Mapping the cotton value chain in Pakistan: A preliminary assessment for identification of climate vulnerabilities & pathways to adaptation

Working paper

PRISE

Pathways to resilience in semi-arid economies

Research for climate–resilient futures

Mapping the cotton value chain in Pakistan: A preliminary assessment for identification of climate vulnerabilities & pathways to adaptation

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Contents

List of tables, boxes and figures

Acronyms

APP	Associated Press of Pakistan
APTMA	All Pakistan Textile Mills Association
APTPMA	All Pakistan Textile Processing Mills Association
AUICK	The Asian Urban Information Center of Kobe
BEE	Business enabling environment
CABI	The Centre for Agriculture and Bioscience International
CLCV	Cotton leaf curl virus
CVC	Cotton value chain
DGK	Dera Ghazi Khan
EDB	Engineering Development Board
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
Ha	Hectares
HS	Harmonised System Classification
IFPRI	International Food Policy Research Institute
KPK	Khyber-Pakhtunkhwa
OCT	Owner-cum-tenant farm
OECD	Organisation for Economic Co-operation and Development
PBS	Pakistan Bureau of Statistics
PCCC	Pakistan Central Cotton Committee
PCGA	Pakistan Cotton Ginners Association
PRGMEA	Pakistan Ready-made Garments Manufacturers and Exporters Association
PRISE	Pathways to Resilience in Semi-arid Economies
PTEA	Pakistan Textile Exporters Association
SMEDA	Small and Medium Enterprise Development Authority
SMEs	Small- and medium-sized enterprises
SUPARCO	Pakistan Space and Upper Atmosphere Research Commission
USAID	United States Agency for International Development
USD	US Dollar
USDA	United States Department of Agriculture
WEF	World Economic Forum
WTO	World Trade Organization

Worker at a spinning factory in Faisalabad © Rajeshree Sisodia/PRISE

Executive Summary

As part of the Pathways to Resilience in Semi-arid Economies (PRISE) project,[1] this working paper aims to analyse existing data on the cotton and textile sector in Pakistan, and identify horizontal and vertical linkages[2] within the cotton value chain (CVC). A broader objective of the PRISE project is to reduce poverty through increased climate resilience and inclusive economic growth.

This research into climate implications for business, as well as other sectors, applies the value chain approach. It focuses on understanding the stakeholders that operate within the cotton sector (from input suppliers to end market buyers), the policy environment in which they function, and the entire process of textile manufacturing and export. This approach was chosen to understand the consequences of climate risks as well as the adaptation measures needed to cope with adverse impacts in order to ensure the resilience of all actors involved in the value chain.

Analysis based on literature and discussions with stakeholders suggests a negative association between climate change impacts and cotton production. Cotton production in Pakistan has suffered huge losses due to various climate extremes in the past 35 years. Major impacts of climate change can be observed for both upstream (spinning, weaving etc.) and downstream (cotton producers, ginners etc.) actors/industries. Analysis also reveals that governance can play a major role in increasing resilience to climate risks such as floods and droughts.

There are also some clear entry points for climate change impact in the CVC. These appear closer to upstream production processes, mainly cotton production at farm level. The impact then trickles down to downstream industries, but in varying degrees. For example, large textile manufacturing units are more resilient to climate change impact on cotton producing areas due to a high reliance on imports, whereas small cottage industries suffer more because they solely rely on domestic cotton. Moreover, analysis of relevant policy reveals that the textile sector is better protected, whereas the cotton production sector faces a comparatively less supportive policy regime.

Due to a limited number of studies on the subject, there were some clear limitations on this paper. We did not profoundly analyse the working relationships between actors and supporting market actors (transport, agriculture banks, etc.). This will be done in the next phase of research.

This paper is organised as follows: Section 1 discusses the value chain approach in general and answers how the value chain approach provides useful insights for climate risk analysis; Section 2 highlights the methodology of the paper; Section 3 provides an in-depth situation analysis of the cotton and textile sector in Pakistan; Section 4 focuses on mapping horizontal and vertical linkages in the CVC, institutional framework, and the role of vulnerable groups in the CVC; Section 5 summarises the literature and historical evidence of climate extremes and other climate-related vulnerabilities faced by Pakistan during the last two decades; Section 6 provides site justification and ways forward for further research.

1 Visit the PRISE website for more details: www.prise.odi.org

2 For more information on these terms, refer to Section 1.1.

1. Value chain analysis: an introduction

A value chain is a cumulative process through which a product gains value at each step before reaching end users. The interrelatedness of the actors and firms involved in a value chain is what makes this concept relevant to modern approaches to development that centre on social capital.

Value chains provide a market system approach to development and, now, are increasingly discussed in the context of poverty and income inequality (Mitchell and Ashley, 2009; OECD, 2015). While the global economy is becoming depressed with poverty and income traps, value chains provide important entry points for tackling such massive challenges by:

- integrating small and medium enterprises into large and competitive value chains;
- promoting inclusive market competiveness;
- increasing capabilities of market actors/institutions; and
- forging new networks (WTO, 2013).

1.1 Value chains and climate change

Taking a value chain approach to climate resilience and adaptation entails two major benefits. First, it accounts for climate issues holistically, because any positive or negative impact of climate variability on a single actor in any industry has implications for associated actors/firms/industries within and across the value chain itself. A value chain perspective thus allows us to look at both the impacts on individuals as well as on whole market/system. Second, the analysis of climate risks within a value chain framework proves helpful in identifying shared opportunities and threats, as well as effective collective adaptation options.

Climate change is now perceived to be a high-impact risk facing businesses and communities across the globe (WEF, 2016). Climate variability has resulted into various physical, financial, regulatory and product-demand risks for the goods and services industry (Agrawala et al., 2013). However, sufficient evidence exists to support the notion that value chains in developing countries—especially semi-arid regions—are more exposed to climate-induced vulnerabilities (Lemma et al., 2015).

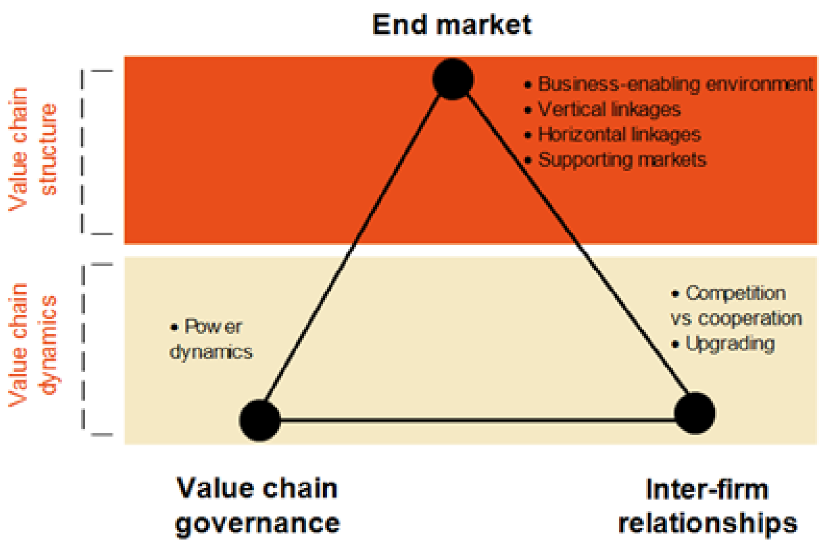
Citing an example of how one actor in a value chain promotes the resilience of another actor, Amado and Adams (2013) highlight the coffee supply company Green Mountain Coffee Roasters. Keeping the changing climate in mind, Green Mountain forecasts suitable areas for growing coffee and shares that information with farmers, which has resulted in the sustainable production of coffee, which positively effects other actors along the value chain. In another initiative, the clothing company Levi Strauss & Co. educate cotton growers about ways to increase cotton productivity (Ibid.). Literature also highlights evidence where large national and multi-national corporations have integrated climate risks into business models and address climate risks as a part of supply chain management (Thorpe and Fennel, 2012; Crawford and Seidel, 2013). Schuchard (2014) summaries the discussion on supply chain climate risks held during Business for Social Responsibility Spring Forum, saying that analysts believe risk managers can trace and address climate risks in a particular value chain by focusing on:

- geographical factors (such as whether or not a region is particularly vulnerable to climate threats),
- indirect linkages (such as price change of a substitute product as the result of a natural calamity), and
- existing business strategies (sustainability strategies).

Three gaps clearly emerge after an in-depth review of existing national literature on the subject (discussed in detail in section 3, 4 & 5); these gaps provide a way forward for further research. First, most of the studies on the CVC take a linear value chain approach and fail to capture the diversity within the CVC (e.g. vertical and horizontal linkages, gender roles, etc.). Second, the literature does not take into account climate implications for the whole CVC; research on climate impacts on individual actors in the CVC fails to present a comprehensive picture by excluding associated actors in the value chain. Third, spatial characteristics have not been incorporated into CVC analysis. While international literature (notably Hewitson 2014 et al.; CDKN 2014; and Lemma et al. 2015) establishes that climate change may impact some regions more than others (such as semi-arid lands) and that climate risks may magnify due to the socioeconomic and geographical setting of a particular region (e.g. high poverty, low water availability), there is a high possibility that CVCs in semi-arid regions may be at higher risk from climate change. Hence there is need to focus on socioeconomic as well as geographical features of a particular region while doing the climate risk analysis. Keeping these limitations of the existing literature in mind, the authors aim to holistically cater for such gaps in research over a three-phase process.

Value chain analysis for this study was carried out in light of USAID (2015) guidelines. USAID's approach is two-dimensional, comprised of both a structural and a dynamic analysis of the value chain (Figure 1). But, while structural and dynamic frameworks guide value chain analysis, end market, value chain governance and inter-firm relationships are key factors in defining structure and dynamics. Other factors that inform structural and dynamic analysis include vertical and horizontal linkages, power dynamics, and upgrading, all of which are explained in detail below:

Figure 1: Value chain analysis framework



Based on USAID (2015).

1.2 Structural analysis

Structural analysis identifies all the individuals and firms in a particular value chain and is characterised by end markets, business-enabling environment (BEE), vertical linkages, horizontal linkages and supporting markets.

End markets

USAID (2015) describes an end market as an individual to whom a final product is being sold and/or the place where that product is sold (in other words, who the end user is and/or where the final transaction takes place in a value chain). This can be within or beyond national borders. Analysing end markets provide useful information about the quantity of the product sold, its buyer, and the geographical reach of the final product. These insights can be useful in determining profit maximisation markets (with competitive advantage, high profit margins, etc.) and risk minimization markets (through diversified investment).

Business-enabling environment (BEE)

BEE includes the examination of customs, regulations, policies, international standards, agreements and treaties under which actors and firms associated with a value chain operate. Incorporating BEE analysis into the value chain analysis helps identify constraints and opportunities for SMEs to become part of a large value chain, and providing BEE can help find ways to formalise informal industrial setups to protect vulnerable upstream actors in a value chain.

Vertical linkages

A product reaches its final market through vertical linkages between firms. Analysis here is essential to identify weak linkages (e.g. limited exchange of knowledge, lack of trust) that undermine the competitiveness of a value chain. Strong vertical relationships enable skill transfer, competitiveness across the entire industry, and upgrading. The identification of weak or missing links is crucial to value chain analysis.

Horizontal linkages

These linkages are the inter-firm relationships—both formal and informal—at various stages across a value chain. Strong horizontal linkages result in increased bargaining power for firms, risk sharing, skill sharing, reduced cost of transactions, and creating economies of scale (decrease in cost of production through increased scale of production.

Supporting markets/support services

Actors and firms in value chains can provide support services to other value chains: financial services (e.g. lending, investment, etc.), cross-cutting services (e.g. telecommunication, advertising, etc.) and sector-specific services (e.g. equipment, raw materials, training, etc.). Value chain analysis seeks to understand how access to support services can be enhanced for value chain actors, as well as strengthening supporting markets.

1.3 Dynamic analysis

Dynamic analysis takes into account how actors or firms behave and respond to value chain structure. It is characterised by value chain governance, inter-firm relationships and upgrading.

Value chain governance

Governance in a value chain incorporates the relationship between various actors of value chain, service providers, and regulatory institutions. Analysis of value chain governance is about finding answers to questions such as:

- Who has control over a particular production activity?
- Who can influence actors?
- Who sets parameters for an industry to operate?
- What implications do power dynamics have for SMEs?
- Is the distribution of gains equal for every firm in a value chain?

Inter-firm relationships

Win-win relationships between firms promote industry competitiveness and help in upgrading firms in a value chain (see below). Exploring the type and quality of relationship between different firms is the aim of this analysis.

Upgrading

Upgrading refers to effective innovation (e.g. technology upgradation, an increase in skilled labour) and reform (e.g. improving the working environment, better incomes) at particular parts of the value chain. Power dynamics between firms play an important role in enhancing opportunities to upgrade.

2. Methodology

Research on the CVC is divided into three phases:

1. Identification of vertical and horizontal linkages in Pakistan's CVC.
2. Identification of current and future climate risks within the CVC, especially vulnerable groups and current adaptive practices.
3. Adaptation options for communities, and business and private sector investment opportunities when responding to climate change in semi-arid lands through vertical and horizontal transformation.

This paper focuses exclusively on phase one and lays the groundwork for phase two, which will focus on the dynamics of climate change in the context of the CVC, particularly in Pakistan's semi-arid districts. Gender is a cross-cutting theme for previously mentioned research phases.

The methodology adopted for this paper includes the following steps:

1. Researching industry statistics (production, trade, pricing, etc.) and writing a literature review on the CVC.
2. Drafting linkages of the value chain map based on the literature review.
3. Conducting interviews and focus groups[3] with value chain representatives (one from each functional level of the value chain) and experts such as agronomists, economists, journalists, government-level agricultural advisors to map a) the vertical and horizontal linkages in the CVC; b) the role of vulnerable groups in the CVC; and c) institutional arrangements.
4. Adjusting the value chain map in light of stakeholder feedback.
5. Making a preliminary assessment of existing literature and key informant interviews to identify climate risks to the CVC (a detailed analysis of this would be done in phase two of this research).
6. Identifying and justifying semi-arid study sites for phase two.

3 Details on key stakeholders involved in the CVC are given in Appendix 2. The stakeholder groups mostly belong to the following categories: private actors (blue), government (green), and supporting markets (red).

3. Pakistan’s cotton and textile sector

The cotton crop makes up roughly 14% of the total cropped area of Pakistan (PBS, 1981-2015), and is the main crop of the kharif season, Pakistan’s rainy season that starts in May and lasts until December. Its arrival in factories typically starts in August, and its third or fourth harvest continue until March. On average, the Punjab province accounts for 80% of Pakistan’s total cotton production, whereas the Sindh province contributes 20%.[4] For the most part, cotton is produced by small farmers who cultivate less than 5 ha of land. An estimated 1.3 million farmers grow cotton in Pakistan (Khan, 2016).

The textile sector is the largest industrial sector in Pakistan and accounts for approximately 40% of the industrial labour force (Ministry of Finance, 2016). This sector uses 40% of commercial loans provided to the manufacturing sector, provides 25% of industrial GDP and makes up roughly 57% of Pakistan’s exports (Ibid.). Additionally, 10 million farming families live off the textile industry (Ministry of Finance, 2014). Compared to other textile producing countries, Pakistan’s textile value chain has the lowest wage rate ($0.39 USD per hour) (Hussain et al., 2009). The integrated cotton and textile sector includes 1300 ginneries, 523 textile mills, and 300 cottonseed crushers and oil expellers (Ministry of Finance, 2016).

Figure 2 gives an overview of Pakistan’s cotton-producing provinces from 1981 to 2014. On average, almost 80% of the overall cotton cultivation area lies in Punjab, followed by Sindh with 20%, Balochistan with 1%, and Khyber-Pakhtunkhwa (KPK) with 0.04%. Since 1981, Punjab’s cotton cultivation area has expanded by 47%. However, as compared to its 1981 area, KPK’s cotton cultivation area has declined in recent years (from 2009 to 2012). In Balochistan’s case, there is an increase in land area for cotton cultivation, from 300 ha in 1981 to 41,000 ha in 2015. Despite this expansion, there are still huge piles of land in Balochistan yet to be explored. There are ongoing efforts to bring new land under cultivation in Balochistan and KPK.

Punjab in particular has seen a comparatively greater variation in cultivated land for cotton. For example, in 2010 the crop area for cotton production was reduced due to flooding, whereas in 2011-2012, cotton was sown on a larger area as seeds were available at subsidized rates, and because of favourable weather conditions and a decrease in pest attacks (PBS, 1981-2015).

In Balochistan, government incentives played a significant role in increasing cotton crop acreage in 2001. To produce top-grade cotton there, the government distributed subsidised seeds to farmers (a 50% subsidy) and assured the purchase of unsold stock over the next three years (Dawn, 2001). In 2007, another government-led agriculture development project was initiated that focused on introducing cotton to an additional 19 districts (APP, 2007).

Cotton harvest © Kimberly Verdeman

4 Based on the average figure of province contribution to Pakistan’s total cotton production (from 1981 to 2016).

Punjab in particular has seen a comparatively greater variation in cultivated land for cotton. For example, in 2010 the crop area for cotton production was reduced due to flooding, whereas in 2011-2012, cotton was sown on a larger area as seeds were available at subsidized rates, and because of favourable weather conditions and a decrease in pest attacks (PBS, 1981-2015).

