. The adoption of the ARDL cointegration method also does not require pretests for unit roots, which is the case for other cointegration techniques, however; the technique will crash in the presence of $I(2)$ variables (Nkoro & Uko, 2016).

The ARDL cointegration approach is applied in two steps. First, the existence of a long-run relationship is tested using the Wald (F-test) bounds test for cointegration. The second step involves the estimation of long-run and short-run coefficients from the ARDL equation, which proceeds only if a cointegration relationship was found from the first step.

The Wald bounds test is based on the null hypothesis of a non-existent long-run relationship between the dependent and independent variables. Thus, the test is conducted on the joint significance of the coefficients of the lagged variables (Pesaran, et al., 2001; Nkoro & Uko, 2016). The presence or non-existence of a unit root is determined by the F-statistic computed from the Wald bounds test, which is compared against two sets of asymptotic critical values for cointegration testing, computed by Pesaran, et al. (2001). One set, referred to as the lower critical bound (LCB), assumes that all variables in the ARDL model are $I(0)$, and there is no cointegration among the underlying variables. The upper critical bound (UCB) assumes that the variables are $I(1)$, thus indicating cointegration among the variables.

The null hypothesis is rejected if the computed F-statistic is greater than the UCB, meaning that the variables are co-integrated. On the other hand, we fail to reject the null hypothesis if the computed statistic is less than the LCB as there is no cointegration. If the F-statistic falls between the LCB and the UCB, the result of the inference is inconclusive (Pesaran, et al., 2001; Nkoro & Uko, 2016).

The next step is the reparameterization of the ARDL model into ECM once a long-run relationship is determined between the underlying variables. This involves first, finding the appropriate lag length for the variables in the ARDL model, which is an important step in achieving Gaussian error terms (normal error terms, no autocorrelation, heteroskedasticity etc). The appropriate long-run model is determined by selecting the optimum lag length (k) using the Akaike Information Criterion (AIC). From this, the model with the smallest AIC estimates is selected (performs relatively better) and will be used to compute the associated ECM (Pesaran, et al., 2001; Nkoro & Uko, 2016).

The long-run coefficients are estimated using the ARDL model, while the short-run parameters are obtained from the estimated ECM associated with the long-run estimates. The ECM provides short-run coefficients, along with the error correction term, which is the speed of adjustment parameter. Stability tests on the residuals are generated on the models, specifically, the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMQ) stability tests are applied, as proposed by Brown et al. (1975). The CUSUM and CUSUMQ tests are based on the null hypothesis of coefficient stability where the underlying model is plotted against breakpoints, and if plots of the CUSUM of CUSUMQ statistics are within the 5% significance level critical bounds, we cannot reject the null hypothesis of stable parameters.

4.4.2 Summary Statistics

Table 4.2 and Table 4.3 present the summary statistics along with the source for the data series. The descriptive statistics indicate that none of the series is normally distributed, except for rainfall and sunflower yields. A positive skewness value suggests that a series is not normally distributed.

Table 4.2: Summary statistics for commodity prices and cotton area

	Seedcotton price	**Sunflower price**	**White Maize price**	**World price**	**Dryland Area**	**Irrigation Area**
Mean	351.43	2205.12	1054.31	1108.88	47.41	17.86
Median	254.00	1579.78	810.27	880.88	24.71	12.76
Maximum	900.00	6064.02	2873.80	2666.09	157.33	53.97
Minimum	87.800	460.84	225.27	241.200	0.96	2.96
Std. Dev.	239.35	1616.15	737.54	703.57	48.48	14.13
Skewness	0.96	0.75	0.77	0.84	0.78	1.30
Kurtosis	2.83	2.23	2.43	2.52	2.35	3.71
Jarque-Bera	5.11	3.94	3.73	4.18	3.94	9.99
Probability	0.08	0.14	0.16	0.12	0.14	0.006

Observations	33	33	33	33	33	33
Source	Cotton SA	DAFF	DAFF	Cotton SA	Cotton SA	Cotton SA
Period	1986-2018					

Table 4.3: Summary statistics for production and local procurement

	Rainfall	Dryland Yields	Irrigation Yields	Local Procurement	White Maize Yields	Sunflower Yields
Mean	329.36	0.6408	3.3281	24.76	3.3874	1.1646
Median	329.51	0.6060	3.4700	20.77	3.1515	1.2226
Maximum	467.66	1.1290	4.9460	71..99	6.0208	1.5453
Minimum	183.53	0.3010	1.8620	1.22	0.6656	0.3734
Std. Dev.	61.46	0.1880	1.0099	22.04	1.1405	0.2330
Skewness	-0.05	0.6703	0.0698	0.67	0.0371	-1.2950
Kurtosis	2.73	3.4219	1.5750	2.37	3.1331	5.6946
Jarque-Bera	0.11	2.7160	2.8188	2.99	0.0281	16.8790
Probability	0.95	0.2572	0.2443	0.22	0.9861	0.0002
Observations	33	33	33	33	29	29
Source	SAWS	Cotton SA	Cotton SA	Cotton SA	Grain SA	Grain SA
Period	1986-2018				1990-2018	

4.4.3 Lag Selection and ARDL Specifications

Unit root tests were conducted for the surety that none of the underlying series is $I(2)$. The unit root tests are illustrated in Table 4.4 and Table 4.5. The results indicate that some of the variables (i.e rainfall) are stationary at level, while most of the variables only attain stationarity at first differences. The unit root tests confirm that variables are either $I(0)$ and/or $I(1)$.

