



The ICAC Recorder

International Cotton Advisory Committee



Cotton in Latin America & the Caribbean

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Editorial

This issue of the ICAC Recorder features three insightful articles. Two of them — by Dr Marcelo Paytas and Ms Lorena Ruiz — are dedicated to the history and future prospects of the cotton sector in Latin America and the third by Dr Sundaramoorthy Chandrasekaran who presents key insights from the Ninth Asian Cotton Research and Development Network (ACRDN) meeting.

The cotton sector in Latin America has experienced fluctuations in production over the past few decades, but the region holds significant potential for the future. The historical importance of cotton in countries such as Brazil, Mexico, Argentina, and Peru is undeniable, and although challenges persist, the prospects for recovery and growth remain strong. Dr Paytas offers an excellent comprehensive historical overview of cotton production, examines its challenges, and explores future opportunities. One of Latin America's primary competitive advantages is its diverse geography, which allows cotton cultivation in a wide range of climates and altitudes. From the high-quality Peruvian Pima cotton to Brazil's robust yields, the region's ability to produce a variety of cotton types positions it as a versatile supplier to the global market. Additionally, the proximity of Latin America to major textile markets in North America provides a logistical advantage, reducing transportation costs and turnaround times for manufacturers.

Another significant benefit is the adoption of technological advancements in cotton farming. Countries like Brazil and Argentina have embraced genetically modified (GM) cotton, resulting in higher yields and a reduced need for chemical inputs. This not only boosts productivity but also aligns with the global demand for sustainable farming practices in cotton production.

However, as Ms Ruiz points out, fully capitalizing on these advantages remains a challenge. Issues such as inconsistent access to financing, infrastructure deficits, and the need for more coordinated public policies to support cotton farmers are critical. In her article, "Competitive Advantages of the Latin America and the Caribbean Region in Cotton Production and Processing," Ms Ruiz highlights several factors that position this region as a key player in the global cotton industry. Addressing these challenges will be crucial for unlocking Latin America's full potential, especially as global demand shifts increasingly toward sustainably produced textiles.

The Ninth Asian Cotton Research and Development Network (ACRDN) meeting, as described by Dr Sundaramoorthy Chandrasekaran in "The Ninth Asian Cotton Research and Development Network Meeting (ACRDN)," brought together key stakeholders from across Asia to discuss the current state and future prospects of cotton in the region. Asia remains a dominant force in the global cotton market, both as a producer and consumer, with countries such as India, China, Pakistan, Bangladesh, Vietnam, and Indonesia playing key roles in either leading cotton production or consumption. A central theme of the ACRDN meeting was the need for increased research and collaboration to address the challenges facing cotton in Asia. The recommendations highlight key strategies to advance cotton production, sustainability, and innovation. In the plenary sessions, overcoming mechanization's capital intensity, fostering climate-resilient cotton through scientific exchanges, and utilizing cutting-edge tools for trait discovery were emphasized. Additionally, focusing on water-deficit tolerance and launching a pilot carbon credit initiative were proposed. Special lectures called for improving rainfed productivity and fostering public-private partnerships. Concurrent sessions explored diverse areas such as soil health, pest management, precision farming, and value addition to cotton by-products, advocating for multidisciplinary approaches, integrated nutrient management, AI and robotics in farming, and circular economy initiatives. Emphasizing traceability, technology forecasting, and sustainable textiles were also prioritized for a more resilient cotton industry. The meeting concluded with a call for greater regional collaboration, both among Asian countries and with global partners, to share knowledge, technology, and innovations that can help tackle the challenges facing the cotton sector.

In conclusion, the future of cotton production, both in Latin America and globally, depends on collaboration, innovation, and sustainability. Latin America, with its unique advantages, is well-positioned to expand its role in the global cotton market, provided that infrastructure, financing, and policy support challenges are addressed. The insights from the Ninth ACRDN meeting underscore the importance of regional cooperation in advancing research, technology, and sustainable practices. By fostering knowledge-sharing and building partnerships, the global cotton industry can navigate future challenges while ensuring that cotton remains a vital, sustainable, and equitable crop for generations to come.