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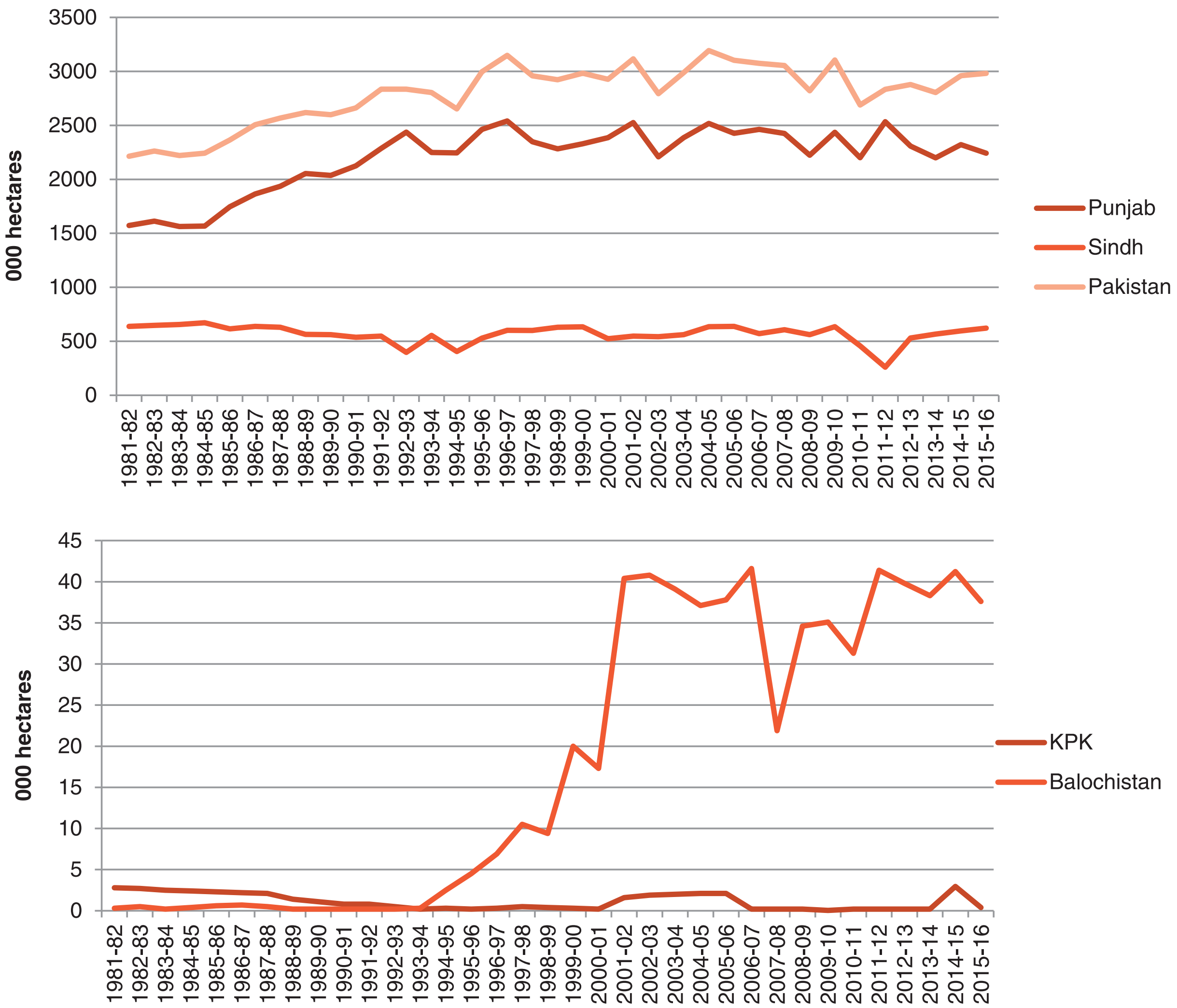
3.1 Cotton and textile production (1981-2014)

Raw cotton production

According to USDA (2016), Pakistan is currently the fourth-largest cotton-producing country after India, China and the US; and the third-largest cotton-consuming country in the world. Pakistan is also the sixth-largest cotton-importing country in the world, with 0.7 million metric tons cotton imports (USDA, 2016).

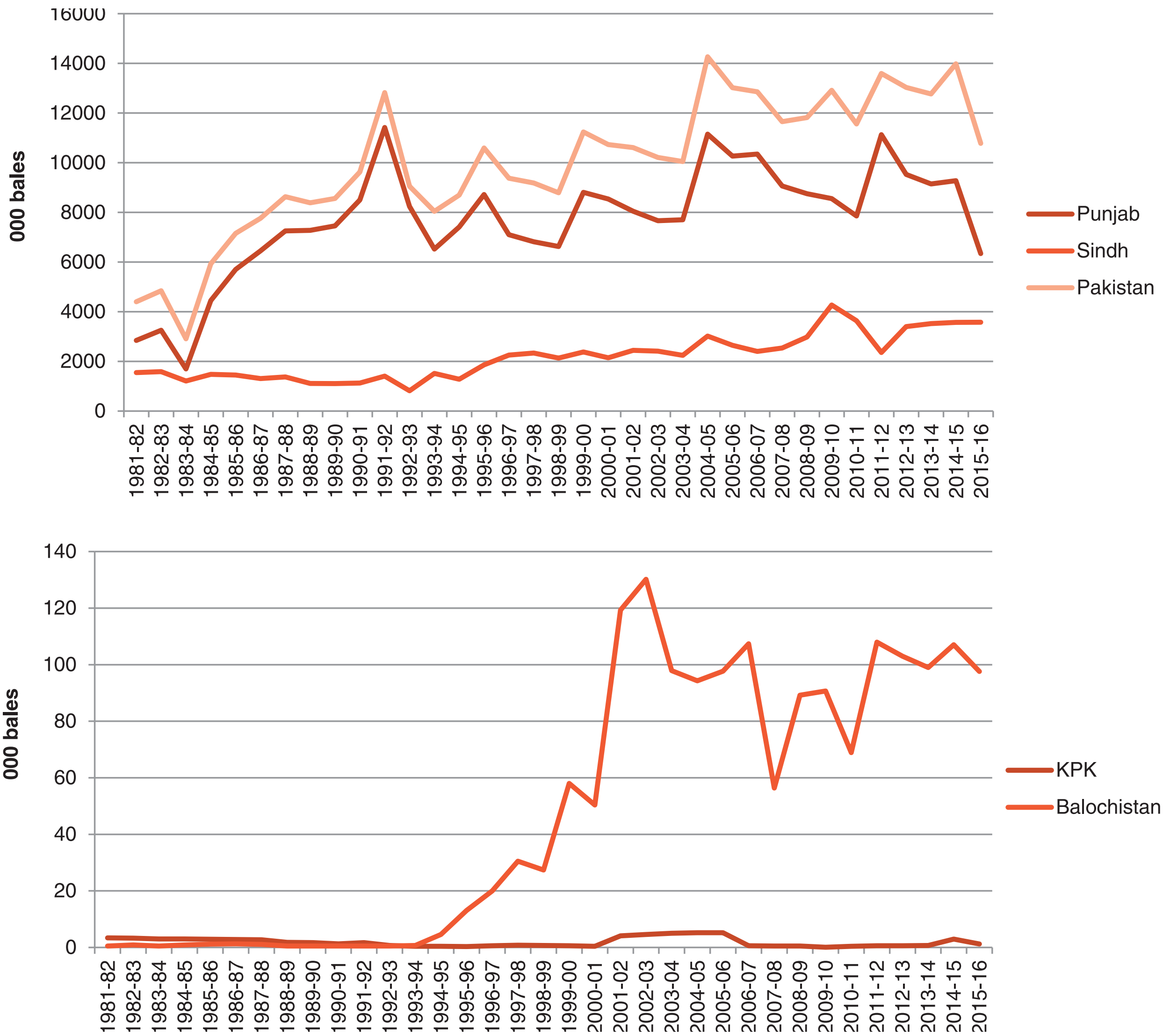
Figure 2: Annual raw cotton producing area by province ('000' hectares)



Source: Author's own with PBS data, available online and in print (1981-2009, 2009-2015).

Figure 3 provides an overview of annual cotton production by province. An increasing trend in production can be observed across the entire country. Cotton production throughout Pakistan has been increasing at a faster pace, especially when compared to increases in area of cotton production (i.e. land used for cotton crops). This is particularly due to technological advancements in the cotton-production sector. However, there are larger inter-annual variations in production. The cotton leaf curl virus (CLCV led to low cotton production during 1993-1994 and 2003-2004, where 1991-1992 and 2004-2005 saw high cotton production due to favourable weather conditions and better pest control practices (Salam, 2008). Moreover, Pakistan experienced massive flooding in 2010 as well as heavy rainfalls in Sindh in 2011 and 2012, which caused a decline in cotton production. This shows that climate extremes and crop diseases, which are also induced by environmental factors, are major features that define annual trends in Pakistan's cotton production.

Figure 3: Annual raw cotton production in Pakistan by province (000 bales)



Source: Author's own with PBS data, available online and in print (1981-2009, 2009-2015).

In response to shifts in production, the price of cotton has also proven to be rather volatile. The Ministry of Finance (2011) reports that prices of cotton increased tremendously from PKR 7,150 ($68.2 USD) per maund[5] in October 2010 to a record high of Rs 12,500 per maund ($119.2USD) in March 2011; after massive flooding in 2010, cotton production plummeted and cotton prices soared in 2010 due to a decade-low cotton production. The price for cotton lint reached a seasonal high of Rs 6,000 ($57.2USD) per maund. The spot rate for cotton set by the Karachi Cotton Association also increased by Rs 100 ($0.95USD), making it Rs 5,600 ($53.4USD) per maund (Agricorner, 2016a/b). However, in 2008, cotton prices plummeted from Rs 3,700 ($35.3USD) to Rs 3,200 ($30.5USD) in the wake of a depressed global cotton market due to the global financial crisis (Pakissan, 2008). While price is a major factor in determining

5 1 maund (Pakistan) equals 0.04 metric ton.

profit margins for farmers and other cotton-related textile players, it also has a tendency to influence the production pattern. For example, low cotton prices at the first harvest encourage farmers to invest less on plant protection and management because they foresee less return. This causes a decline in cotton production during the second and third harvests.[6] Additionally, local cotton prices in Pakistan are usually less then international prices because of non-standardised practices and the lack of a quality-based pricing system; farmers get paid based on weight, so there is less concern to produce quality cotton.

Decline in cotton production in 2015-16 is another example of climate repercussions. Cotton production in Pakistan witnessed a steep downward trend after 2014-2015, with a shortfall of about 2.93 million bales, as compared to last year's production statistics (PBS 2015). Pakistan's total 2013-2014 cotton production was roughly 12.769 million bales, to which Punjab contributed a hefty 9.145 million bales and Sindh contributed 3.523 million bales. In contrast, Punjab's 2015-2016 cotton production has plummeted to 6.3 million bales whereas Sindh has remained steady with its previous year's production, coming in at 3.57 million bales. Total cotton production in 2016 amounted to 10.782 million bales.

According to agriculture researchers, the decline in production can be largely linked to climatic factors. Representatives of Ministry of Textile also believe that excessive rain during August 2015 washed away pesticides and diluted soil nutrients, giving various pests, especially the pink bollworm, easy access to destroy the unprotected cotton crop (Khan, 2015). Other factors contributing to the decline, according to our stakeholders, include fake and low quality seeds, the lagging performance of agriculture research institutes to come up with heat resistant varieties, and the declining interest of cotton farmers to invest in good, quality input supplies due to low returns on last year's cotton crop. Stakeholders also lament that low returns on cotton crops have caused cotton farmers in Punjab to shift towards planting other profitable, low-maintenance crops (such as sugarcane), which has resulted in lower cotton crop acreage, hence less production. This suggests that governance and resilience go hand in hand, and that better governance can help overcome some, if not all, vulnerabilities.

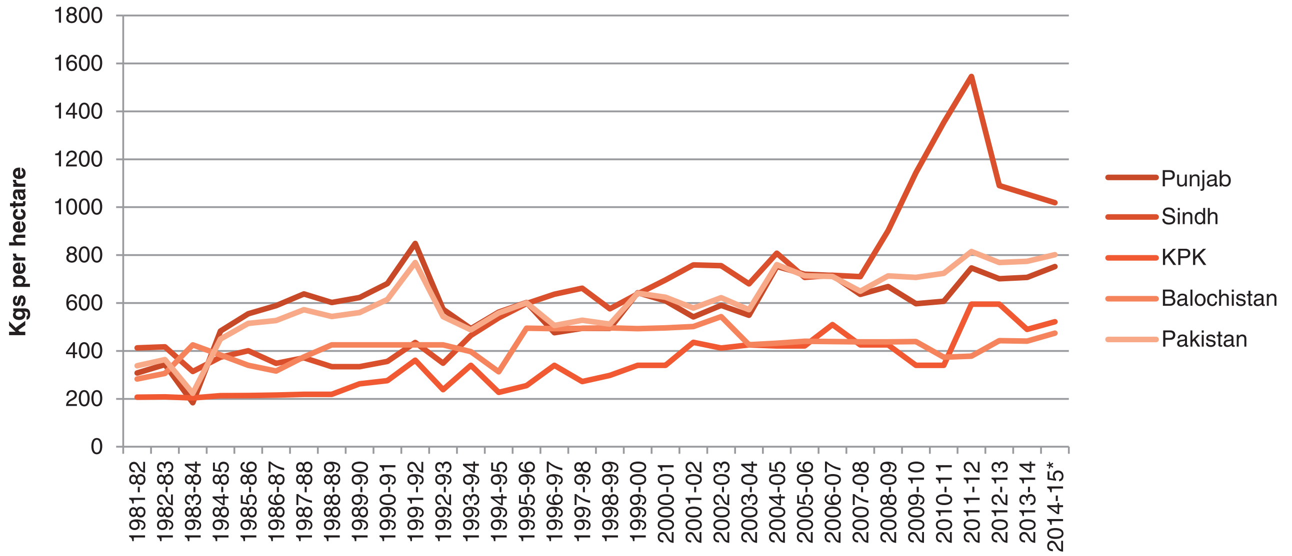
With such a huge decline in production, national losses are estimated around Rs 0.6 trillion ($5.7 billion USD) (Khan, 2016). These losses trickle down to textile labourers, farmers and other related industries, such as the solvent industry and banola oil (cottonseed) industry. Experts believe this is due to the high cost of production and low domestic cotton productivity. While large textile manufacturers rely on imports in times of domestic cotton decline, small and medium enterprises bear the brunt of the production crisis.

Figure 4 provides annual cotton yields by province. From 1984 to 1996, Punjab had the highest yield. In 1996, Sindh's efficiency in productive began to rise and it surpassed Punjab's cotton yield. Presently, Sindh produces more than 1000 kg/ha of cotton, as opposed to roughly 700kg/ha in Punjab. However, the production area in Sindh (see Figure 2) has not expanded since 1996 and has stagnated around 520,000-640,000 ha. Experts interviewed believe that Sindh's higher yields are due to a more conducive environment for cotton production, (i.e. especially mild night temperatures) as well as higher numbers of plants per acre.

High crop yields in 2004-2005 raised farmers' expectations and a large number of them shifted to cotton from sugarcane in hopes of higher profits. However, 2005-2006 witnessed a reduced cotton yield (13% from the previous year) in spite of that increase in cultivation area, which highlights environmental factors as the cause of depreciating crops. The amount of loss from that lower yield was around PKR 53.4 billion ($518.7 million USD) (Salam, 2008).

6 Cotton crops usually require three to four rounds of harvests, or picking, per season (done by manual labour in developing countries).

Figure 4: Annual cotton yields by province

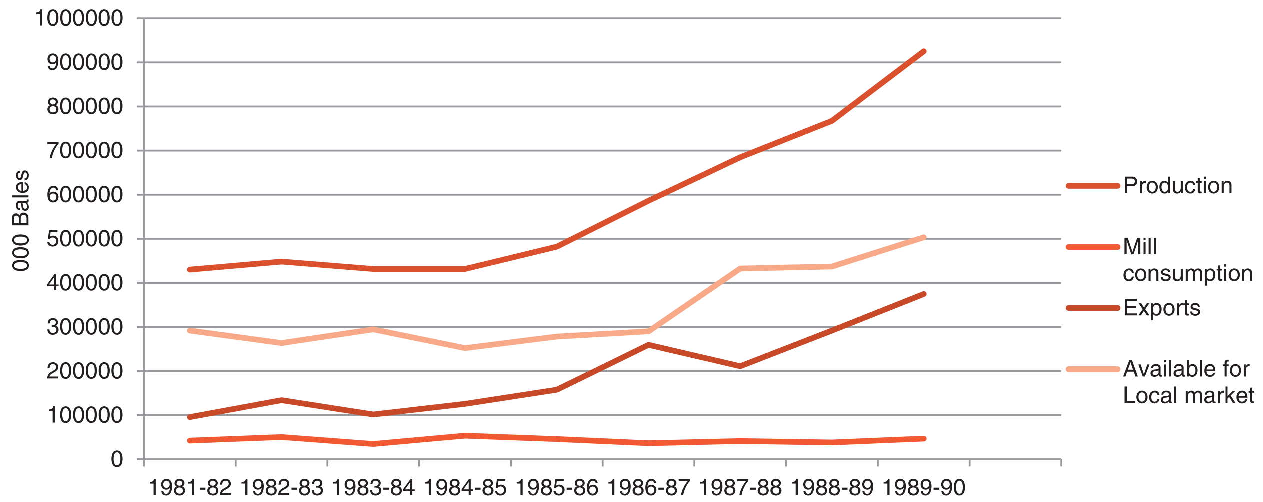


Source: Author's own with PBS data, available online and in print (1981-2009, 2009-2015).