Table 4.4: Unit root test at level

Variable	Model	Unit Root Test	
		ADF	PP
$Dryland$	Intercept	-0.9038	-1.4030
	Trend and Intercept	-0.9538	-2.0089
	None	-1.5207	-1.6578*
$Irrigation$	Intercept	-2.4065	-2.3861
	Trend and Intercept	-1.6832	-1.4937
	None	-1.9266*	-1.9412*
$Rainfall$	Intercept	-5.8205***	-5.8192***
	Trend and Intercept	-5.8763***	-5.8721***
	None	-0.4746	-0.7776
$Local\ Procurement$	Intercept	-1.3074	-1.3074
	Trend and Intercept	-2.6584	-2.7355
	None	-1.3752	-1.4269
DL_{rev}	Intercept	-1.4409	-4.3115***
	Trend and Intercept	-5.3544***	-5.3926***
	None	0.1788	-0.9897
Irr_{Rev}	Intercept	-0.8644	-0.9693
	Trend and Intercept	-3.9831**	-3.8648**
	None	0.9926	1.3690
WMZ_{Rev}	Intercept	1.7837	0.5725
	Trend and Intercept	-2.7548	-2.2317
	None	3.4090	1.9325
$Suns_{Rev}$	Intercept	-3.4370**	-3.4716**
	Trend and Intercept	-4.04405**	-4.8064***
	None	0.4705	0.3931

*Asterisks ***, **, * denote statistical significance at 1%,5% and 10% levels respectively*

Table 4.5: Unit root tests at first difference

Variable	Model	Unit Root Tests	
		ADF	PP
$\Delta Dryland$	Intercept	-5.6412***	-5.1478***
	Trend and Intercept	-5.4464***	-5.2975***
	None	-5.5755***	-5.0150***
$\Delta Irrigation$	Intercept	-5.5838***	-5.5837***
	Trend and Intercept	-6.2438***	-6.3121***
	None	-5.5887***	-5.5891***
$\Delta Rainfall$	Intercept	-7.1704***	-10.3195***
	Trend and Intercept	-7.1089***	-10.1373***
	None	-7.2928***	-10.4896***
$\Delta Local\ Procurement$	Intercept	-5.8232***	-5.8222***
	Trend and Intercept	-5.7218***	-5.7213***
	None	-5.8142***	-5.8127***
ΔDL_{Rev}	Intercept	-11.6450***	-18.3162***
	Trend and Intercept	-5.0350***	-30.9748***
	None	-11.7705***	-16.7767***
ΔIrr_{Rev}	Intercept	-5.2128***	-17.9056***
	Trend and Intercept	-5.1756***	-17.3712***
	None	-8018***	-7.9557***
ΔWMZ_{t-1}	Intercept	-2.7878*	-4.4554***
	Trend and Intercept	-3.4828*	-4.5540***
	None	-4.6190***	-4.3710***
$\Delta Suns_{t-1}$	Intercept	-7.4293***	-7.5402***
	Trend and Intercept	-7.2537***	-7.3844***
	None	-7.4581***	-7.3989***

*Asterisks ***, **, * denote statistical significance at 1%,5% and 10% levels respectively*

Given that unit root tests have been conducted to verify the order of integration in the underlying variables, the next step for the ARDL procedure is to select the appropriate lag length before applying the ARDL bounds (Wald) test. Table 4.6 and Table 4.7 present the lag selection criterion for the dryland and irrigation ARDL. The lag orders were computed using R software, specifically the ARDL package, which searches for the best ARDL order specification with the aid of the auto_ardl command (Natsipoulos, 2021). The AIC criterion is used as it gives robust results in comparison to SC and HQ, thus performing better (Abbas, et al., 2019).

Table 4.6: Automatic lag selection - dryland ARDL

Model	DL	DLRev	WMZRev	SunsRev	Local Procurement	Rain	AIC
1	1	2	1	2	2	1	249.7390
2	1	2	2	2	2	1	251.4329
3	1	2	1	2	2	2	251.7240
4	2	2	0	2	2	1	251.9408
5	1	2	2	2	2	2	252.2947

Table 4.7: Automatic lag selection - irrigation ARDL

Model	Irr	IrrLRev	WMZRev	SunsRev	Local Procurement	AIC
1	1	2	2	2	2	209.3491
2	2	2	2	2	2	211.3491
3	1	2	2	2	1	214.0586
4	2	2	2	1	1	214.3822
5	1	2	1	1	1	219.3552

The underlying ARDL models are estimated using the lag lengths specified by the AIC selection criteria. The theoretical specification of the ARDL model(s) can be presented as follows:

$$Y_t = c_0 + c_{1t} + \sum_{i=1}^{p} \emptyset Y_{t-i} + \sum_{i=0}^{q} Bix_{t-i} + \varepsilon_t \qquad (9)$$

Where

Y_t is cotton area, dryland *(DL)* or irrigation *(Irr)*

X_t are the explanatory variables, *p* and *q* are the optimum lag orders

Explanatory variables *(X_1……….Xt)* are defined as:

Cotton revenue (DL_{Rev} , Irr_{Rev})

White maize revenue (WMZ_{Rev})

Sunflower revenue ($Suns_{Rev}$)

Rain, and local procurement

Reparameterization of the ARDL model into ECM yields the following specification:

$$\Delta Y_t = c_0 + c_{1t} - a(Y_{t-1} - \theta_{xt}) + \sum_{i=1}^{p-1} \omega_{yi} \Delta Y_{t-i} + \sum_{i=0}^{q-1} \omega'_{xi} \Delta x_{t-i} + \varepsilon_t \quad (10)$$

Where a represents the speed of adjustment parameter and θ is the long-run coefficient.