– Keshav Kranthi

Cotton in Latin America and the Caribbean: A Historical Overview, Current Dynamics, and Future Challenges

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Dr Marcelo Paytas graduated as an Agricultural Engineer from the National Northeast University, Corrientes, Argentina, and obtained a PhD at the University of Queensland, Australia, in Cotton Physiology and Agronomy. He currently serves as Director of INTA (National Institute of Agricultural Research), Reconquista Santa Fe, Argentina, where he is a researcher and project leader of the cotton team with a focus on crop physiology and agronomy,

biotechnology, and genetic improvement. A member of APPA (the Association for the Promotion of Cotton Production), which associates all representatives of the cotton chain of Santa Fe, Argentina, he also serves a coordinator of academic and technical agreements between INTA and other national and international organisations. A member of the ICAC's SEEP Committee and ICRA, Mr Paytas's main interest is to link and promote research and development together with the cotton industry through Mr Marcelo Paytas public and private interaction for sustainable production.

INTRODUCTION

Historically, cotton production has been central to the economic and social development of Latin America and the Caribbean.

While some countries have seen significant growth and subsequent declines in production over the years, others have experienced notable expansions in recent decades.

The cotton industry, encompassing everything from field cultivation to textile and clothing manufacturing, has been a major source of employment and economic activity in the region. Public policies and the organization of both public and private sectors have played crucial roles in shaping the industry's evolution and sustainability.

This chapter will explore the historical development of cotton production in Latin American countries, focusing on the evolution of cultivation systems, germplasm development, agronomic practices, and the economic and social impacts, including industrialization. It will also examine the current state of the industry and future trends.

ARGENTINA

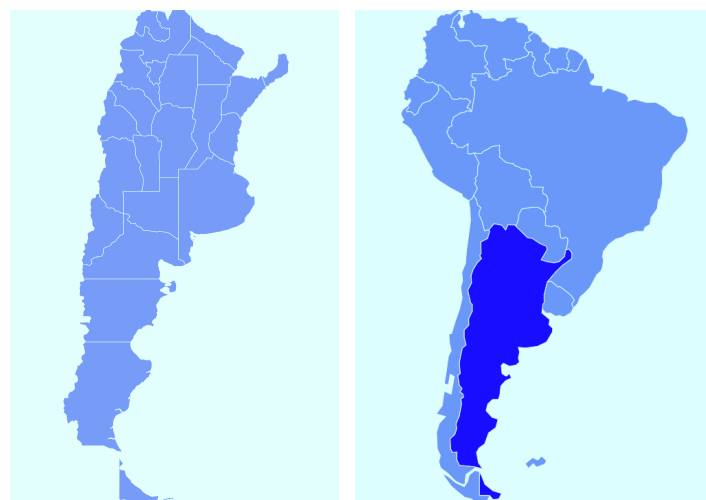


Figure-1. Map of Argentina

Cotton production in Argentina began over 400 years ago, experiencing an extensive period of growth before a gradual decline. By around 1860, the industry had nearly disappeared, despite British efforts to revitalize it. Cotton did not reemerge as a significant cash crop in Argentina until approximately 1890 (Berger, 1969).

Spanish missionaries introduced cotton to Santiago del Estero in 1556, and it quickly spread to neighboring provinces such as Tucumán and Catamarca. Cotton was the first product exported from Buenos Aires, with a shipment of cotton fabric leaving the port in 1587, manufactured on looms in the north of the country.

In the 16th and 17th centuries, apart from the Antilles and Mexico, the principal cotton-producing areas in the Americas were Brazil and the Viceroyalty of Rio de la Plata (Virreinato del Río de la Plata). During the conquest era, cotton was highly valued and frequently mentioned in historical documents. In 1702, the Council of Tucumán (Cabildo de Tucumán) officially recognized cotton as a form of currency. The standard valuations were: one "arroba de pabito" (a type of thick, untwisted cotton thread) was equivalent to three pesos; a pound of wick was worth five reales; a pound of thread was valued at two pesos; and a stick of canvas was priced at one peso, as noted by historian Sánchez Oviedo. The high



Figure-2. Spanish missionaries introduced cotton to Santiago del Estero in 1556 (image: Keshav Kranthi)

quality of cotton fiber from Catamarca earned international acclaim. Additionally, the Jesuit Missions played a crucial role in advancing cotton cultivation and industry in northern Argentina, including the Litoral region.