An analysis of the data reveals that variation in all the three indicators—area, production and yield—is either explained by governance or climatic factors. While climate is an exogenous phenomenon, adaptation coupled with government support can, over the years, help to stabilize sharp variations in agricultural productivity.

Figure 5 provides market-level data of raw cotton supply and distribution for the last 10 years. Almost 89% of the total cotton produced is consumed domestically (both mill and non-mill). However, after the processing stage (see Figure 13), the cotton purchased by domestic mills is largely exported. Moreover, raw cotton imports, which are a major adaptive tool for the CVC in times of low domestic production, account for 10% of Pakistan's total cotton production on average. This is evident from the data, as the domestic consumption of cotton outnumbers domestic cotton production. Apart from filling in the production gap, cotton imports are also used to produce quality textile outputs. Generally, Pakistan produces low-grade, small staple cotton, however, to meet international demands for high-quality textiles, long staple cotton is imported.

Figure 5: Supply and distribution of raw cotton (000 bales)



Data source: Author's own with APTMA's data, 2015.

Labourers putting raw cotton into cleaning machine © Samavia Batool

Furthermore, estimates from the 2001-2002 Household Integrated Economic Survey reveal that 24% of farmers in Pakistan produce cotton, out of which only 16.6% own some or all of their cotton-producing land (Orden et al., 2008). Lack of land ownership signifies that income generated from cotton production has huge implications for food security and the livelihood and wellbeing of the farming community. Over time, low economic returns on cotton may also result in farmers shifting from cotton to other, more profitable crops.

Cotton production by district [7]

Punjab and Sindh are the key contributors to cotton production in Pakistan. After wheat and rice, cotton is the third most-cultivated crop in Punjab by crop area, and is sown only on irrigated land. Canal tube-wells are the most common source of irrigation for cotton crops in the district, followed by canals (PBS, 2014). Figure 6 shows cotton production according to district,[8] highlighting yield levels and trends.[9]

Major cotton producing districts are clustered in Punjab's southern region. The production average from 1981 to 2012 shows that the Rahim Yar Khan district contributes the most to Punjab's cotton production (13%), followed by Bahawalpur (11.7%), Vehari (11%) and Multan (10.4%). Over time, northern districts of Punjab show a significant decreasing trend in cotton cultivation area and cotton production primarily due to farmers switching to other, higher return crops such as potato, maize, etc.. This, however, does not reduce Punjab's overall cotton production as these districts already had a comparatively low percentage of cotton production.

Since 1981, the average annual growth rate of cotton production in Sindh has increased by 5.5%. Districts in northern Sindh contribute more to the overall cotton production of the province as compared to southern districts: Sanghar contributes the most (22.4%), followed by Shaheed Benazirabad (13%), Khairpur (12.1%) and Ghotki (10.7%). In these districts (except for Saheed Benazirabad), trends in cotton production show

7 A map of Pakistan's districts can be found in the Annex 1.

8 Districts are the third order of administrative unit in Pakistan, after Provinces and Divisions.

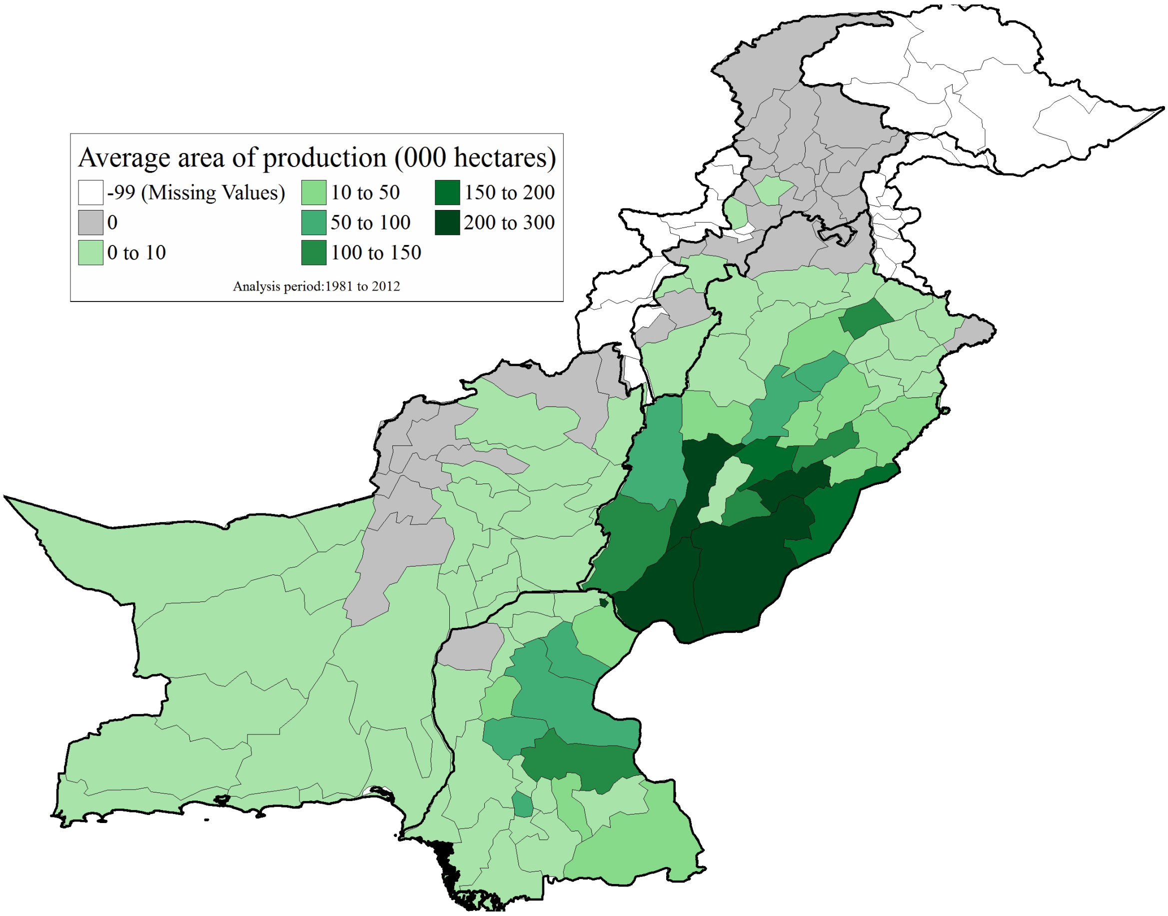
9 Data source: Directorate of Agriculture, Crop Reporting Service (Punjab, Sindh, KPK and Balochistan – 2015).

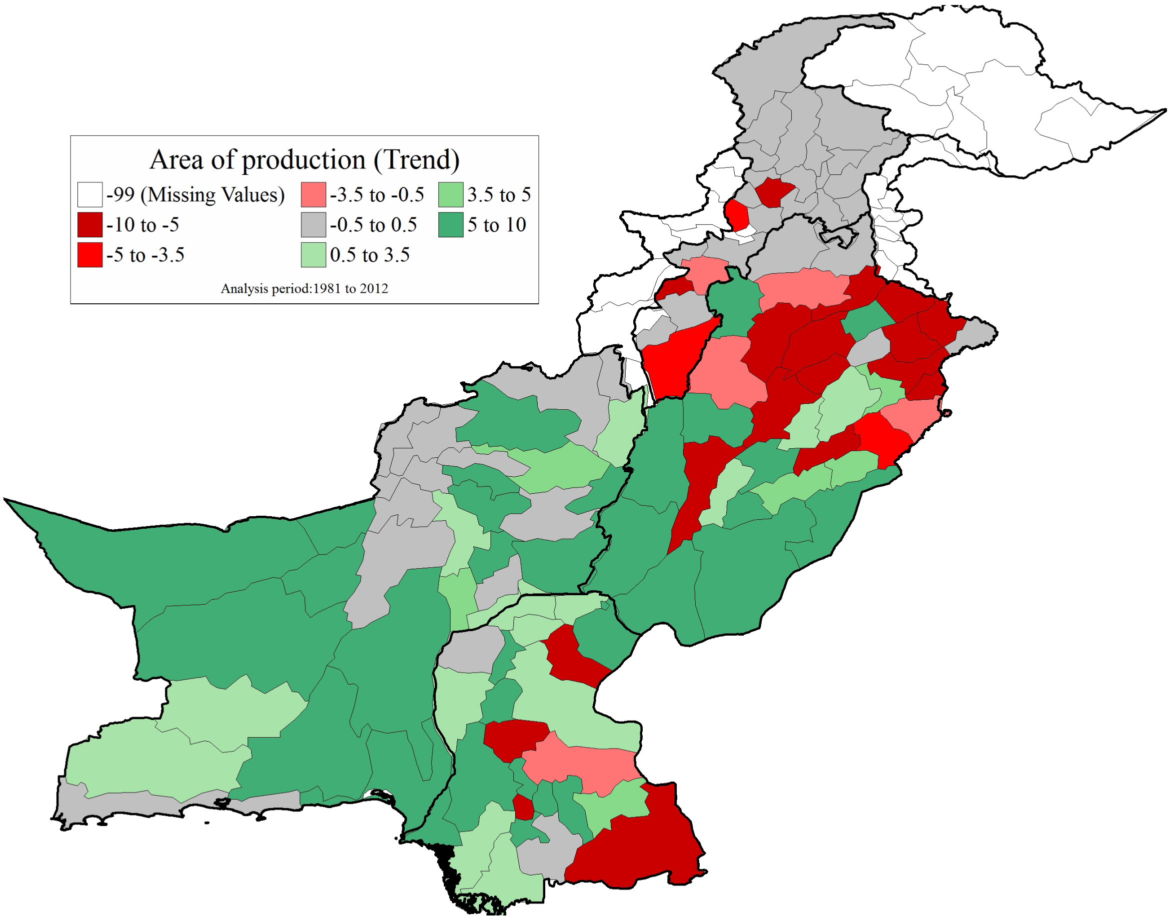
a rapid increase compared with a mild increase in cotton-producing areas; this signifies higher yields over less acreage (more kg/ha). On the other hand, in the districts of Tharparkar, Sukkur, Shaheed Benazirabad, and Hyderabad, trends show a significant decrease in cotton production as well as cotton-producing area. Average production of cotton in these areas (except Shaheed Benazirabad) ranges from 68,000 bales to 185,000 bales, which is the lowest compared to other districts in Sindh. A continuation of this trend would cause Shaheed Benazirabad's district contribution to decline, therefore causing Sindh's annual cotton production to decline; this is because of Shaheed Benazirabad's high contribution to the province's cotton production.

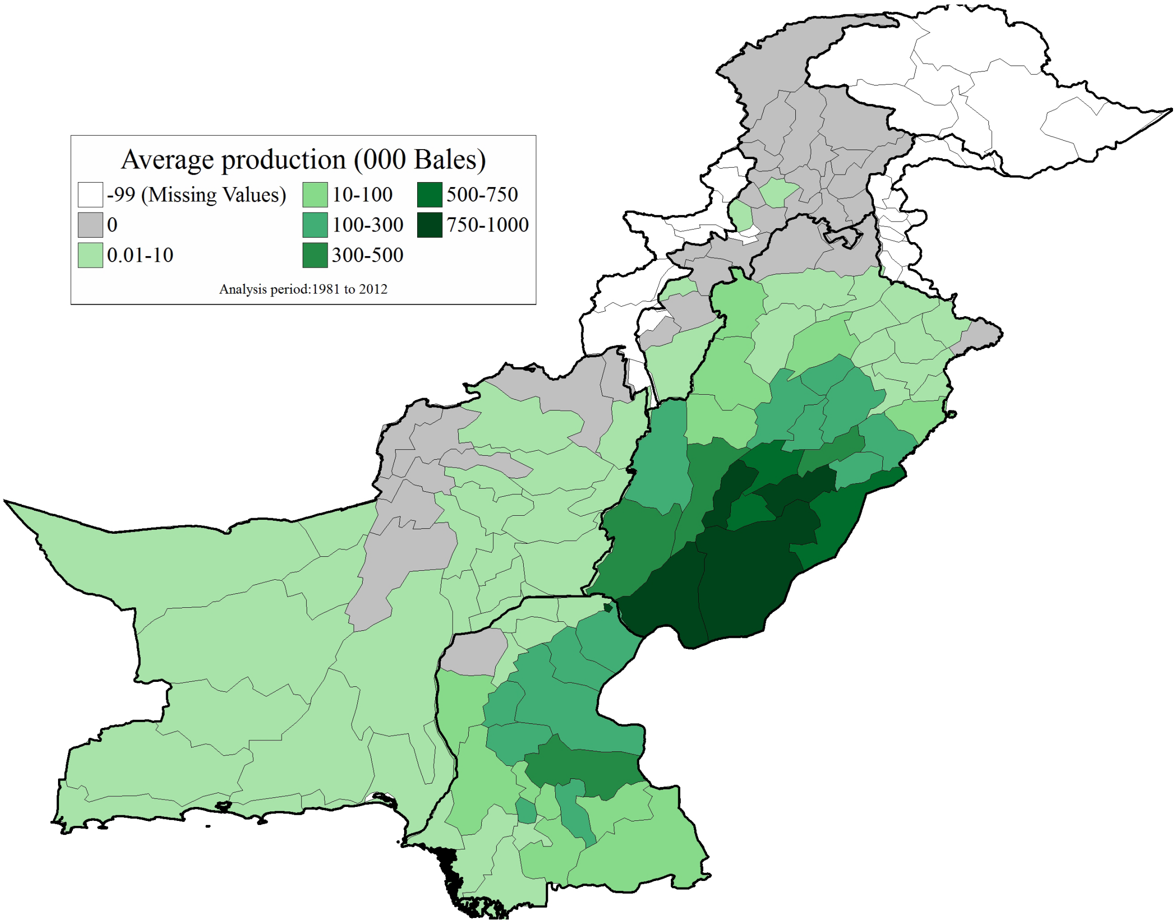
In KPK, Dera Ismail Khan contributes the most (92%) and its average contribution per year is around 1700 bales, which makes about 0.001% of the total cotton production in the country. Since 1981, cotton production in KPK has decreased, on average, by 38%. Trends in almost all cotton-producing districts have shown a decline in cotton production and cotton-producing area. An insignificant increase in yield, however, can be observed for some districts.

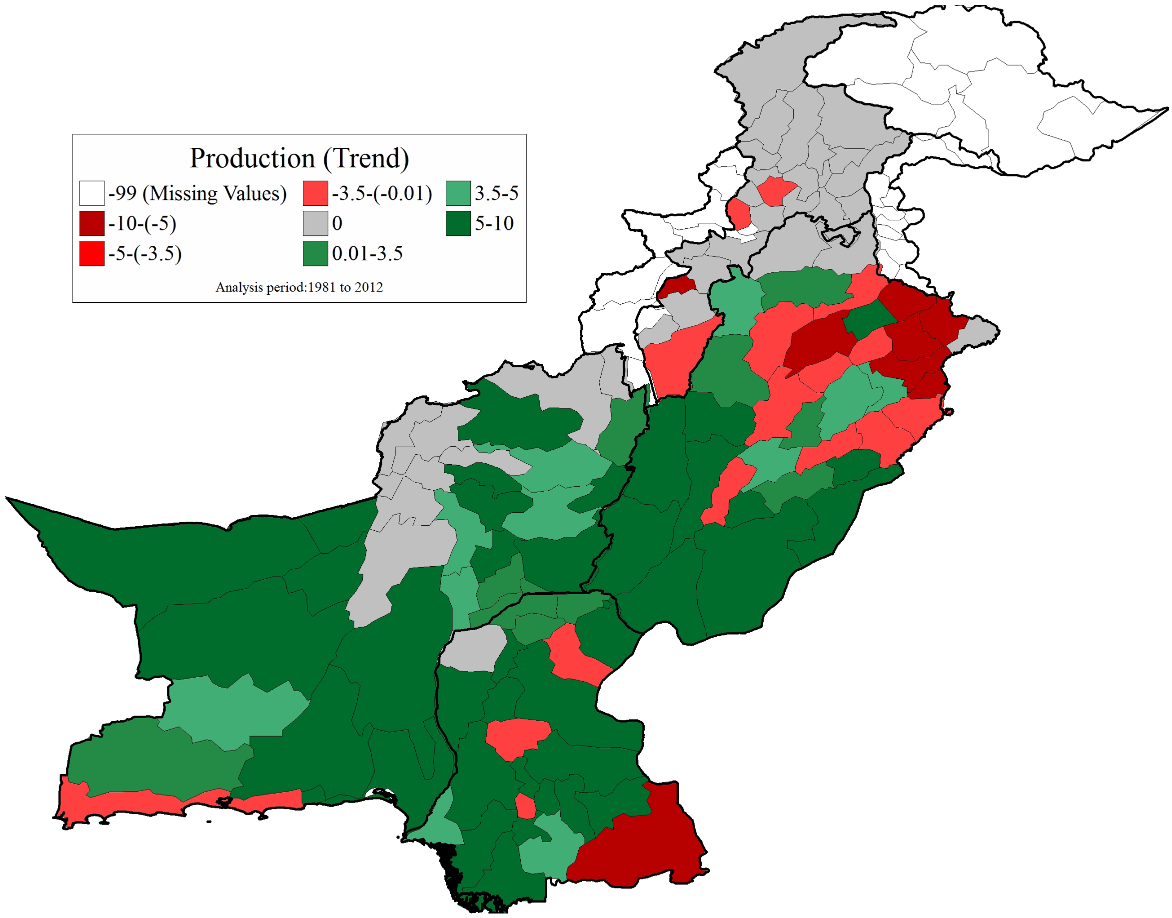
Cotton production in Balochistan has shown an average growth rate of 38% during the last 31 years (slightly more than 1% per year). There are three major cotton contributing districts: Nasirabad contributes the most (22%), followed by Lesbela (17%) and Khuzdar (14%). Trends in almost all of Balochistan's districts have shown a significant increase in yield. This increase can be attributed to higher land productivity (environmental factors) and government incentives for producing cotton.