4.4.4 Empirical Results

The ARDL for dryland and Irrigation is estimated using R software, shown in Table 4.8 and Table 4.9. The ARDL bounds test results are presented in Table 4.10, from this we can reject the null hypothesis of no cointegration, given that the F-statistic is higher than the upper critical bound.

Table 4.8: ARDL output - dryland area

Variable	Coefficient	T-statistic
Intercept (c)	104.6000	3.328 ***
DL_{t-1}	0.69370	5.696***
DLRev	-0.0009	-0.257
$DLRev_{t-1}$	0.0008	0.243
$DLRev_{t-2}$	0.0059	1.724
WMZRev	0.0054	0.280
$WMZRev_{t-1}$	-0.0069	-1.524
SunsRev	-0.0160	-2.781**
$Sunsrev_{t-1}$	-0.0097	-0.442
$SunsRev_{t-2}$	0.0089	-2.284**
Local Procurement	0.3923	1.061
Local $Procurement_{t-1}$	-0.1430	-0.436
Local $Procurement_{t-2}$	0.706	-2.135**
Rain	0.0858	-2.050
$Rain_{t-1}$	0.1255	2.384**

*Asterisks ***, **, * denote statistical significance at 1%, 5% and 10% levels respectively*

Table 4.9: ARDL output - irrigation area

Variable	Coefficient	T-statistic
Intercept (c)	24.0556	2.35**
Irr_{t-1}	0.5414	3.244***
IrrRev	0.0002	0.392
$IrrRev_{t-1}$	0.0003	0.502
$IrrRev_{t-2}$	0.0004	0.810
WMZRev	0.0015	1.670
$WMZRev_{t-1}$	0.0011	0.508
$WMZRev_{t-2}$	-0.0058	-2.524**
SunsRev	-0.0079	-2.686**
$SunsRev_{t-1}$	0.0019	0.723
$SunsRev_{t-2}$	-0.0008	-0.408
Local procurement	0.4081	2.196**
Local $Procurement_{t-1}$	-0.0437	-0.247
Local $Procurement_{t-2}$	-0.3193	-2.027

*Asterisks ***, **, * denote statistical significance at 1%, 5% and 10% levels respectively*

Table 4.10: ARDL bounds test

Dependent	Independent	F-statistic	F-Stat Bound (5%)	
			LCB	UCB
DL	DL_{Rev} WMZ_{Rev} $Suns_{Rev}$ Rain Local Procurement	6.678	2.62	3.79
Irr	Irr_{Rev} WMZ_{Rev} $Suns_{Rev}$ Local Procurement	4.4205	2.86	4.01

The output from the ARDL model in Table 4.8 suggests that the coefficient for lagged dryland area is in line with supply theory, and significant at 1%. Dryland revenue has a positive impact on area when lagged, but does not show statistical significance. Lagged white maize and sunflower revenue are economically significant, with sunflower revenue statistically significant at 5% at levels and period t-1. Local procurement is in line with priori expectations at levels and period t-2 with statistical significance at a 5% level. Rainfall is positive in all periods but is statistically significant (5%) at time t-1.

Interpretation of the positive impact of rainfall on area is that although cotton is a drought-tolerant crop, area will increase based on the amount of rainfall received in the previous season.

The distribution of rainfall at specific stages of the plant's development is critical in determining yields and fibre quality[27] of the cotton crop and thus considered when making area decisions. The positive relationship between area and rainfall is also related to the timing of the season, for instance, the year 2019 represents cotton harvested in 2019, so rainfall in period t-1 is rainfall in 2018. Thus, for a summer crop that is planted at the end of 2018 and harvested in 2019, it is expected that rainfall in 2018 will affect area for the 2019 season, as the rain was sufficient or not, to initiate planting in 2018 for the crop to be harvested in 2019.

The ARDL model for irrigation area in Table 4.9 shows that area at period t-1 is positive and significant at a 1% level. Irrigation revenue is also in line with priori expectations but is not statistically significant. The revenue for substitute crops white maize and sunflower is economically significant at period t-2, which suggests that it takes time to convert from cotton to maize or sunflower. While sunflower revenue is also negative and statistically significant (5%) at levels, white maize revenue is statistically significant at period t-2.

From the empirical results in Table 4.8 and Table 4.9, cotton area will increase in response to an increase in cotton revenue and local procurement, but the increase in local procurement results in a bigger impact on area. The impact of local procurement on area is in line with expectations and results from the model implemented under the local procurement initiative of the SCC where producers essentially deliver on contract. As the initiative aims to get procurement commitments from local retailers which influences sourcing by ginners and spinners, producers then plant in response. Also, of the two substitute crops, sunflower revenue has a greater influence on dryland area in the long-run (i.e at period t-1), while white maize revenue has a greater impact on irrigation area in the long-run (i.e at period t-2). The practicability of the negative effects of white maize and sunflower is that an increase in the revenue from growing these crops in a specific season will cause cotton area to decline in the following seasons with the final decision based on profitability and producers thus choosing the more profitable crop. This can also be attributed to the fact that farmers cannot adjust immediately to changes in revenue and ultimately profitability (i.e when the price of a substitute crop increases) due to the fixity of land assets (Chaudhary, 2005). Furthermore, when producers make a planting decision, it is often based on expected prices, which are influenced by previous years, as opposed to current season prices, which may not be clear yet at the time of planting. Given the contracting model, producers will have some idea, but the second payment, which depends on quality etc. only occurs after the crop is processed and prices can change quite significantly from expected levels when planting decisions are taken.