For more than 200 years, cotton was the most important productive system in the provinces now part of Argentina's Northwest region. Documents indicate that cotton played a significant role in the conquest of the Viceroyalty countries and is closely linked to Argentina's history. In 1683, the official emblem of the province of Catamarca featured cotton as a typical product of the land. In the province of Corrientes, indigenous people produced cotton for their own use before it reached Santiago del Estero. The crop continued to expand in some regions of Litoral (East) and Catamarca (West), with Argentina producing more cotton than the United States during those years (Delssin, 2003). This dominance persisted until the early 19th century, when cotton's prosperity in the Viceroyalty was abruptly interrupted by significant technological innovations.

The invention of the mechanical ginning machine with saws by Eli Whitney in 1793 and improvements in spinning and weaving machines led to a shift. Consequently, cotton production expanded in the southern United States, becoming competitive due to a substantial reduction in costs from mechanized ginning (Delssin, 2003). This shift resulted in a decline of cotton cultivation and manual industry in Argentina, which continued until the end of the 19th century and the beginning of the 20th century.

The American Civil War, beginning in 1861, prompted the English industry to seek new sources of cotton. This led to



Figure-3. Illustration of Eli Whitney with his patented gin (1793). (image: Keshav Kranthi)

the launch of policies to promote cotton cultivation in various countries around the world. In 1862, Argentina initiated its first major cotton promotion campaign, which involved importing seeds and two manual saw gins. However, this enthusiasm was short-lived, as the end of the American Civil War restored competitiveness to U.S. cotton production.

In 1904, the Argentine Ministry of Agriculture launched a new campaign to boost cotton planting, providing North American seeds and training for producers.

Following World War I, cotton expanded rapidly as a cash crop. From 1917 onward, the introduction of mechanical ginning significantly increased the volume of cultivation and helped define the production areas that persist today. During the 1924/1925 season, 80% of cotton production came from Chaco, 13% from Corrientes, with the remainder from other neighboring provinces.

As cotton production increased, so did the labor force. According to the National Census of 1895, there were 2,227 women employed in garment factories and 588 in espadrille factories. With the advent of mechanical ginning, there was a significant rise in labor demand. By the late 1910s, the workforce had expanded to 26,200 men and 22,555 women employed in garment, bag, and espadrille factories, with many of the major operations located in Buenos Aires (Carvalho and Aguirre, 2017).

In 1935, the National Cotton Board was instrumental in compelling the Argentine government to protect and promote the cotton textile industry, particularly during 1936 and 1937. This initiative led to an expansion of cotton cul-

tivation to 410,000 hectares during those years, with continued growth in the subsequent decades. The exploitation of lands previously deforested by companies linked to the “Quebracho” was also promoted. Additionally, strengthening domestic consumption allowed for the expansion of cotton cultivation into new production areas under supportive public policies.



Figure-4. By the late 1910s, the workforce had expanded to 26,200 men and 22,555 women employed in garment, bag, and espadrille factories (image: Keshav Kranthi)

Between 1960 and 1970, the provinces of Chaco and Formosa produced 80% of Argentina’s cotton, with the remaining production spread across Corrientes, Santa Fe, Santiago del Estero, and smaller amounts in Córdoba, Misiones, Salta, Jujuy, Catamarca, and La Rioja. Today, cotton is cultivated across a broad area between the Tropic of Capricorn and approximately 31° S latitude. This region exhibits considerable environmental diversity, with climatic conditions ranging from humid in the extreme northeast (over 1,500 mm of rain per year) to semi-arid in the northwest (less than 750 mm of rain), where irrigated areas constitute less than 10% of the national surface (Carvalho and Aguirre, 2017).

In the 1980s, the distribution of cotton cultivation remained relatively stable, with Chaco being the leading producer (over 65%), followed by Formosa (around 10%), Santa Fe and Santiago del Estero (about 8% each), and Corrientes (3%). In the 1990s, there was significant growth in the northwestern provinces, with Santiago del Estero rising to second place, and Salta alternating positions with Formosa and Santa Fe. Corrientes dropped to sixth place, and smaller areas were planted in Entre Ríos, Catamarca, and Tucumán.