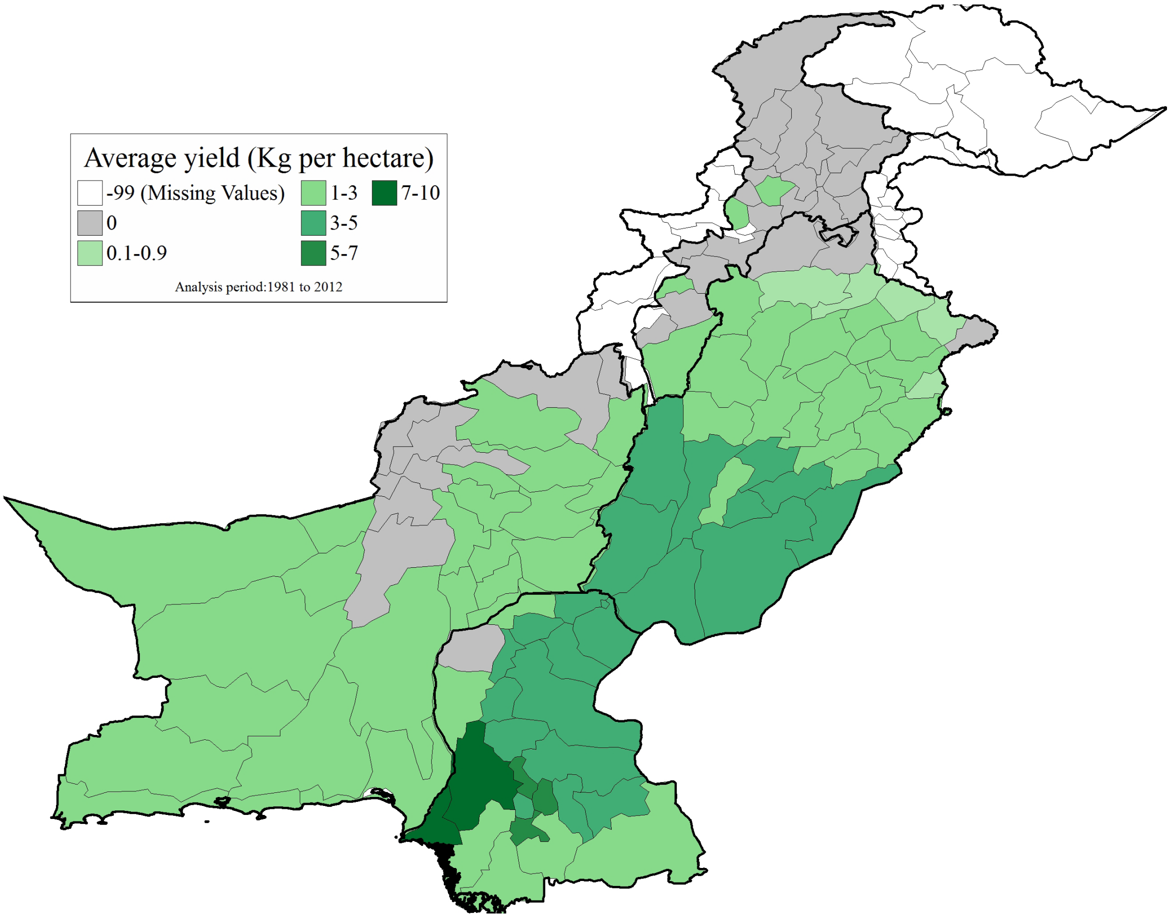
Figure 6: District cotton averages and trends in area of production, production and yield

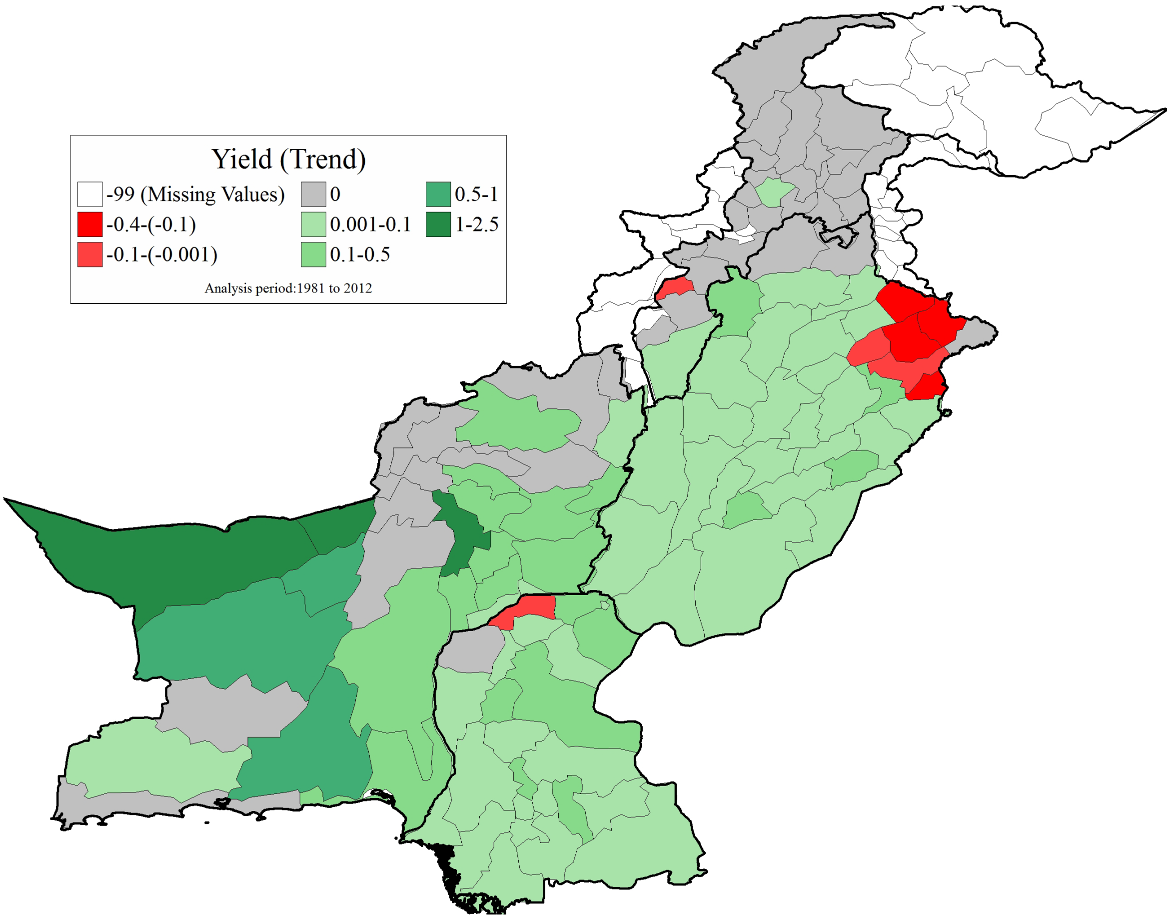





Average production (000 Bales)
-99 (Missing Values)
0
0.01-10
10-100
100-300
300-500
500-750
750-1000
Analysis period:1981 to 2012


Production (Trend)
-99 (Missing Values)
-10-(-5)
-5-(-3.5)
-3.5-(-0.01)
0
0.01-3.5
3.5-5
5-10
Analysis period:1981 to 2012





Source: Author's own with PBS data, available online and in print (1981-2009, 2009-2014).

Land use and cotton cropping pattern

The 2010 Agricultural Census (PBS, 2010) presents an overview of cotton cropping patterns in Pakistan. Table 1 summarises the cotton crop area. Out of the total cropped area under private farms, 14% is used to cultivate cotton. In Punjab and Sindh, respectively 15 and 20% of the farms are used to cultivate cotton. Small- and medium-sized farms (3-10 ha) contribute more land to cotton production in Punjab, whereas medium-sized farms (5-20 ha) dedicate comparatively larger proportions of land for cotton production in Sindh (PBS, 2010).[10]

Table 1: A snapshot of land-use patterns for cotton

Farm size (ha)	Pakistan		Punjab		Sindh	
	Cotton crop area as a % of total cropped area in Pakistan	cultivated area (ha)	Cotton crop area as a % of total cropped area in Pakistan	cultivated area (ha)	Cotton crop area as a % of total cropped area in Pakistan	cultivated area (ha)
Farms (total)	14	3733863	15	2681782	20	1024395
Under 0.5	10	91785	12	69370	27	22033
0.5 to 1	13	244726	14	171845	27	72110
1 to 2	14	520673	14	366403	24	152487
2 to 3	13	536899	14	430553	19	103536
3 to 5	14	713003	14	551721	21	156285
5 to 10	14	717812	15	538078	20	175368
10 to 20	15	498033	17	312225	19	181939
20 to 40	13	230917	14	125548	17	101152
40 to 60	14	70836	17	45666	18	24157
60 and above	14	109165	16	70368	20	35328

Source: Agricultural Census, 2010.

Table 2 shows cotton crop area per tenure. In Pakistan, 13% of owner farms, 15% of owner-cum-tenant (OCT) farms, and 15% of tenant farms produce cotton. OCT farms and tenant farms dedicate a greater proportion of land to cotton production in Punjab (16% each), whereas tenant farms in Sindh have more land dedicated to cotton production (24%).

Table 2: Land use by tenure

Farm size (ha)	Cotton crop area as a % of total cropped area		
	Pakistan	Punjab	Punjab
Private farms (total)	14	15	20
Owner farms	13	14	20
OTC farms	15	16	20
Tenant farms	15	16	24

Source: Agricultural Census, 2010.

10 See Agriculture Census (2010), accessed online at: http://www.pbs.gov.pk/sites/default/files/aco/publications/agricultural_census2010/Tables%20%28Pakistan%20-%20In%20Hectares%29.pdf

Textile production

Textile manufacturing in Pakistan is largely clustered around Karachi, Faisalabad, Lahore and Multan. Ginners received 13.3 million bales of seed cotton in 2013-2014 compared to 12.9 million bales in 2012-2013 (see Table 3).

Table 3: Cotton arrival in ginning factories

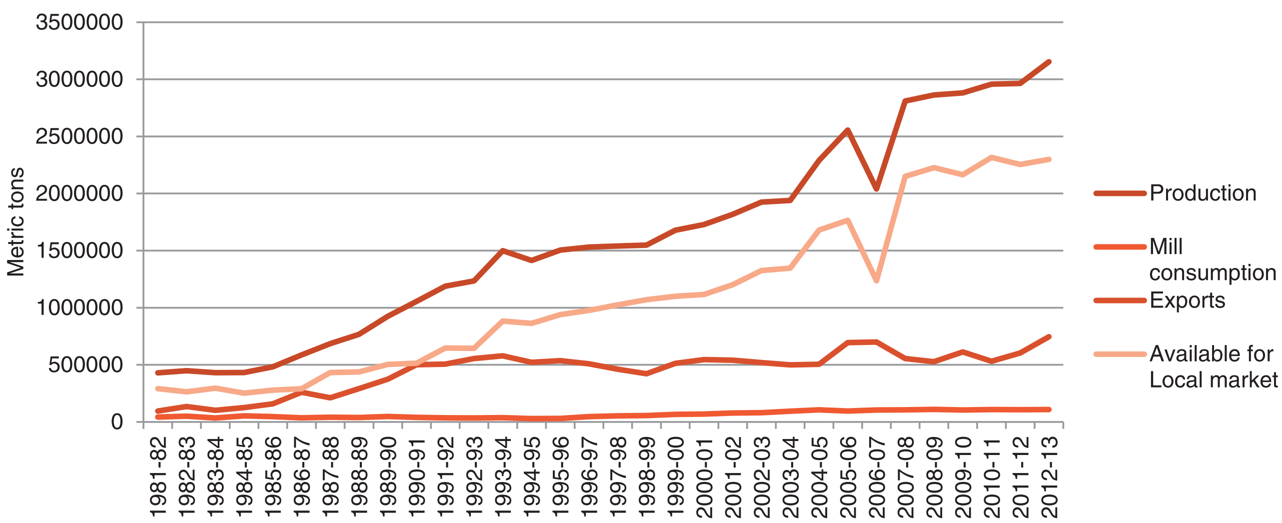
Year	Seed cotton arrival into ginning factories (000 bales)				Raw cotton pressing in ginning factories (000 bales)			
	Punjab	Sindh	Balochistan	Pakistan	Punjab	Sindh	Balochistan	Pakistan
2009-2010	8458	4212	22	12693	8458	4212	22	12693
2010-2011	7904	3670	24	11698	7901	3770	24	11695
2011-2012	12132	2620	62	14814	12124	2620	62	14806
2012-2013	9508	3354	53	12916	9507	3352	53	12912
2013-2014	9631	3697	63	13392	9629	3696	63	13389

Source: COTISTICS, August 2015.

Pressed bales from Punjab are sold mainly to textile industries (except for a few districts that sell some bales to exporters), whereas a large number of pressed bales in Sindh are sold directly to exporters and the rest to textile units (Pakistan Cotton Ginners Association, 2015). Cottonseed is a valuable co-product of raw cotton, which is further processed to produce seed oil and seedcake. Seed oil is used by oil industries and seedcake is used as animal feed. The annual production of cottonseed in 2014-2015 was about 0.4 million tonnes.

Nearly 4% of Pakistan's annual yarn production is consumed by mills for further processing; 18-25% is exported; and a massive 60-70% is consumed domestically (non-mill consumption) (see Figure 7). In 2013-2014, Pakistan produced a total of 1 billion sq m of cloth, with a higher percentage of medium and superfine cloth as compared to fine and coarse cloth. Out of this, 55% was produced as gray cloth, 30% as dyed and printed, 9% as bleached, and 5% as blended (APTMA, 2015). Details on the types of cloth produced in Pakistan can be found in Table 4.

Figure 7: Cotton yarn production and distribution (metric tons)



Source: Author's own with COTISTICS data, 2015.

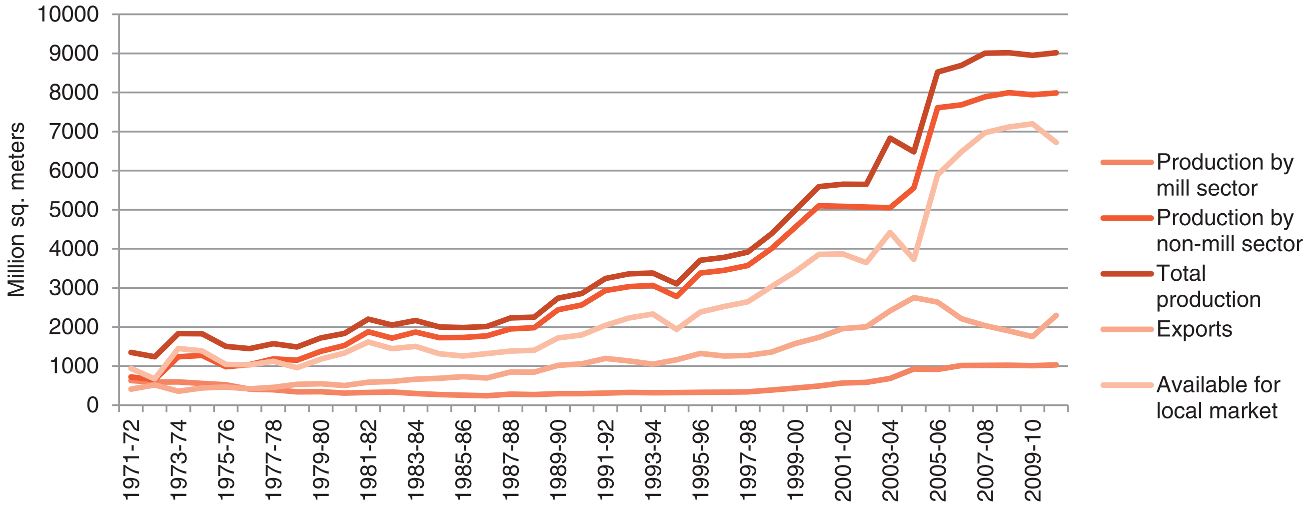
Table 4: Cotton cloth production (000 sq m)

Year	Cloth production catagories				
	Fine	Medium	Coarse	Super fine	Total
2009-2010	190608	343013	182452	293514	1009587
2010-2011	194271	351635	186272	297474	1029652
2011-2012	193619	346381	184818	299441	1024259
2012-2013	194332	347017	185677	302072	1029098
2013-2014	197477	343540	186602	308483	1036102

Source: COTISTICS, 2015.