Cotton growers (Table 4.9) do not have to wait for the end of the season to make area decisions in consideration of global price quotations given the differences in seasons between the Northern and Southern hemisphere, although the resultant price in the local market is also dependant on the exchange rate and quality aspects. Even so, an increase in revenue in the current season will support an increase in area in the following season.

A positive impact on area for revenue of substitute crops can be an indication that sunflower and maize are planted in rotation with cotton (Mahofa, 2007). Sunflower is not commonly

[27] Fibre quality is also an important aspect in price determination

grown under irrigation conditions (NDA, 2010) but can perform well, achieving yields between 3 to 3.5 t/ha (2 to 3 t/ha under dryland) (PANNAR, n.d.).

Relating these results to the fluctuations in SA cotton area, producers will switch to alternative crops when prices are more favourable. Since the local cotton price is primarily derived from the global price (A-Index) and given that the latter has been trading at lower levels previously compared to grain prices on international markets (Figure 2.7), dampened by demand and supply aspects discussed in chapter 2, producers considered these crops as more lucrative compared to cotton. This also highlights the impact of an integrated local market on the bigger global market on area (Figure 4.1), considering the total area before and after 1996.

Concerning the objectives of this study, the empirical results confirm that domestic procurement is a bigger driver of cotton area than revenue – where prices are influenced strongly by international market dynamics. The results also propose that the growth in area between 2014 and 2018 was influenced more by the local procurement aspect of the SCC than purely on price changes, which makes sense given the contracting model. Through the local beneficiation approach of the SCC, producers were linked to other stakeholders of the value chain, and most importantly providing the access to local marketing channels. This gave them surety of the market at a predetermined price. In addition, the results suggest that the SCC was effective in achieving its primary goal of improved market access through local supply pools.

It is acknowledged that the empirical results are positive to the influence of the SCC, but based on an imperfect proxy variable in the form of domestic procurement. Ideally, the actual number of procurement commitments made under the cluster would be used as opposed to ultimate buying, as a bigger crop could, in any event, result in more cotton being bought domestically, but data on these commitments is not available and therefore could not be used. Also, exports play an important role in the additional procurement of seedcotton by ginners as seedcotton is processed into lint for selling in the local market or for export. Since we cannot separate between the two, lint processing at the spinning level is used as a measure of local procurement. Given these limitations, the empirical results should be considered with care.

Despite the confirmed positive relationship between cotton area and local procurement, there have also been periods when increased local procurement did not lead to an increase in area. A specific period in which this did not hold was in the 2019/20 production year when the area planted declined to 27 thousand hectares from 38 thousand hectares in 2018/19. A probable cause of farmers not responding to local procurement through increases in area is limitations in processing capacity at the ginning level. For example, the challenge of outdated ginning facilities in recent years increases the time it takes to process the crop, thus sometimes delaying payments to the farmers. When payments are late, farmers are unable to meet financial obligations in time (i.e wages, loans etc) and to plan in time for the next season, moreover, they lose confidence in the industry and become sceptical to enter into new agreements. Although there have been investments in ginning machinery of late, specifically at the Loskop gin, such inefficiencies further in the value chain have contributed towards the dampened growth in cotton area (for example in 2019/20) instigated towards the end of the period of the SCC, also perhaps influenced by the discontinuation of the Cluster.

The decline in cotton area during this period can also be a function of not having a perfect measure for domestic procurement, as stocks also play a role in additional contracts issued by the gin for the sourcing of seedcotton from farmers. If the gin still has stock from the previous year due to delayed processing, that can still be bought, this may lead to fewer contracts for additional production, to get the old stock out first.

An additional aspect to note from the empirical results is that revenue (Table 4.8) only impacts area positively after one or two years, that is an increase in revenue in the current season will boost area in subsequent seasons. This also suggests that in comparison to irrigation farmers (Table 4.9), many dryland farmers may not utilise information on international markets to make area decisions preparatory to planting – possibly indicative of this is information being less accessible to small-scale farmers. Conversely, this can also be attributed to the rotation of cotton with other crops.

Overall, the models indicate a good fit, with adjusted R^2 values of 0.94 (dryland) and 0.74 (irrigation). The estimated F-static values are 32.16 (dryland) and 7.53 (irrigation). Stability tests are conducted on the two models shown in Table 4.11 and Table 4.12. The results for the CUSUM and CUSUMQ tests are presented in Figure 4.2 and Figure 4.3. Plots for both stability tests are between the critical boundaries, at a 5% level of significance, confirming stability in the parameters of the ARDL models.