Pakistan exports roughly 19-25% of its cotton cloth, whereas its domestic consumption is about 75-80% of its total production (see Figure 8). Comparing Figures 7 and 8 with Figure 5 suggests that the production of cotton is less than domestic consumption, whereas the production of yarn and cotton cloth meets domestic demand, leaving little room for yarn and cloth imports.

Figure 8: Production, consumption and export of cloth



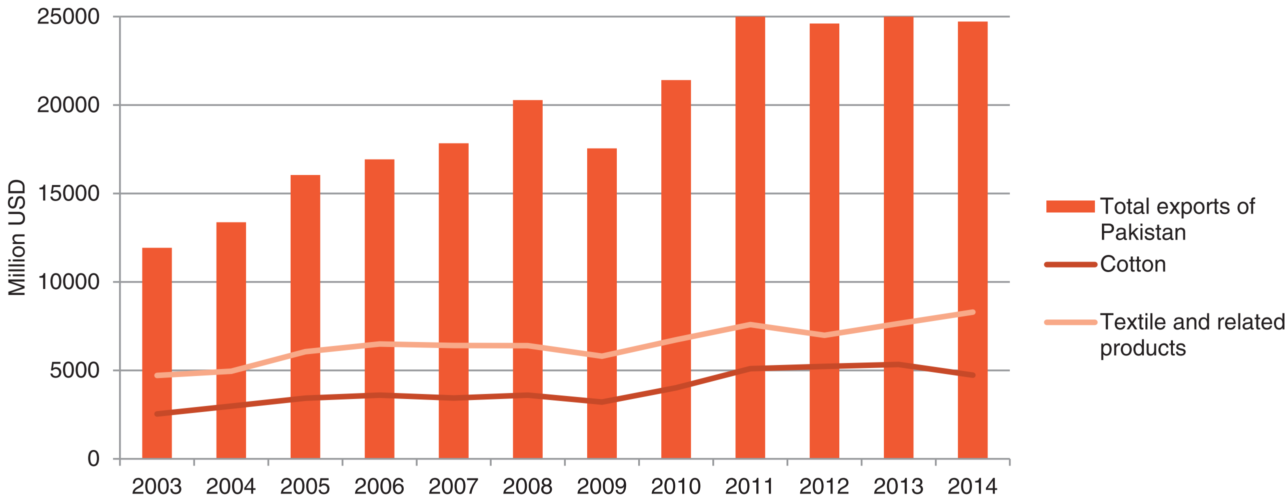
Figures for the non-mill sector are estimated by APTMA.

Source: Author's own with APTMA's data, 2015.

3.2 Cotton and textile imports and exports

Cotton is the thirteenth-largest imported commodity group in Pakistan and the largest exported commodity group. Combined, cotton and textile products[11] make up 55.4% of Pakistan's total exports, but only 2.3% of Pakistan's total imports. Over the last 12 years, exports of cotton have increased by 87% and exports of textile products have increased by 76% (see Figure 9). However, cotton exports have shown higher variability (higher value of coefficient of variation) when compared to textile product exports. This can be explained by the volatile nature of domestic cotton production as a result of various climatic and governance factors, such as the availability of water, access to extension services, credit facility, etc. (see Figure 3). A stable trend in the export of textile products may be due to the higher resilience of textile manufacturers to any change in supply of domestic inputs. This is due to their reliance on imported inputs (e.g. cotton and yarn).

Figure 9: Comparison of cotton and textile exports with Pakistan's total exports from 2003 to 2014)



Source: Authors' compilation from International Trade Centre 2016 data. Figure 10 compares the annual contribution of cotton and textile products

11 Data for cotton exports and imports are based on products listed under Code 52 of the HS Classification, which includes raw cotton, cotton yarn, cotton waste and woven cotton fabrics. Data for textile and related products is calculated by adding the data for products under Codes 61, 62 and 63 of the HS Classification, which mostly include various intermediate (e.g. knitted fabric, textile made-ups, etc.) and high value added products (e.g. knitted and woven apparel).

to Pakistan's total exports. In 2014, raw cotton alone contributed 19.1% to Pakistan's total exports. Its share in total exports, however, has decreased by 10% since 2003. Textile product exports in 2014 contribute a hefty 33.5% to Pakistan's total exports, but their share in total exports has also declined by 15% since 2003.

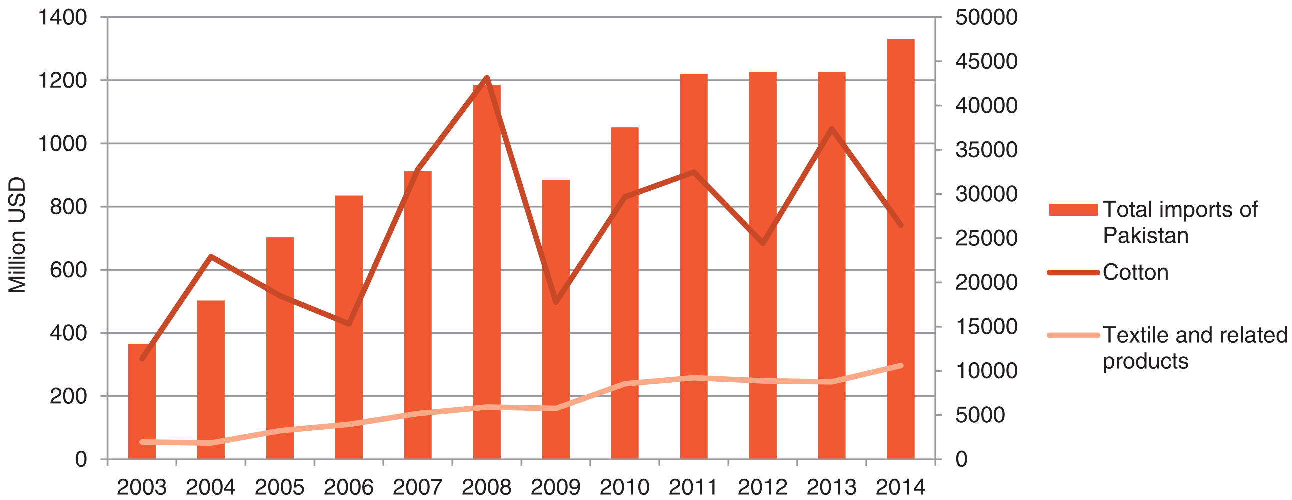
Figure 10: Annual contribution of cotton and textile exports to Pakistan's total exports

Source: Authors' compilation from International Trade Centre 2016 data.

Figure 11 compares cotton and textile imports to Pakistan's total imports; both categories form a small portion of the total imports of the country. Pakistan imports more cotton products as compared to textile products (opposite in case of exports – Figure 9). One of the major reasons for such a high number of cotton imports is because of the strong global demand for high-grade cotton when producing export products. Typical imports include upland and long staple cotton, as well as medium staple cotton, to augment domestic supplies for processing and re-export as high-end textiles (USDA, 2015).

High variability in cotton imports partially supports the argument of increased imports during low production of domestic cotton. For example, cotton imports declined in 2009 while cotton production during the same period increased by 9%, as compared to 2008. Similarly, cotton imports increased substantially in 2008 and 2010 as a result of a decline in domestic cotton production (by 10.5%), when compared to the previous years' cotton production (see Figure 3). Similar trends can be observed for the production and import data in 2013 and 2014. It is also important to highlight that this relationship holds true for some years and not others, which shows partial causality between the two variables.

Figure 11: Comparison of cotton and textile imports with Pakistan's total imports

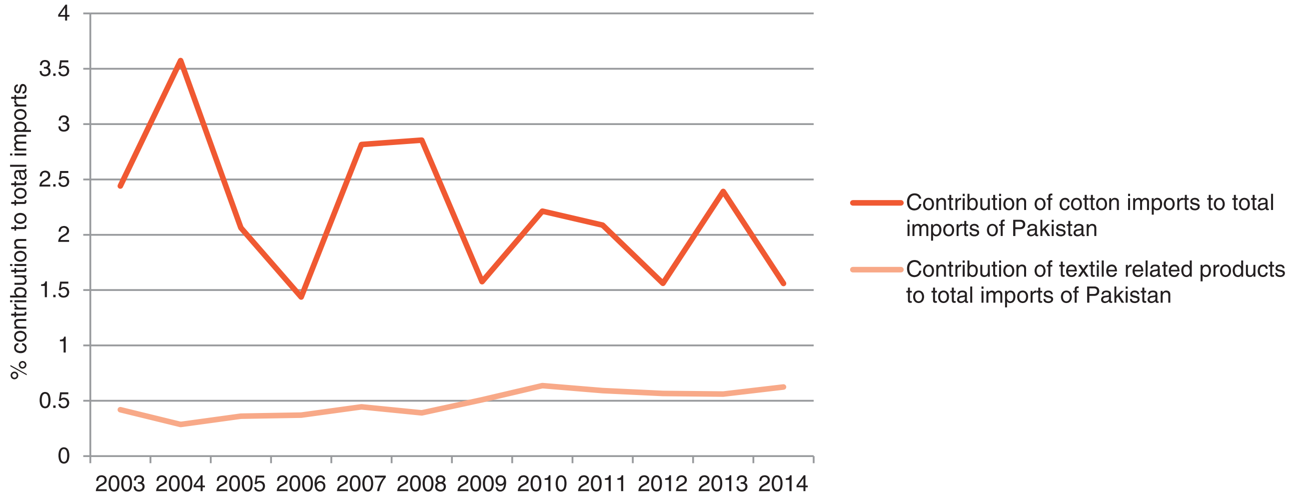


Note: Primary axis refers to cotton and textile imports; Secondary axis refers to total imports of Pakistan (Million USD).

Source: Authors' compilation from International Trade Centre 2016 data.

Figure 12 further explores the contribution of cotton and textile products to the total imports of Pakistan. Between 2009 and 2014, the share of cotton imports to total imports have stayed roughly between 1.5% and 2.5% Its share reached a maximum of 3.6% in 2004. This was a result of a 101% increase in cotton imports; at that time, Pakistan experienced only a 37% increase in its total imports. On the other hand, textile product imports show a very slow and stable upward trend (contribution to total imports increased from 0.4 to 0.6 since 2003).

Figure 12: Annual contribution of cotton and textile imports to Pakistan's total imports



Source: Authors' compilation from International Trade Centre 2016 data.

Table 5 provides an overview of cotton and textile related exports and imports from 2003 to 2014, including products and destinations. According to the International Trade Centre's data, a high intra-industry trade exists for cotton (i.e. the trade of similar products). For example, cotton yarn and raw cotton are major exports of Pakistan, but these items are also imported in huge quantities. This observation also stands correct for other cotton and textile products.

Pakistan imports a huge bulk of cotton and textile products from the US, China and India, while the US, the UK and Germany are major destinations for Pakistan's cotton exports. Moreover, Pakistan imports most of India's and China's cotton products, as well as textile products from China and Korea.

Table 5: Products and destinations for cotton and textile exports and imports

Major cotton-related exports (2003-2014)	Major exports to:	Average value of exports (2003-2014) (000 USD)	Major imported products (2003-2014)	Major imports from:	Average value of imports (2003-2014) (000 USD)
Cotton					
Woven cotton fabrics (various types)	Bangladesh, Turkey, China, Sri Lanka	2153274	Raw cotton	US, India, Brazil, Afghanistan	643790
Cotton yarn	China, Bangladesh, Turkey, Korea, Portugal	1546558	Woven cotton fabrics (various types)	China, Thailand	48047
Raw cotton	Indonesia, Bangladesh, Vietnam, China, Thailand	163128	Cotton yarn	India, Egypt, China, Indonesia	35427
Cotton, carded or combed	Italy, China, France, Belgium	13434	Cotton waste (including yarn waste and garneted stock)	Bahrain, Bangladesh, UAE	877
Cotton waste (including yarn waste and garneted stock)	Italy, France, China, Belgium	49345	Cotton, carded or combed	India	192
Textile and related products					
Bed, table, toilet and kitchen linens	US, UK, Germany, Belgium, Netherlands	2527921	Worn clothing and articles	US, UK, Korea, Germany, Canada	96285
Men's suits, jackets, shorts trousers, etc.	US, UK, Spain, Germany, Netherlands, France	750405	Blankets and travelling rugs	China, Korea, Spain, UAE	19382
Men's shirts, knitted or crocheted	US, UK, Belgium, Germany, Netherlands	579470	Tents & camping goods, tarpaulins, sails for boats, etc.	China, Korea, Vietnam, UAE	6907
Women's suits, jackets, shorts, dresses, skirts, etc.	US, Germany, UK, France, UAE	410918	Men's suits, jackets, shorts, trousers, etc.	China, UK, Bangladesh, US	5741
Made up articles, including dress patterns	US, UK, Germany, Netherlands, Canada	315607	Babies' garments, knitted or crocheted	China, Thailand, Indonesia, Vietnam	5246

Source: Trade Map, International Trade Centre (2016).

4. The cotton value chain

Cotton yarn on spools ©Samavia Batool

The CVC is one of the largest value chains in Pakistan, extending from cotton production to ready-made garments to exports. It takes many actors, industrial units and processes to convert cotton lint into a final product. This value chain is spread across formal and informal sectors. The formal sector is comprised of spinning units (textile mills) while weaving, knitting, garments, and towels lie mostly in the informal sector in the form of small/cottage units (SMEDA, 2005).

There is a huge reserve of literature on the CVC in Pakistan. These value chains are largely explored in the context of supply chain management, linkages with poverty and employment (Orden et al., 2008), potential for value addition (Hamid et al., 2014), and energy crises (Ali and Nawaz, 2012). Some researchers have also done skill gap analysis for certain parts of the CVC (CABI, 2008) along with SWOT analysis (strengths, weaknesses, opportunities, threats) (Hussain et al., 2009).

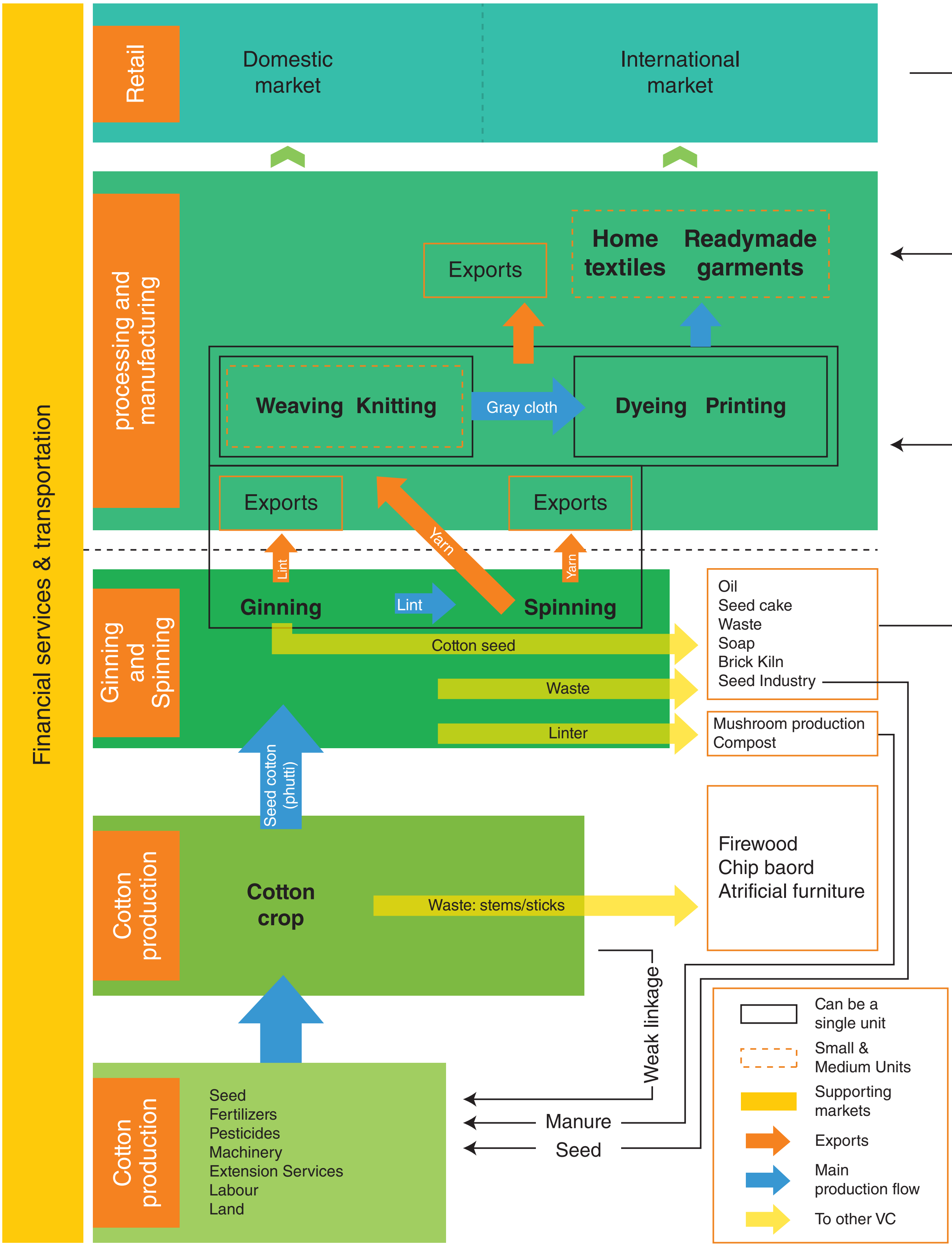
However, the literature only maps linear vertical linkages in the CVC and there is a need to analyse both vertical and horizontal linkages in order to trace climate impacts within and across Pakistan's CVC. Focus group and key informant interviews helped in the identification of formal and informal linkages in the CVC. A literature review has been done to fill the information gap. The following questions have helped frame the mapping of the value chain:

1. Which vertical and horizontal linkages exist within Pakistan's CVC?
2. What is the regulatory framework for cotton production, manufacturing and export?
3. What is the role of women and other vulnerable groups in Pakistan's CVC?

This value chain mapping exercise would help identify potential entry points as well as pathways for climate risks (phase two of research).

4.1 Structure & linkages

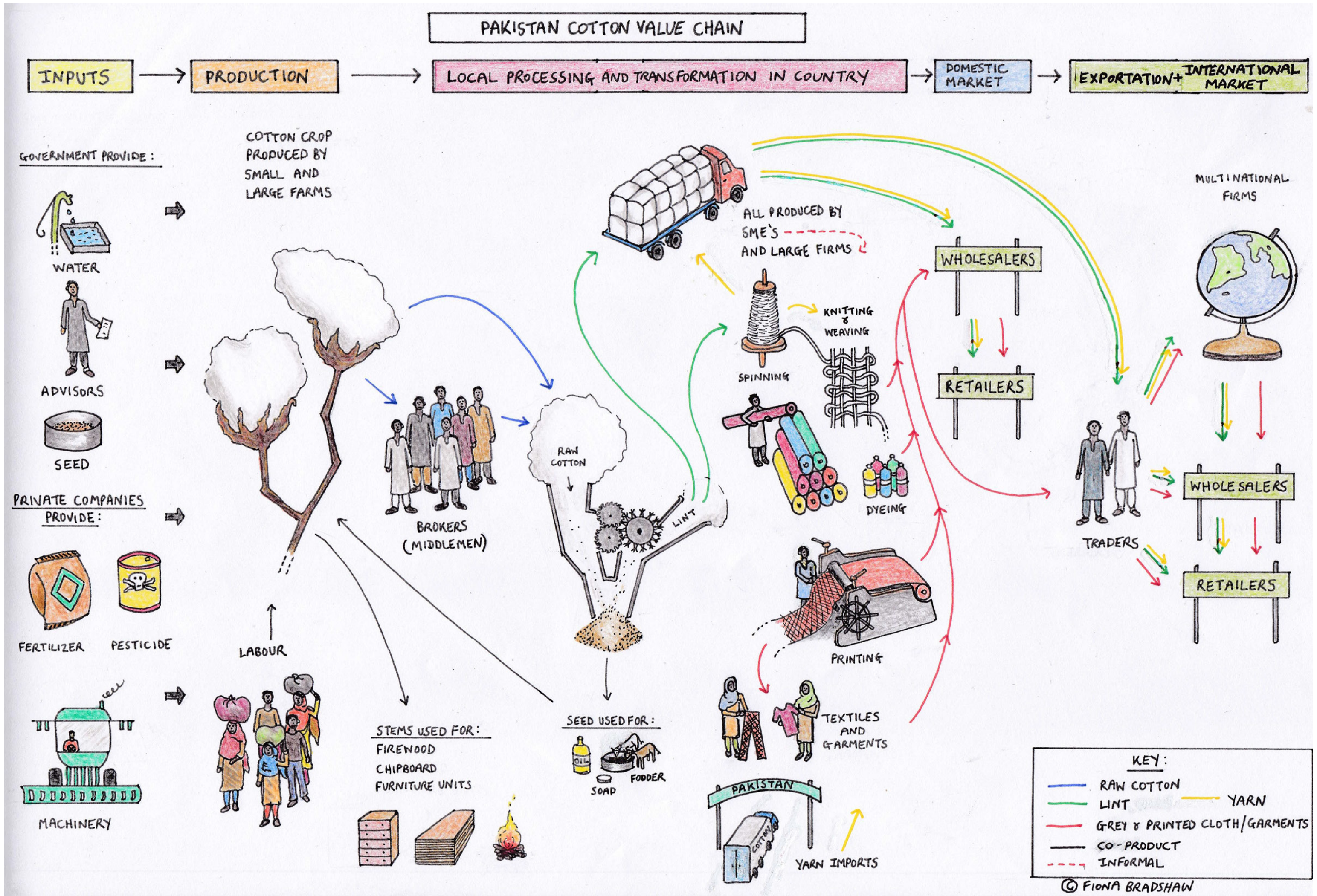
Figure 13: Vertical and horizontal linkages in Pakistan's CVC



Source: Authors' own, based on stakeholder feedback and literature review.

Figure 14 provides a more simplified version of this value chain, clearly identifying the transformative and value addition stages. It depicts major cotton and textile imports and exports, along with gender divisions in the labour force associated with this sector.

Figure 14: Transformative and value addition stages in the CVC



Source: design by Fiona Bradshaw, based on author's feedback.

Cotton production

Seed, fertilizer, pesticide, machinery, credit, and extension services are major inputs to cotton production. Fertilizer and pesticide companies are largely private sector owned, with little regulation from the public sector; public institutions have no control over input prices. Credit facility is provided by both public institutions (e.g. agriculture banks) and private commercial banks. Extension services (information about crop management and use of pesticide, fertiliser) are provided to farmers by district/provincial agriculture departments and agriculture universities/research institutes (both public and private).

Almost 99% of land used for cotton is privately owned. Self-cultivation and tenancy arrangements are both utilised. Family members (including females) are largely involved in self-cultivation activities on own-land (under single ownership). The tenancy system is quite diversified in Pakistan, with various arrangements including sharecropping, which is when the harvest is shared between the landlord and tenants.

A major output of cotton crops is seed cotton (also known as phutti). Waste from cotton plants (stems and sticks) is predominantly used by households as firewood and by other manufacturers to produce clip boards and artificial furniture. Seed cotton is not a storage-friendly crop. Due to its high oil content, it cannot be stored for long periods of time, therefore no formal storage arrangements are made by the farmers. However, it can be stored once the boll is separated from seed. Female cotton pickers collect cotton bolls, which are then stored for a few days either on the farm or at home.

Cotton sales usually depend on the size of the cotton farm, the grower's access to the market, and more importantly the financial capacity of the producer. Large-scale farmers typically sell crops directly to ginners; this is regulated through a mutual agreement. Small- and medium-scale farmers either sell crops directly to ginners or take them to mandi (market place) to sell to artis (middlemen). These middlemen are one of the CVC's major weak links. They connect cotton producers to actors in the downstream industry, but their informal operation compromises the profit margins of farmers—the middlemen determine prices. Generally, the price of cotton is set by the Pakistan Cotton Ginners Association and based on the Karachi Cotton Association's spot price, international raw cotton price (or the Cotlook A index), and the domestic price of banola oil. While the All Pakistan Textile Mills Association (APTMA) is the single association of cotton buyers in Pakistan, they almost have a monopolistic control over pricing. Ginners can purchase cotton for low prices (less than the market price) from farmers who own very small cotton farms (less than 1 acre) and have little access to the market place. They also buy cotton below the market price from individual cotton pickers who receive payment for their labour in cotton. Large farm owners, on the other hand, auction their cotton produce as well.

The quality of cotton is determined by picking, transportation and the ginning process. Cotton is generally hand-picked in Pakistan, and the trash content in raw cotton is roughly 9% whereas for machine-picked cotton in other cotton producing countries, it's 3.5%. In order to remove contamination, a process called 'beating' is followed, however excessive beating in an attempt to remove high trash content compromises the quality of the cotton.

Lack of decent technology is another reason for producing low quality cotton. At the production stage, farmers do not have access to modern machinery and rely on manual labour for land preparation, sowing, weeding, etc. Poor transport infrastructure and obsolete cotton cleaning processes (i.e. lacking the latest machinery) further deteriorate the quality of cotton produced in Pakistan.

Generally, cotton farmers in Pakistan are taxed under provincial agriculture tax ordinances, which are based on land ownership or income from that land, whichever is higher (Punjab


Contaminated cotton © Samavia Batool

Agricultural Income Tax Act, 1997).[12] This is currently collected as land tax as opposed to agricultural income, which was the case prior to 2001 (Business Recorder Research, 2016). Moreover farmers are required to pay indirect taxes, in the form of General Sales Tax, on agricultural inputs like seeds, pesticides, fertilizers and farm machinery. This, along with high cost of electricity to irrigate fields through tube-wells, raises the cost of production and therefore reduces the return on the crop.

Ginning and Spinning

Ginning is the process of separating cotton fibre from its seed. Pakistan currently has 1300 ginning units. This industry produces two by-products: cotton lint and cottonseed. Both small and large ginning units exist in Pakistan. Despite its significance, this industry lacks modern and efficient technologies resulting in impure cotton fibre and a low lint-to-seed ratio (SMEDA, n.d. a; Dawn 2013; EDB, n.d.). Poor marketing skills, non-standardised ginning practices, and lack of government support price are some of the major issues facing the ginning sector in Pakistan (Aslam and Rasool, 2013).

Cotton ginning machine © Samavia Batool

Since 2010, ginning industry has been operating on low profits as both quality and quantity of cotton production has declined as a result of climate change. Ginners have reported serious quality issues with local cotton. As a result, ginners in Punjab have now started to purchase cotton from Balochistan which results in high transportation cost and hence low profits. With declining production, high competition between ginners to purchase cotton has emerged. Not only this, the operation time (which as usually around 3 months) have now reduced to 20 days. A large number of firms are operating below capacity i.e. a firm with the capacity of crushing 100,000 bales is now crushing only 25,000 bales in one season.

Ginned cotton, or lint, is a cleaner form of raw cotton that is transferred to the spinning units for further processing (pack size is 170 kg, which equals one bale). Major locations for lint export are Indonesia, Vietnam and Bangladesh. Cottonseed, the remaining part of the cotton boll, is used as animal feed and to produce banola oil, seed cake, soap, etc. Cotton waste (fibrous waste mostly composed of short fibres) is exported to France, Italy, Korea, Thailand, and the US among other countries (Cotistics, 2015). It is then used to make coarse yarn and non-woven clothes.

Yarn is the output of spinning units and is a major component for knitting, weaving and the textile made-up sector, which includes ready-made garments, knitwear, dyeing and printing, etc. Yarn is exported as well as sent to weaving (to produce gray cloth), knitting units, and garment manufacturing units. Some large textile manufacturers have in-house spinning facilities, which combine weaving and knitting as well as dyeing and stitching.

The spinning industry is a major part of the CVC as it is the primary step in adding value to raw cotton fibre. According to SMEDA (n.d. b), 113 million spindles, out of a global total of 163 million, are in Asia. Pakistan has the third-largest unit of spindles among Asian countries and is the fourth-largest producer of yarn in the world. One of the major drawbacks of small-sized spinning units is the lack of modern and sophisticated technology, which causes locally produced yarn to have a thread count of 40-50. There is a higher demand for a finer count yarn (60-120 thread count), so local manufacturers mostly import 60-count yarn and above to meet international market demands. On the other hand, large textile units, having in-house spinning facility, produce higher count yarn for further processing.

Low-end units of the CVC (cotton yarn and spinning) are more export-oriented than upper-end units, such as garment manufacturing, which comparatively have a greater value addition (Hamid et al., 2014). As a result, Pakistan's textile exports are skewed towards low and medium value added products, such as cotton yarn and textile made-ups (towels, bed sheets, blankets, etc.). This takes away the value addition that Pakistan can earn by going further up the value chain. Khan (1998) mentions that Southeast Asian countries, including Japan, Hong Kong, Indonesia and South Korea (all major markets for Pakistan's cotton yarn export), earned the value addition on Pakistan's cotton yarn export by re-exporting it after significant

12 Agriculture income is a provincial subject and is exempted from federal income tax ordinance.

value addition. However, since 2000, the export of high value products (e.g. knitwear and made-ups) have been on the rise (Siegmann, 2009).

Manufacturing: weaving, knitting, made-ups

There are 400 textile mills, 7 million spindles, 30,000 automatic looms, 0.25 million small home-based looms, 4000 garment units with 0.2 million sewing machines, 650 printing and dyeing units, 300 large scale banola oil units, and 20,000 small oil expellers in Pakistan (Khan, 2016a). Manufacturing units are mostly clustered in Faisalabad, Karachi, Lahore and Multan. The weaving and knitting sector is dominated by SMEs that are mostly clustered in Faisalabad and Karachi.

Weaving, knitting and printing are considered to be some of the strongest sub-sectors of the CVC, whereas clothing, dyes, and chemical manufacturing are usually overlooked when it comes to exports and policymaking. Most of the textile manufacturing units have modern technology in place, which is imported from Germany, Switzerland, Belgium, Japan, China, the US and the UK (Hussain et al., 2009).

Even though there is a lack of quality research on the cotton and textile sector, the Pakistan Central Cotton Committee (PCCC) was set up to promote research on cotton-related issues for the smooth supply of cotton to the textile industry. In order to keep the PCCC working, a tax called 'cotton cess' is collected from textile mills. A fee of Rs 50/bale ($0.48USD/170 kg) is charged on the export or local consumption of cotton from these mills. Moreover, a 4% import duty has to be paid by all textile units on the import of raw cotton. This import tariff was imposed to promote the use of locally produced cotton. However, textile manufacturers argue that this duty should be removed because long-fibre cotton, which is in high demand on the global market, is not produced in Pakistan, hence the need to import it for further processing. This, again, points towards quality issues with local cotton, and differences in supply and demand between cotton production and manufacturing, all of which need to be addressed for promoting a competitive value chain.

A weak linkage between the upstream cotton industry and the downstream textile industry results in low quality and high production cost. In order to promote inclusive growth across the value chain, enhancements such as skills and knowledge exchange, private sector investment in agricultural technology, innovation sharing, and enabling business environment (e.g. the relaxation of duty on the import of agricultural machinery) would promote intra-value chain competitiveness.

Supporting markets

Transport and credit are major supporting industries for the CVC in Pakistan. There is a huge network of agricultural credit banks that support cotton farmers for production activities. Zarai Taraqiati Bank Limited is the largest provider of agricultural loans to farmers. They provide short term (for 6 months), medium term (up to 5 years) and long term (up to 8 years) loans for farm inputs (for example, tractor, fertilizer, seed etc.), solar pumps, bio-gas units, poultry, orchids etc. They also offer short-to-medium term loans for women (up to Rs. 25,000 (250 USD)) for framing, textile and clothing etc. While landholding is a requirement for these schemes, seasonal laborers are ineligible for these schemes. Small and medium farmers are mostly reluctant to take these loans due to limited financial capacity to pay interest. `In the case of transport, vulnerable links are quite unclear at this stage.


Khal, separated from cotton seed, to be used as firewood © Samavia Batool

Associated Industries

Other secondary industries associated with the CVC include banola oil, cardboard, firewood, soap and seedcake. Cotton waste is supplied to these industries as well as used for domestic use in the form of firewood. These industries are highly dependent on cotton, and any adverse climate impact on the crop is likely to affect performance. In-depth analysis will be conducted at later stages in order to better understand these industries and their role, their vulnerabilities and their adaptation strategies.

4.2 Value chain governance and inter-firm linkages

Prior to 1988, the government had a strong hold on the cotton and textile industries, as it was the sole supplier of production inputs (e.g. seeds, pesticides, fertilizer) and also controlled the pricing, export and marketing of final products. The Cotton Export Corporation, a government body, was responsible for buying cotton from farmers and exporting it to other countries. Banuri (1998) also noted that credit, research and extension policies determined resource allocation for farmers until the mid-90s. The power to determine profit margins for farmers then moved into the hands of input suppliers after the policy environment eventually gave way to the private sector. In 1989, the private sector was allowed to purchase cotton directly from ginners, and in 1994, an export duty imposed by the government was also abolished (Salam, 2008). With the advent of the World Trade Organization (WTO) in 1995 came a liberalised global cotton and textile trade regime. The private sector began to take hold of major input and manufacturing industries in early 2000s.