Generally, various aspects can lead to unexpected signs of the explanatory variables in regression outputs. In this case, probable causes include the use of secondary data and associated discrepancies. In addition, the inclusion of explanatory variables for cotton area is exhaustive and not limited to the variables used in this study, but due to limitations in quantifying certain aspects (i.e late payments, limited processing capacity etc) of the value chain, only these factors were used. Also, cotton is a relatively small crop in comparison to maize and sunflower (StatsSA, 2017), therefore giving mixed results when comparing the revenue of the different crops.

The ARDL-ECM versions of the models above are included in Appendix A. The error correction terms are negative and statistically significant at 1%, indicating a higher speed of adjustment for irrigation area from the short-run to the long-run. In the dryland case, only 31% of the disequilibrium in the short-run is adjusted to the long-run, while for the irrigation area 46% of the disequilibrium is corrected.

Table 4.11: ECM stability diagnostic tests - dryland

Test	Test Statistic	*p*-Value	Conclusion
Breusch-Godfrey	0.0086	0.92	No serial correlation up to order 1
Breusch-Pagan	19.17	0.51	Fail to reject the null hypothesis of homoscedasticity
Ljung-Box	0.0207	0.89	No serial correlation
Shapiro-Wilk	0.9304	0.01	Reject the null hypothesis of normality of residuals at 5%

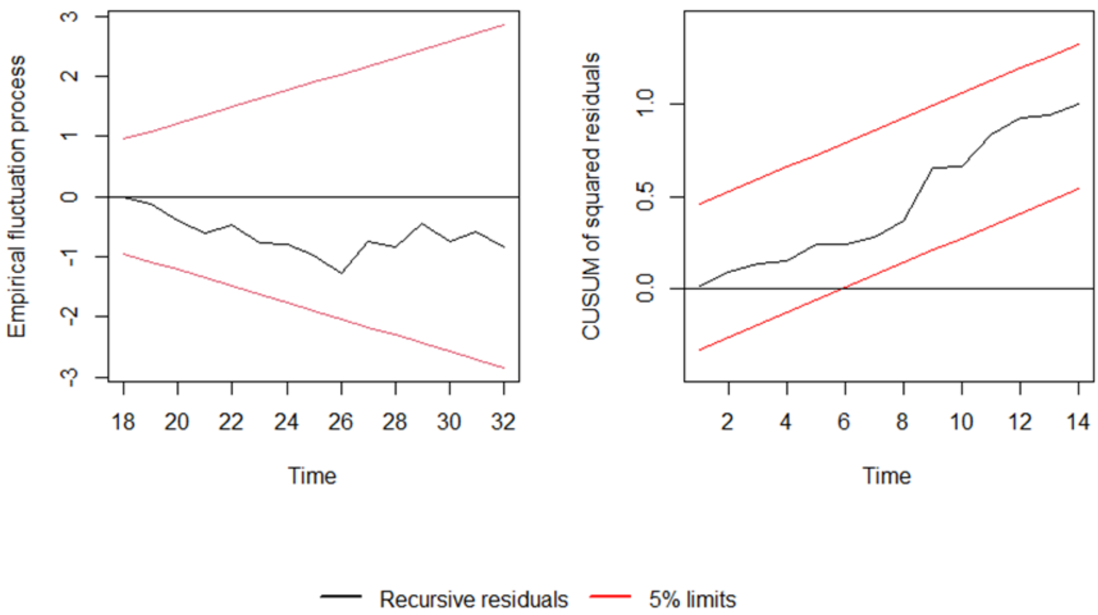

Figure 4.2: CUSUM and CUSUMQ plots – dryland

Table 4.12: ECM stability diagnostic tests - irrigation

Test	Test Statistic	*p*-Value	Conclusion
Breusch-Godfrey	0.2867	0.60	No serial correlation up to order 1
Breusch-Pagan	12.15	0.59	Fail to reject the null hypothesis of homoscedasticity
Ljung-Box	0.23	0.63	No autocorrelation
Shapiro-Wilk	0.98	0.89	Residuals are normally distributed

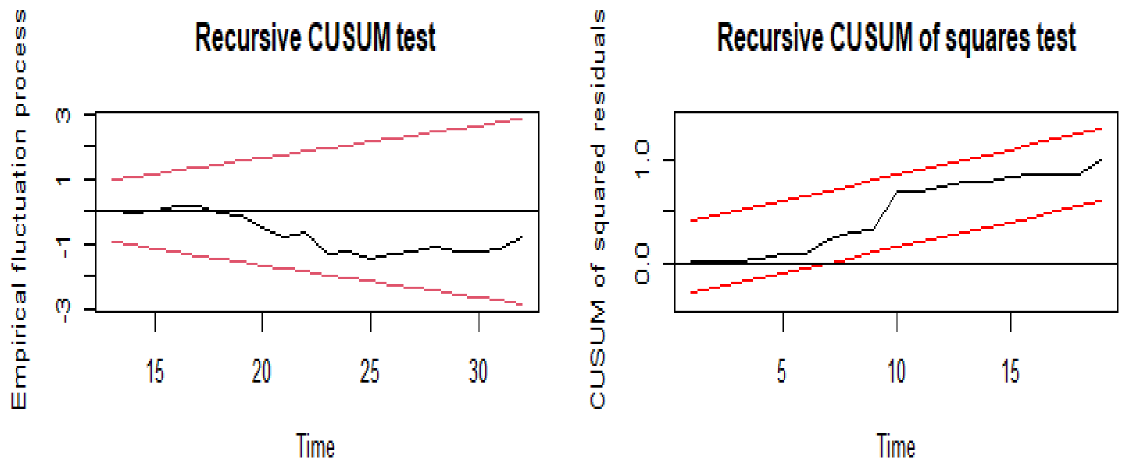

Figure 4.3: CUSUM and CUSUMQ plots - irrigation

The models are accepted based on the results of the residual diagnostic and stability tests. Residual diagnostics investigate whether the error terms are white noise (identically and independently distributed, *i.i.d*). The error terms are confirmed to be white noise processes as there is no autocorrection in residuals and heteroscedasticity. If the null hypothesis of homoscedasticity was rejected, indicating the presence of heteroscedasticity then a coefficient covariance matrix would be used to change the heteroscedasticity adjusted standard errors. This adjustment changes the standard errors, while the coefficient estimates remain the same.

4.5 Conclusion

Chapter 4 provided a theoretical overview as well as an economic analysis of the factors which contribute towards cotton production by employing regression models. The results show that both revenue and local procurement levels have impacted on cotton area responses, but the response to increased domestic procurement was greater. This is in line with expectations given the contracting model typically followed in the cotton sector. With respect to the efficiency of the SCC, it should be interpreted with care as domestic procurement is an imperfect proxy variable for the procurement initiatives under the SCC. Furthermore, sunflower was found to be an important substitute crop for dryland cotton area in the long-run and white maize is significant for irrigated area.

Interpretation of the relative contributions of local procurement and revenue on area is that before the implementation of the SCC, area was dampened by low local procurement levels given competition from cheaper imports, lower producer prices compared to grains, combined with inefficiencies in the ginning process causing delays in payments to farmers thus making white maize and sunflower an alternative to cotton. The sourcing of homegrown cotton for spinning and manufacturing of various products under the local procurement initiative of the SCC has supported the recent revival in cotton area, but with the existing challenge in processing efficiency and discontinuation of the cluster, it is not certain if this growth will be maintained. Procurement initiatives may be positive but if the value fails to reach the farmer efficiently, producers are unlikely to remain with the crop and issues such as late payments dampen trust in the value chain.

CHAPTER 5
SUMMARY, RECOMMENDATIONS AND CONCLUSION

5.1 Summary

The local cotton industry used to be one of the thriving subsectors in SA, with cotton being central to national agricultural priorities during the 20th century. However, cotton production has shown a downturn over the past two decades, largely attributed to structural reforms in the national government and subsequent transformation in agricultural policy.

SA's political history has influenced reforms in the marketing of agricultural commodities, inclusive of cotton. The cotton market transformed from a controlled system (1996) whereby the Cotton Marketing Board was at the forefront of marketing and price control, procuring the local cotton crop regardless of the available quality, to a free market system where producers seek buyers independently and market participants negotiate prices.

With this transformation, marked by the revision of the Marketing Act, the local market became part of the larger global market through the link in prices. The integration of SA into the world market implies that local prices are responsive to changes in the world price and that SA producers compete with the global market through imports for cotton products. Movements in the international cotton price are dictated by the global demand for cotton, which in turn determines global production and stock levels.

Both economic and to some extent ecological factors played a role in the decrease in cotton area and production over time. Literature has highlighted profitability as the main challenge that discourages cotton producers, which is affected by the costs of production, the availability of technology to the farmer, as well as the producer price as determined by the quality of the seedcotton. Therefore, cotton competes with food crops such as maize as producers consider economic returns in making planting decisions.

While the SA government has made multiple attempts to revive the local cotton industry and implement protection measures against low cost imports for cotton products, cotton production remained mostly below 20 thousand hectares between 2000 and 2019. The most recent cotton specific intervention, the SCC was introduced in 2014, with the view of a holistic value chain approach. The SCC ran from 2014, ending in early 2019 with interventions in the quality of production through globally recognised practices (the Better Cotton Initiative), the introduction of new technology; as well as, linking value chain stakeholders (farmers, ginners and spinners) through local procurement contracts. During the period of the SCC, cotton area increased above 20 thousand hectares and reached 41 thousand hectares in 2018 (Figure 1.1).

In the same period (2014-2019), the international cotton price was trading at above-average levels. Given the link between local and international prices, the domestic lint price also showed an increasing trend. As a result, the domestic cotton area was on a rise, indicating a possible revival and a renewed interest in cotton by farmers. According to Bruwer (2020), the percentage of locally produced cotton, of all cotton processed locally increased from 8% to 26% in the four years of the Cluster. In addition, the consumption of homegrown cotton by spinners has since stabilized at 20%.

The existence of the SCC and the occurrence of higher prices in the international market space are presumed to have caused this revival in cotton area. Therefore, the objective of this paper was to test the effectiveness of the introduction of the SCC and prices (as a component of revenue and influenced by global dynamics) on cotton area. This was done by analysing the relationship between cotton area, revenue and local procurement to capture the effects of the SCC through increased local procurement. Also forming part of the objectives was an analysis of price relationships (seedcotton and lint) to determine the extent to which domestic prices are affected by international price dynamics.

In achieving the research objectives, chapter 2 introduced the global cotton space and how demand determines prices and the supply of cotton. The global cotton situation is important given that SA exists in the wider global environment. The chapter further provided an overview of the South African cotton industry by giving a summary of the value chain, its actors and marketing provisions.