Currently, profit outcomes for cotton growers are determined by the price and quality of input supplies provided by private pesticide and fertilizer companies. The characterisation of the relationship between pesticide companies and farmers as defined by Banuri (1998) still stands correct, as a few multinational companies have monopolized the pesticide and fertilizer market, which then results in high price inputs for farmers. The fertilizer price data provided by the National Fertilizer Development Centre shows a massive increase in fertilizer prices after 2000. For example, the price of urea per 50 kg has increased from Rs 363 ($3.46USD) to Rs 1045 ($9.90USD) in 2011, and the price of DAP fertilizer per 50 kg has increased from Rs 632 ($6.03USD) to Rs 3236 ($30.80USD) in 2011.[13] Moreover, in the last decade, fertilizer use efficiency for cotton has significantly declined (i.e. more fertilizer is required per unit of yield). This points toward the poor regulation of Pakistan's input industry, which has resulted in low returns for cotton growers and high profit margins for the private sector.

While the price of raw cotton is based on the international price of cotton, price volatility still causes losses for cotton growers. In order to benefit cotton growers, the government steps in via price intervention. The Trading Corporation of Pakistan is usually directed to procure a certain amount of cotton from farmers (typically 1 million bales) as per the intervention price, which is kept higher than the prevailing market price. This, according to some cotton experts, is not an effective strategy because it benefits only a small proportion of cotton growers, particularly large and influential farmers. Apart from cotton pricing, the government also regulates the import and export of cotton by imposing various duties.

The textile sector, on the other hand, enjoys a conducive policy environment. Textile policy from 2014 projected through to 2019 lays out a perspective development plan for the textile sector through tariff rationalization, product diversification, technology upgradation, SME development, and vocational training for the labour force. As ambitious as it is, this policy has serious drawbacks when it comes to implementation. This policy exclusively caters to the interests of industrialists, and there is no policy to safeguard the interests of cotton producers. The textile industry, which includes weaving, dyeing and printing, ready-made garments, and home textiles, operates under international treaties and standards as well. These treaties are more binding compared to domestic policies.

The textile sector also has a number of representative bodies, such as the All Pakistan Textile Mills Association (APTMA), the All Pakistan Textile Processing Mills Association (APTPMA), the Pakistan Textile Exporters Association (PTEA), the Pakistan Cotton Ginners Association (PCGA), and the Pakistan Ready-made Garments Manufacturers and Exporters Association (PRGMEA). APTMA is the strongest lobby group representing large-scale yarn producers. Cotton producers, on the other hand, do not have any exclusive representative body and have a limited representation through the Pakistan Farmers Association, Farmers Associates Pakistan, Anjuman-i-Kashtkaran, and the Pakistan Kissan Board.

The Ministry of Textiles is the facilitating body of the textile sector. It provides incentives and a conducive environment for textile units. Incentives could include grants, short- and long-term capital, change in tariff structure, etc.

13 This variation in price also reflects the overall increase of inflation in Pakistan during the reporting period (i.e. from 2000 to 2010).

The women of Baltistan used an age-old method to convert their local wool into shawls. Turning a wooden spindle rapidly between their fingers, balancing it on an upturned bowl or cup © ILOA. Memon 2015.

4.3 Women and other vulnerable groups

Women labourers in the CVC

While climate change is a gender neutral phenomenon, its impact is hard felt by women. The differential impact of climate change for women is due to a higher rate of female poverty, limited access to natural resources, lack of ownership of land as well as capital and technology, and greater work burden and oppression (Denton, 2002; Rodenberg, 2009). While the literature traces the linkages between gender and climate change, there is a growing reserve of literature on the crucial role of women in adaptation and mitigation efforts (Bäthge, 2010). Moreover, gender sensitive responses to climate change are indispensable since a significant proportion of women are involved in food production and are mainly responsible for securing water for household and livestock care. Including women in climate-related decision-making can result in resilient households (United Nations Women Watch, 2009).

According to Gender Statistics of Pakistan (PBS, 2014), in 2012-2013, only 32.9% of the male-employed labour force of Pakistan is associated with agriculture, compared to a mighty 74.9% of the female-employed labour force. Interestingly, the per-month average wage for female unskilled workers in Pakistan is just Rs 3753 ($35.8USD) as compared to the wage earned by male unskilled workers, which is Rs 6166 ($58.8USD) (Ministry of Labour & Manpower, 2013-14).

Not only this, 59.9% of the female labourers in agriculture work more than 50 hours per week while only 26.6% of male labourers work above 50 hours a week (PBS, 2014). This excessive work put in by women is indicative of lower wages per hour, forcing them to contribute more hours to earn a living. According to some estimates, women make up 24% of Pakistan's cotton-growing labour force (Dawn, 2014). Almost 600,000 women are engaged in cotton-related activities in the major cotton-producing districts Punjab and Sindh (Ibid.).

The women's labour force becomes involved at the cotton-picking stage. In Pakistan, cotton picking is largely done by female workers (either as paid labourers or household members). Haq et al. (2008) find that the majority of female cotton pickers are aged 30 and under. This process does not require any skills, and sometimes children younger than 18 are also tasked to pick cotton in the field. Typically, women who pick cotton have, at most, an eighth-grade level of education. This points towards the low socioeconomic standing of female cotton labourers. In recent years, however, the effective transition rate for girls from middle to secondary school has shown improvement.[14] Key informant interviews with female cotton workers reveal that the interest to work in cotton fields declines with an increased level of education; the more educated a female is, the less interested she is in working as a farm labourer. Interviewees showed interest in teaching at local schools or not working at all (only housekeeping).

The working environment for female labourers is not only difficult in terms of weather changes but also in terms of health and safety. At the cotton-picking stage, residues of pesticides remain on the cotton boll even after it is picked. If the worker is pregnant, these residues can likely transfer to the unborn child. Some workers also bring their children to the cotton fields, which is another way pesticide-related disease in children can spread. Several times during interviews, the use of safety masks used by male cotton labourers during crop sprays were reported. When asked, both male and female labourers agreed that wearing safety masks help protect labourers (usually male) from inhaling hazardous chemicals. However, when asked about the need to wear gloves when picking, which is usually done by females, because similar chemicals remain on cotton bolls, both male and female cotton labourers responded that they do not think it is necessary. This highlights an urgent need to educate female cotton labourers about possible health hazards and the importance of avoiding them.

The role of women in the CVC has, over time, undergone two major changes. First, educated farming households (with three or more members having completed high school or college) and households in a peri-urban setting are less likely to involve female members of the family in farm activities. In this case, female workers are hired on daily wage basis. Secondly, while women were typically restricted by the household heads to only work in cotton fields, more and more women are now becoming part of the cotton processing sector and are working as industrial labourers.

Field visits through various industries also revealed difficult working environments for women in the manufacturing sector. There, women mostly work with trash removal units, some of which do not provide masks, making women more susceptible to allergies from cotton fibres.

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14 Transition rate is defined as the percentage of students advancing from one level of schooling to the next. The effective transition rate for girls from primary to secondary has increased from 86% in 2010-2011 to 92% in 2014-2015 (National Education Management Information System, 2016)

Small-scale cotton farmers and short-term farm labourers

Initial interactions with key stakeholders revealed a comparatively high vulnerability to extreme climate events in the case of small-scale cotton producers (those who own less than five acres of land) and short-term labourers including daily/seasonal wage labourers. Credit facility is a primary factor determining the economic resilience of any farming household. While it is generally available to land-owning farmers, they are more likely to overcome climate-induced crop loss through agricultural loans. It is also important to highlight that small-scale farmers have access to loans through such informal channels as middlemen, personal contacts, etc. Moreover, small-scale farmers have a low adaptive capacity as they lack access to information, such as knowing what steps to take in order to reduce climate change-induced crop loss; have a heavy reliance on traditional methods of production; and use obsolete—and less effective—farming equipment. Daily or seasonal wage labourers are also highly affected by climate-induced crop loss. Any direct negative impact on crops result in decreased wages and potential unemployment. For example, labourers are generally paid based on per-acre produce. As climate change reduces the per-acre yield, lower wages are offered to labourers, and they can even face unemployment for long stretches of time. So, with zero access to bank loans they resort to other employment in SMEs, such as local ice factories, brick kilns, etc.

5. Climate implications for the CVC

5.1 Climate and the CVC: a literature review

Cotton is one of the most sensitive crops. It responds to even minor changes in climatic parameters (e.g. changes in temperature, precipitation, etc.) and socioeconomic settings (e.g. water availability, change in prices, etc.). In a majority of studies, a predominantly negative correlation has been found between climate change and cotton production; there is evidence from different parts of the world that shows reduced cotton crop productivity is a result of climate variability. Bange (2007) states that the growth of cotton is usually hampered by changes in CO2 concentration in the atmosphere, low water availability, high atmospheric evaporation rate and heat stress, which are likely induced by climate change. High temperature in particular may increase the growing period of cotton bolls (Richardson et al., 2002) and reduce boll and lint yield (Singh et al., 2007).

A report from the International Trade Centre (2011) presents a comparative analysis of climate impacts across several countries, including China, Pakistan, Australia, the US and Brazil among others. This study finds that a likely decrease in rainfall along with rising temperatures can cause the crop's demand for water to increase in all of the study areas. While the pace of glacial depletion is getting faster, there is a likelihood that water in the Indus River (shared by Pakistan, India and China), which is a major source of irrigation for nearby cotton crops, would start to run dry by the end of this century. In a most extreme climate scenario, other research estimates that Pakistan's cotton production is expected to reduce by 2% around the 2080s (Yu et al., 2013), however other research estimates that the average cotton yield would reduce by 20% after 2050 (Iqbal, 2011).

Cotton sowing usually takes place during the summer and mostly in areas where the average temperature is above 43°C. As a result, crop productivity is affected (Rahman, 2006). Using a fixed effect model, Siddique et al. (2012) estimate the impact of change in climate indicators, such as temperature and precipitation, on cotton production in five districts of Punjab. This study finds that cotton production may decline by 42.33 thousand bales per 1°C if temperatures exceed 32°C (the maximum temperature cotton crops can withstand). Further, if there is a 1 mm increase in precipitation over the 40 mm threshold, cotton production may reduce by 0.5 thousand bales. Moreover, Siddique et al. (2012) estimate a loss of 13.29% and 27.98% by 2030 if temperatures rise by 1°C and 2°C, respectively.

Potential rises in temperature are seen as a major risk to the CVC as daytime temperatures in cotton-producing regions can reach 50°C; cotton suffers a negative impact on yield when daytime temperatures exceed 32°C (Farooq et al., 2015). Heat stress also results in the loss of vegetative or generative parts of the crop (e.g. buds, flowers, bolls) (Ton, 2011). A rise in temperature also increases evapotranspiration, causing the plant to need more water.

Crop models applied by Iqbal (2011) and Yu et al. (2013) predict a decline in yield between 2% and 42% by 2080. A crop model applied by Hebbar et al. (2013) for Indian cotton production predicts no significant change as yield declines are offset by an increase in photosynthesis triggered by elevated atmospheric CO2 concentration. Other issues discussed in climate change-related literature include the salinization of soils (Yu et al., 2013), possible new pests and weeds, water logging, and an increase in nutrient loss due to an increase in erosion (Ton, 2011).

Thorpe and Fennel (2012) highlight that there were quality issues with Pakistan's cotton export to international companies after the 2010 floods. This caused those international companies to incorporate climate risk into their business model. This paper also recognises that cotton production in Pakistan is not only at risk from climate-induced natural disasters but also from water scarcity.

Reviewing the literature clearly revealed a gap in the research of climate implications for the entire CVC; none of the studies on Pakistan highlight how textile processing industries are either directly or indirectly affected by climate change. One factor that might explain this gap in literature is that textile processors have a high level of resilience (low vulnerability to climate risks) because they rely on imported cotton during any shortages in domestic supplies. However, while major textile processors may have a lower vulnerability to climate risks, there is still a need to explore vulnerability pathways for downstream industrial units and associated industries for which production losses translate into high-cost production.

Moreover, the human dimension of climate-related risks needs to be explored. Some potential questions to address are:

- How does climate change affect the working environment of agricultural and industrial labourers?
- Does climate change lead to the loss of employment through health and safety issues?
- Do changing climatic parameters create new job opportunities? For example, more employment opportunities for labourers in the ice factory due to increases in temperature.

Exploring these questions would give greater insight on how climate change impacts human capital in the CVC.

5.2 A preliminary assessment of climate impacts on the CVC

Over the years, climate change has caused various damage to cotton crops in various ways, sometimes through sudden flooding and sometimes through gradual changes in rainfall patterns or temperature. In either case cotton crops are affected, which alters socioeconomics on a national level because the CVC is spans the entire country, providing livelihoods and support to thousands of people. Several climate vulnerabilities arise at the production stage, including losses due to changes in precipitation patterns, increases in temperature, changes in soil moisture content and floods. When cotton crops are damaged as a result of increases in temperature or climate-induced pest attacks, the demand for better quality seed, pesticide and fertilizer soars. This causes input prices to go up, resulting in the high cost of production per acre. While a large proportion of agricultural households depend on cotton production, crop losses result in lower expenditures on food and health and education, ultimately pushing those households further below the poverty line. On the other hand, opportunities for greater profit arise for pesticide and fertilizer companies through the sale of better quality products and extension services to farmers for the promotion of company's product.

Even at the same production stage, vulnerabilities for different groups of cotton producers can indeed differ. Cotton producers can be divided into the two broad categories: landowners and landless. Landless cotton farmers can be further categorized into wage labourers and contractors. The landless category is more vulnerable to crop losses compared to landowners. For example, cotton pickers are wage labourers and receive less wages when there are lower yields because their wage is dependent on the quantity of cotton picked (in one day). Similarly, if the crop is damaged from flooding, the number of workers is often reduced. Crop loss is a direct threat to the livelihoods of wage labourers, who also do not have access to agricultural credit because they do not have the collateral required for a loan. Contractors, however, are relatively less vulnerable. They either pay a fixed amount of rent per acre to landowners or participate in sharecropping, which is when tenants give landowners a share of their crop in exchange for land use. They usually have access to agricultural loans and in some cases the landowner covers the cost for seed and fertilizer, which shifts some of the loss burden to the landowner.


Cotton seed covered with sheeting to protect it from rain ©Samavia Batool

As we move higher up the value chain, the impacts of climate change reduce. For example, ginning factories can have quite variable outcomes depending on the degree of loss to the crop. If, due to high temperatures and a resulting pest attack, only the quality of the crop is affected, the ginners usually pay lower prices for cotton. On the other hand, if there is complete damage to the cotton crop in a particular region and yields drop, ginners are left with a low input supply, hence a low output. Imports of raw cotton increase during these periods of low domestic cotton production.

At the spinning stage, the role of imports is stronger as any decline in domestic raw cotton production is usually substituted with imported cotton. Similar trends can be seen at other downstream processing industries. A higher reliance on imports at the processing stage means that, as the cost of production rises, opportunities for new labour market entrants reduce. While occasionally reported, the loss of employment for existing labourers is, however, not significant. Climate change has another secondary entry point into this industry through labourers. As the temperature increases, working conditions worsen, which directly impact the health and safety of industrial labourers, a large number of whom are women. We will explore these vulnerability pathways in detail in phase two of our research.

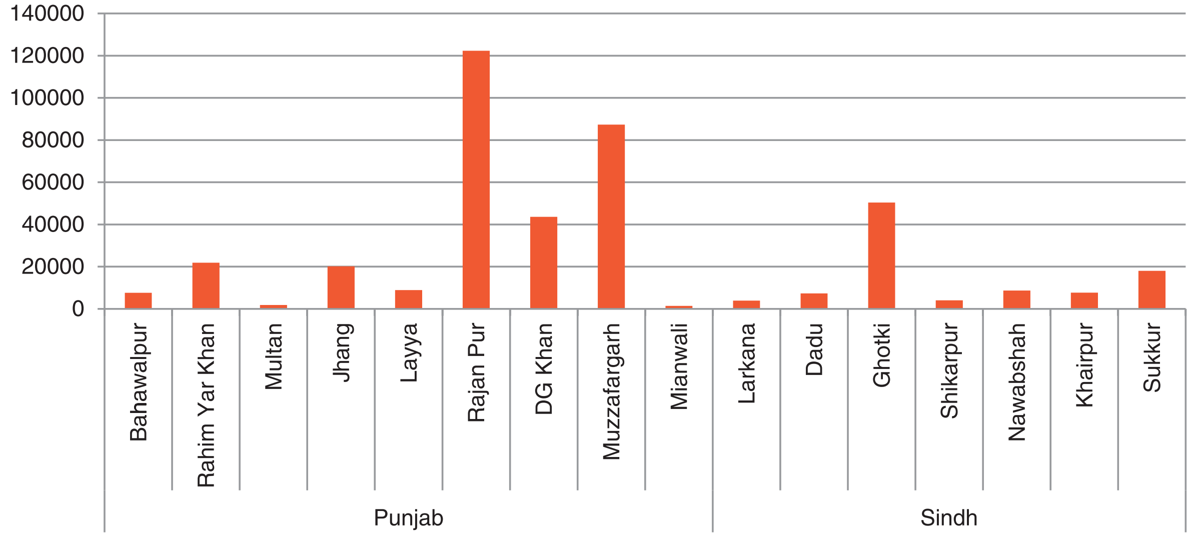
5.3 Historical evidence of climatic repercussions on cotton production in Pakistan

Cotton crops are mostly cultivated along the left bank of the Indus, but these crops are extremely vulnerable to flash floods. Floods have been a major climate-induced disaster that has significantly reduced Pakistan's cotton production in the last few years. Since 1980 Pakistan has suffered 13 floods, the floods in 1992 and 2010 being the most severe. According to the Pakistan Weather Portal (2015), almost 13,208 people were affected in 1992, with 1008 casualties, and approximately 20 million people were affected in 2010, with more than 1781 casualties.