Chapter 3 gave an overview of pricing dynamics, that is the movement in the international cotton price and how these were reflected locally. The main goal for chapter 3 was to explain how local prices are determined by quantifying price relationships over the long-run, as well as measuring short term adjustment dynamics. The Engle-Granger cointegration method was used. The empirical results prove that the local lint price is linked to the global price, and in turn, the local lint price determines the seedcotton price, which reflects the importance of the quality of the lint extracted from the seedcotton. Empirical results of the Engle-Granger cointegration procedure also showed that both the local lint price and seedcotton production determine the seedcotton price.

Chapter 4 provided a theoretical and econometric analysis of the factors which determine cotton production using the ARDL cointegration technique. The results obtained from the ARDL procedure showed that cotton area is more responsive to local cotton procurement for processing compared to revenue. Also, white maize is a bigger competitor to cotton under irrigation while sunflower competes better with dryland cotton.

After over a decade of low and declining acreage, the suggestion from the empirical results is that the local procurement approach of the SCC has somewhat contributed to the increase in cotton area between 2014/15 and 2017/18 production seasons. On the other hand, exports are also an important contributor to increases in seedcotton procurement, as it broadens the market for processors and encourages domestic procurement of seedcotton for processing. Given that data on the procurement commitments made under the cluster is not available, versus buying for processing (spinning) and since one cannot separate between the effects of seedcotton processing for the domestic market and export, the results of the study should be considered with care.

The impact of the local procurement initiative of the SCC on area does not exclude the contribution by other efforts of the cluster in the form of improved access to credit, combine harvester introductions and smallholder farmer initiatives which have contributed towards the renewed interest in cotton production. According to Mahofa (2007), the extension of credit to farmers by commercial and agricultural services providers can contribute significantly to cotton production with farmers responding positively.

Moreover, cotton area was lower in the past arising from the competition with cheaper cotton lint imports and final products, also given the uncertainty in payment dates contributing towards farmers losing confidence in the industry. The industry saw a boost in cotton area in the period of the cluster, as cotton imports were lower driven by the incentive by industry towards locally produced products (chinos, underwear, towels etc), and in combination with other aspects of the SCC.

The question remains on how the cotton industry can achieve sustainability in the long-run, given the challenges that still exist in the cotton pipeline (such as late payments to farmers by ginners). In addition, how does the industry maintain the growth path in cotton area pending renewal of the SCC?

5.2 Recommendations

Recommendations are made based on the results obtained from econometric analysis in chapters 3 and 4. The empirical results in chapter 4 indicate that the local cotton area planted is more elastic to local procurement, but the impact of revenue is not ignored as a deterministic factor for profit. Price movements have a direct impact on revenue and given the proven relationship between the local and international cotton price (chapter 4); also, between area and local procurement, SA needs to take advantage of both international and local market opportunities.

South Africa is a small cotton producer, in comparison to the rest of the world, as such, we do not have control over global market dynamics, but our strength lies in the quality of our cotton in the international market. SA cotton is considered as some of the top quality in the world, thus it realises higher prices in the global market (Bruwer, 2019). Given the exceptional cotton quality, developing strong export pools is one way to benefit from premiums in the global market. SA is well placed to benefit from the growing demand for complaint cotton (BCI) in international markets (i.e Europe) (CBN, 2021) given success in BCI cotton production.

SA cotton realises good prices due to good quality, but producers are also challenged by the inefficiencies within the industry which lie in the lead time for payments by ginners (to producers). The study by Mahofa (2007) on the economic determinants of cotton production provides a good frame of reference in terms of the importance of an enabling domestic industry in developing a stable local market, for example through the provision of credit amid volatile international cotton prices.

In addition to the price volatility of the international market, the current COVID-19 pandemic has proven that relying solely on international markets creates major inefficiencies in times of crisis. Since March 2020 (until April/May), the flow of trade in the global markets was at a standstill as many countries in the world implemented temporary import and export bans, putting their domestic supply and demand as a priority. The timing of the pandemic had a limited impact on global cotton production as the 2019/20 crop was already harvested in most parts of the Northern Hemisphere and well developed in other parts of the world. However, temporary trade bans have led to a reduction in world use comparable to that experienced in the global financial crisis, which may contribute to the build-up in global stocks (USDA, 2020).

Patterns in global stock levels, especially between 2011 and 2014 as well as other factors have shown that the global cotton market is unpredictable. Therefore, a balance should be maintained between local and international marketing systems.

Locally produced cotton products have competed with imports in the past but import consumption can be replaced if 50% of these imported garments are produced locally (jeans, chinos, towels, underwear) (Bruwer, 2019). About 300 thousand tons of lint is consumed by spinning mills and replacing these textile imports can meet at least 100 thousand tons of this consumption needs. This goal was already put into place by the Cotton Cluster. As mentioned earlier, 26% of locally produced cotton has been consumed by local spinners in the duration of the cluster. Though the pilot cluster programme was in place for a relatively short term (4 years), the improvement in local procurement (from 8% to 26%) suggests that it may have a greater effect over the longer-term, thus the need to review and to re-implement the cluster (for example, over 10 to 15 years).

The cotton value chain map in chapter 2 (Figure 2.7) highlighted the gap in the value addition of cotton by-products in SA. It is imperative that the competitiveness of cotton, given constraints faced by farmers, is improved. In addressing producer vulnerability, mechanisms for increasing their share in the final product must be established (UNCATD, 2017). Therefore, there lies a lot of potential in by-product value addition as an attempt to increase producer income.