The 2010 flood destroyed 21% of Pakistan's total cultivated area for cotton according to the Asian Development Bank and World Bank (2010). A cotton crop area of 124,000 ha in Muzzafargarh; 107,000 ha in Rajanpur; 29,000 ha in Dera Ghazi Khan; and 23,000 ha in Rahim Yar Khan were lost to flooding, as reported by the Pakistan Space & Upper Atmosphere Research Commission and the Food and Agriculture Organization of the United Nations (2010) (SUPARCO and FAO respectively). A majority of the cotton crop damages reported were in Punjab; most of the areas severely affected in Sindh were on the right side of the Indus, which is not a cotton-producing region. A total of 1.76 million bales were lost during 2010-2011, which is roughly 2 million bales short of the previous year's cotton production. The premature shedding of cotton bolls, the complete loss of cotton bolls, and deterioration in cotton boll quality of due to long immersions in flood waters were the most highlighted impacts of the flood (Agriculture Cluster, 2010; SUPARCO and FAO, 2010).

Figure 15 gives an overview of the cotton areas affected in Punjab and Sindh by the 2010 flood. Rajanpur and Muzzafargarh (Punjab) and Ghotki (Sindh) suffered extreme damages to cultivated land. A total of 315,769 ha of cotton-producing land in Punjab, and a total of 99,930 ha of cotton producing land in Sindh were destroyed. In some districts of Sindh, such as Larkana, 98% of the cotton crop was reported lost (Agriculture Cluster, 2010).

Figure 15: Cultivated cotton crop areas damaged in Punjab and Sindh (ha)



Source: Agriculture Cluster (2010).

In addition to the major losses incurred in 2010, consecutive flooding in 2011, 2012, 2013 and 2014 also caused severe losses to cotton crops. Apart from direct losses in productivity, quality issues in less damaged crops were also observed. Studies estimate the farming community was hit with losses worth Rs 11 billion ($100 million USD) from the 2012 floods (SUPARCO and FAO, 2012).

Apart from the direct damages of climate change on cotton production, key informants highlight that there are secondary impacts of the floods such as increases in raw cotton imports and soaring prices of raw cotton, which mean higher production costs for downstream industries. Key informants also reported loss of employment (although insignificant) due to processing industries reducing profit margins or shifting production from cotton to other water-tolerant crops such as sugarcane. After consecutive flooding in 2010, in some extreme cases, kharif crop production was discontinued altogether.

6. Conclusion and ways forward

The CVC is an extensive structure that has varying degrees of climate vulnerabilities. Climate impacts the CVC both directly and indirectly; there are some clear entry points within the CVC where this occurs. For example, at the production stage, changes in climatic parameters have a direct impact on cotton crops, whereas at the processing stage, extreme heat, which creates increasingly poor working conditions for industrial labourers, has an indirect impact on the CVC. Indirect effects of climate (primarily on production) trickle down to downstream industries, input industries—which cause input shortages and can manifest as higher demands for better seed, pesticides and fertiliser—and finally supporting markets, such as transportation.

An important observation based on historical climate events in Pakistan indicates that adaptation measures, if combined with effective policies (e.g. price regulation, incentive schemes, etc.), reduce the adverse impacts of extreme climate events for cotton farmers, the CVC's most vulnerable group. Moreover, raising awareness of specific issues that face female labourers associated with the CVC is one of the key policy lessons of this study. However, climate change worsen the working environment for both male and female labourers; there is need to identify the risks and search for effective policy options to a) make a more conducive working environment, or b) find and invest in alternative employment opportunities.

Analysis in the preceding sections of this study provides a stepping stone for further research on what sort of climate risks face each actor involved in the CVC and what the current and potential options are for adaptation. It was demonstrated that there is also a need to explore how policies can support the adaptation process. Such an analysis would provide insights on inclusive growth and competitiveness for the CVC. Exploring the potential for the private sector to promote adaptation at the grassroots level (the upstream end of the value chain) would also add significant knowledge to the existing literature on the subject.

Keeping in mind the need to build economic resilience for all the actors involved in the CVC, a detailed study on climate risks would be phase two of our research. We have identified two semi-arid cotton producing districts that will be the focus of phase two: Dera Ghazi Khan (DGK) and Faisalabad. Understanding the climate vulnerabilities of these districts would be the major objective of phase two research, as well as to explore existing and potential adaptation options.

6.1 Study sites – demographics and climatic profiles

DGK produces nearly 42% of the cotton from Pakistan's semi-arid lands and Faisalabad contributes significantly to the processing sector. Demographic and geographical details of each district are discussed in detail below.

DGK

Geographically, DGK is located at 30 ˚03 North, 70 ˚38 East, in the province of Punjab, in the centre of Pakistan, and spans almost 11427 km2 of land. It is divided into four administrative subdivisions (see Table below) and has approximately 2 million residents.

On its eastern edge is the large, barren Koh-e Sulayman mountain belt, and on its western edge are huge stretches of sandy plains. This combination of plains and mountains acts as both a blessing for water-scarce communities and a contributor to enhanced climate vulnerabilities. During the summer temperatures go as high as 46 °C (some of the highest in Pakistan), but winter temperatures can drop as low as 4 °C (District Government, Dera Ghazi Khan, 2016). This area, on average, receives 144 mm of rainfall per year (Bakhsh, 2010). One of DGK's key features is the hill torrents known locally as 'Rod Kohi' (literally 'water coming from the mountains'). These hill torrents have led to centuries-old practice of unorganised and unreliable irrigation, which sees hilltop farmers store water in case of shortages, while farmers downhill are victimised by flash floods. We also plan to undertake case studies to see how climate-induced vulnerabilities change along with changes in irrigation structure.

A study by Arif (2014) found a high incidence of poverty in Punjab's cotton-wheat zone as compared to its rice-wheat zone. Based on Benazir Income Support Programme data, he finds that DGK ranks high on various poverty-related indices, such as poverty by gender and literacy of the household. These findings are in-line with those of Naveed and Ali (2012), and suggest that DGK will serve as an ideal site for this project.

Because DGK is a semi-arid district that produces a huge proportion of cotton and has poverty and climate extremes, it connects well with our overarching goal of finding pathways to reduce climate vulnerabilities and promote adaptive capacities among poor communities. Moreover, the presence of a large number of actors, including cotton producers, ginners, spinners, agriculture banks, and middlemen among others, would enable us to gain insight on how climate change affects different actors throughout the CVC. This in turn would help identify priority policy actions to promote inclusive development of the value chain (in the context of climate change).

Box 1: DGK – district profile

Table: Administrative and demographic details of DGK (2008)

Name of subdivisions (Tehsils)	Villages	Area (sq km)	Population
Dera Ghazi Khan (city)	174	2634	1024030
Kot Chutta	122	1240	702817
Taunsa	197	2769	504852
Tribal Area	350	4784	189297
Total	843	11427	2420996

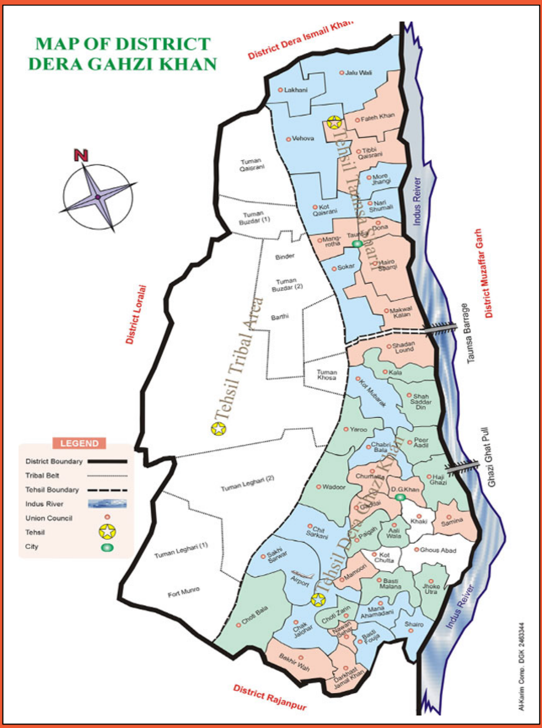
Source: District Government, Dera Ghazi Khan 2016

Table: Demographic indicators

Demographic indicator	value
Average household size	7.9
Population density	137.8 per sq.km
Urban population	228839 (13.93%)
Rural population	1414279 (86.7%)
Sex ratio (males per 100 females)	108.2

Source: District Government, Dera Ghazi Khan 2016

Figure: Map of DGK



Faisalabad

Faisalabad, also situated in Punjab, is one of Pakistan's largest industrial districts. It not only boasts major manufacturing structures but also has an agricultural base. Major crops produced in this district include wheat, rice, maize, cotton and sugarcane. This district covers 1269 km2 of land. According to population, Faisalabad is Pakistan's third-largest city. This district is also semi-arid and receives an average annual rainfall of 384 mm.[15] In summer, daytime temperatures reach 48°C, and in winter, night-time temperatures can fall to 4.8°C (AUICK, 2004). Faisalabad has eight administrative subdivisions (see Box 2).

Although Faisalabad contributes 1.53% to Punjab's total cotton production, it is the third-largest contributor of cotton to the Province's semi-arid districts. Researching this district will help gain insight into cotton production in semi-arid lands. It will also provide insight into how processing and upstream textile units are indirectly affected by climate extremes that face actors in the downstream textile sector (e.g. cotton producers).

Focusing on these two districts, research during phase two will consider climate extremes since 1981. We will examine the impact of these extremes on: cotton production, processing, and trade, among other CVC sectors; businesses and actors; and the role of policy. Using climate data, we will also develop projections for future cotton production in the major cotton-producing provinces of Punjab and Sindh.

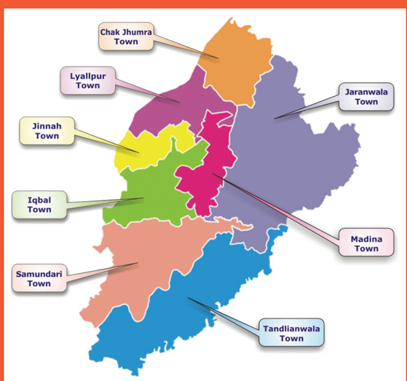
Box 2: Faisalabad – district profile

Table: Administrative and demographic details of Faisalabad (2008)

Name of subdivision (Tehsil)	No. of union councils	Villages	Area (sq km)	Population (1998)
Lyallpur Town	38 (22 urban, 16 rural)	-	-	7,17,710
Madina Town	41 (33 urban, 8 rural)	-	-	797,873
Jinnah town	39 (30 urban, 9 rural)	-	-	765,700
Iqbal Town	43 (28 urban, 15 rural)	-	-	783,173
Chak Jhumra Town	15 (2 urban, 13 rural)	67	-	2,53,806
Jaranwala Town	57 (2 urban, 55 rural)	256	1811	1,054,698
Samundri Town	25 (1 urban, 24 rural)	132	-	-
Tandlianwala Town	28 (3 urban, 25 rural)	-	1284	5,40,802

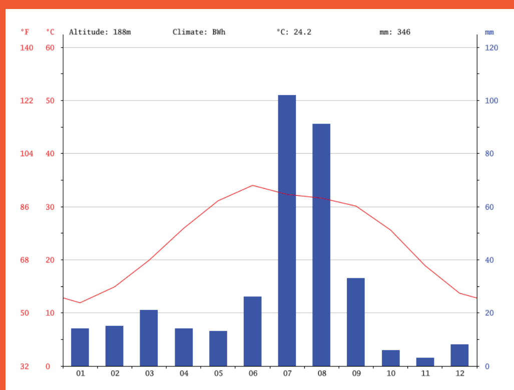
Source: City District Govt, Faisalabad, 2016

Figure: Administrative map of Faisalabad



Source: City District Govt, Faisalabad, 2016

Figure: Temperature and precipitation data (12 month average)

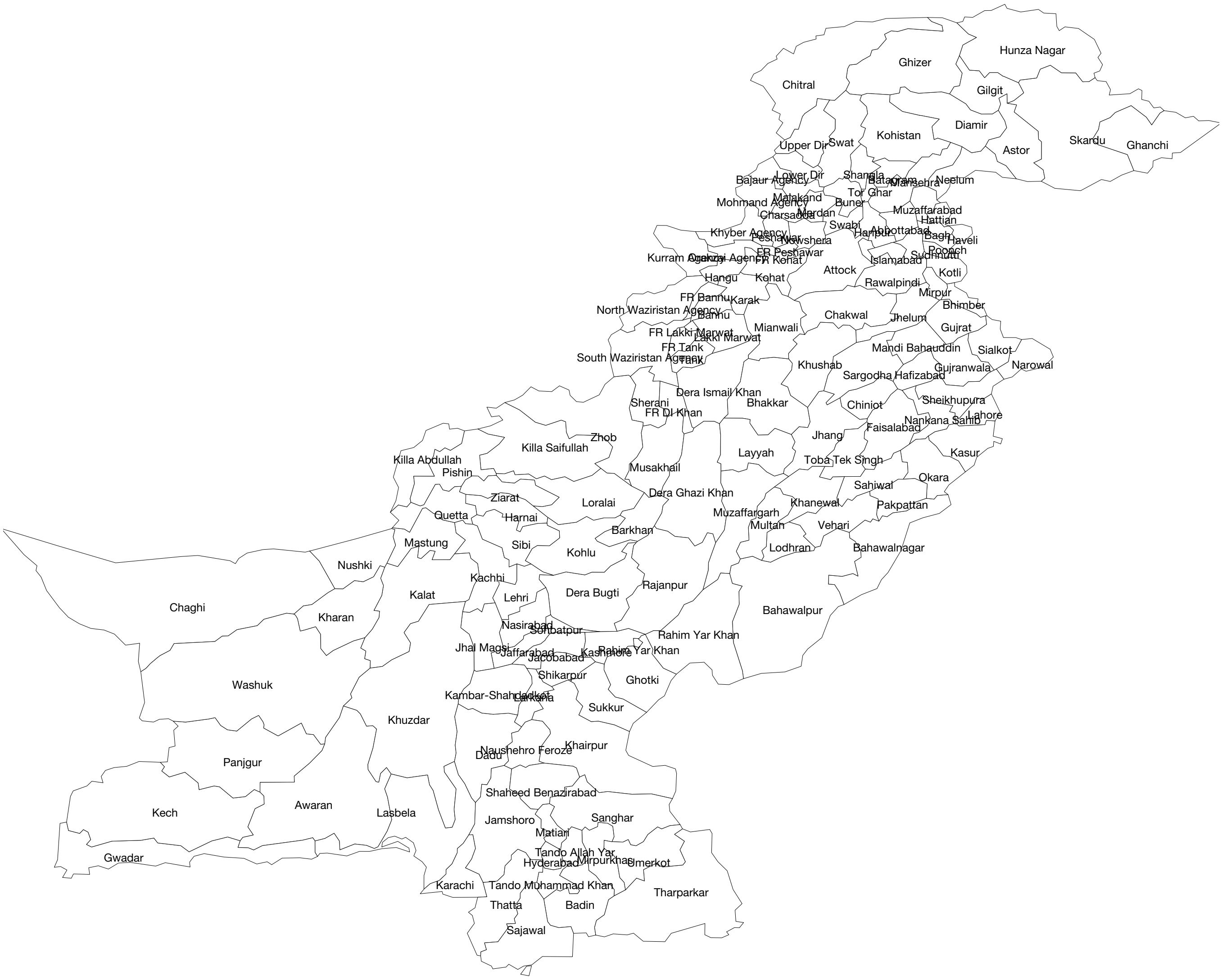


Source: Climate-data.org, 2016

15 The estimates for average annual rainfall differ by source, but all the estimated figures fall under the semi-arid category.

Annexes

Annex 1: Districts of Pakistan



Source: Author's own

Annex 2: Primary stakeholder groups in Pakistan's CVC

	Cotton production	Ginning	Spinning	Processing and manufacturing	Domestic markets	Exports
Agriculture research institutes	Small landholders	Small ginning units (workers and owners)	Small spinning units	Small manufacturing units	Wholesale dealers	Traders
Fertilizer, pesticide, agricultural machinery	Medium landholders					
Large landholders	Large industrial ginning units (industrial labourers and owners)	Large spinning units	Large manufacturing units		Large textile firms	
Seed companies	Landless: contractors	Labour union	Labour unions	Labour unions		Trader unions
	Landless: sharecroppers			Textile unions		
	Academia: agriculture research institutes					
	Middlemen					
	Farmer unions					
International and national research institutes						
Media houses (for research dissemination)						
	Provincial agriculture departments					
	The Ministry of National Food Security & Research					
Extension services (district departments)						
Punjab and Sindh Seed Corporation	Meteorological department					
	Trading corporation of Pakistan					
	Ministry of Textile Industry					
Agriculture and textile research institutes (under ministry/provincial departments)						
Pakistan Bureau of Statistics						
Ministry of Commerce						
Financial services						
Transportation						

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