According to the WTO (2019), the gossypol enzyme in cotton seed (which is poisonous to non-ruminants) can be removed to extend the use of cotton seed oilcake for non-ruminant livestock (cotton seed oilcake is already in use for ruminants), making cotton seed oilcake an alternative livestock feed to other oilseeds (sunflower and soybeans). Extending the market for the oilcake can potentially increase the demand for cotton seed and thus the demand for seedcotton production by farmers (WTO, 2019). According to Bruwer (2020), there is a newly erected seed-processing mill in the Loskop area, which can process both sunflower seeds and cotton seeds.

In addition, cotton stalks share some characteristics with hardwood species, hence these can be used to produce charcoal briquettes. Using cotton stalks as a source of fuel will help in reducing deforestation and providing additional income sources for farmers (WTO, 2019). Also, cotton stalks can be marketed to mushroom producers. Cotton stalks have a high cellulose and lignin content, which makes them an excellent substrate for growing mushrooms (WTO, 2019).

In conclusion, the thought remains that cotton is a potential strategic commodity for smallholder farmer development and perhaps more potential lies here than in large-scale commercial production (WTO, 2019). The opportunities as a strategic crop lie in its importance as a cash crop and the spillover effects of job creation and poverty alleviation. In addition, cotton is a hardy plant, thus having a comparative advantage over other summer crops such as maize and sunflower under dryland conditions.

Developing export pools to realise higher prices in international markets is a potential strategy to generate higher income levels for producers. However, international markets are not always open, thus the need for combination strategies. Moreover, an increasingly unpredictable international market has created the opportunity for growth in local production to meet local demand.

The concepts of the SCC in combination with the value addition of cotton by-products is one way to promote growth in cotton production. Possible strategies to promote growth in the local industry are already in place or have been introduced previously, for example, the introduction of the Cotton Cluster and the preceding growth in local procurement and exports. From these examples, it shows beyond doubt that these strategies have already been thought of, it is only a matter of re-implementation (over a longer period) and addressing inefficiencies in the cotton pipeline to re-boost producers' confidence in the industry.

5.3 Conclusion

This study verified that changes in the world cotton market are transmissible to the domestic market in chapter 3. Having proven price linkages in the two markets, the study extended to test the impact of prices and local procurement on the total area planted in chapter 4 as set in the objectives. The empirical results show that the SCC has a greater impact on the area planted than prices, suggesting the effectiveness of the beneficiation model in rebuilding confidence in the sector.

Even though local procurement has a strong positive impact on area, this proxy is imperfect and is used as it is the best that could be done given the unavailability of data on commitment contracts and procurement volumes publicly. The issue of the change in the marketing regime post-1996 is also important to note when considering trends in production, although the extent this contributes to the downswing in area planted is not covered in the scope of the study. In addition, there may have been other significant changes in the industry during the period of estimations. Given the factors highlighted above, the results of the empirical analysis should be interpreted cautiously. These results are not fully comprehensible, as estimations rely on an imperfect proxy while the differences in market regimes is also not captured. This also suggests that scope exists for an expansion of this work in future, firstly by accounting for marketing regimes in price dynamics and secondly by collecting additional primary data, to capture volumes procured under the SCC initiative more clearly.

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APPENDIX A

A1: Dryland ARDL (1,2,1,2,2,1)

ΔDL	Coeficient	T-statistic
Intercept (c)	104.6131	3.33***
Long Run		
DL_{Rev}	0.0193	1.19
WMZ_{Rev}	-0.0207	-1.30
$Suns_{Rev}$	-0.0878	-2.88**
Local Procurement	-1.4927	-1.22
Rain	0.1294	0.62
Short Run		
DL_{Rev}		
ΔDL_{Rev}	-0.0068	-1.50
ΔDL_{Revt-1}	-0.0060	-1.72
WMZ_{Rev}		
ΔWMZ_{Rev}	0.0069	1.52
$Suns_{Rev}$		
$\Delta Suns_{Rev}$	0.0109	2.25***
$\Delta Suns_{Revt-1}$	0.0089	2.28***
Local Procurement		
ΔLocal Procurement	0.8496	3.04***
ΔLocal $Procrement_{t-1}$	0.7066	2.13***
Rain		
ΔRain	-0.1255	-2.38***
Adjustment (θ)	-0.3063	-2.52***

A2: Irrigation ARDL (1,2,2,2,2)

ΔIrr	Coefficient	T-statistic
Intercept (c)	24.055	2.35***
Long Run		
Irr_{Rev}	0.0023	1.05
WMZ_{Rev}	-0.0071	-0.87
$Suns_{Rev}$	-0.0150	-1.82
Local Procurement	0.0823	0.25
Short Run		
Irr_{Rev}		
ΔIrr_{Rev}	-0.0008	-1.03
ΔIrr_{Revt-1}	-0.0005	-0.81
WMZ_{Rev}		
ΔWMZ_{Rev}	0.0048	1.58
ΔWMZ_{Revt-1}	0.0059	2.52***
$Suns_{Rev}$		
$\Delta Suns_{Rev}$	-0.0011	0.32
$\Delta Suns_{Revt-1}$	0.0009	0.41
Local Procurement		
ΔLocal Procurement	0.3631	2.27***
$\Delta \text{Local Procurement}_{t-1}$	0.3193	2.03*
Adjustment (θ)	-0.4586	-2.75***