Historically, cotton production in Argentina has been a driving force for the primary sector, the industrial sector, and related services. However, its production trend has varied

significantly over the decades. During the 1997/98 season, Argentina achieved a historical production record, reaching a maximum area of 1,133,500 hectares. This was followed by a period of accelerated decline, with the planted area dropping to 160,000 hectares by the 2002/03 season. Several factors contributed to this decline, including unfavorable prices, competition from soybeans, and adverse environmental conditions (Paytas and Ploschuk, 2013).

In recent years, however, the planted area has increased significantly. Key factors driving this resurgence include the adoption of a new seeding system with narrow rows and high densities, which has substantially stabilized production, the development of “stripper” harvesting machines with low acquisition and maintenance costs, and improved prices (Paytas, 2010).

For the 2012/2013 season, the provincial distribution of national cotton production was as follows: Chaco 35%, Santiago del Estero 27%, Santa Fe 30%, Formosa 4%, Salta 3%, and other provinces 2%. These provinces continue to play a significant role in national production. Regarding raw cotton yields, the national average for the last decade (2002–2013) was 1,454 kg/ha, increasing to 1,514 kg/ha in the most recent five-year period. Provincially, the highest yields were observed in Santa Fe and Santiago del Estero, with 1,706 kg/ha and 1,954 kg/ha, respectively, while Chaco and Formosa had lower yields of 1,315 kg/ha and 1,139 kg/ha, respectively (Carvalho and Aguirre, 2017).

Argentina is the second-largest producer and consumer of cotton in the region. Fiber production meets national demand and enables exports to countries such as Indonesia, Vietnam, Turkey, Colombia, and India, among others.



Figure-5. Garments factory in Argentina. (Photo source: Keshav Kranthi)

Almost all cotton is produced using transgenic seeds, with limited availability of genotypes well-suited to the diverse productive regions with specific environmental constraints. Sustainable agronomic management programs and best management practices are implemented in some production areas. These practices include crop rotations, cover crops, zero tillage, integrated pest management, cotton boll weevil management, fertilization, integrated fiber management, and mechanized harvesting. Regions organized within producer

associations, such as the APPA (Association for the Promotion of Cotton Production) in Santa Fe province, demonstrate greater sustainability due to their focus on technology implementation, training, and sector policy execution.

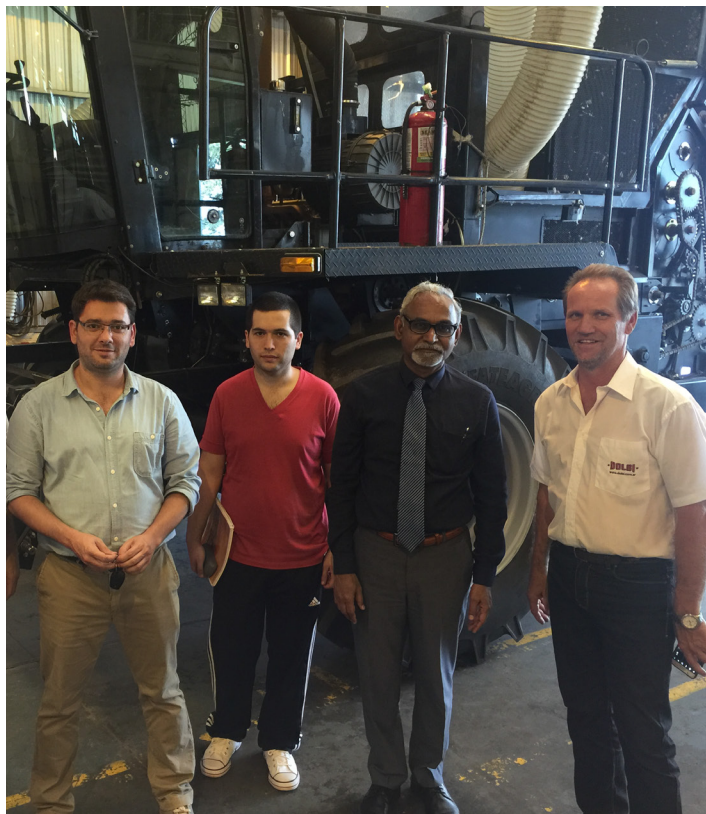


Figure-6. Argentina is an emerging global leader in indigenous farm mechanization. (Photo source: Keshav Kranthi)



Figure-7. The cotton boll weevil continues to pose a serious challenge in South America. (Photo source: Keshav Kranthi)

The primary current and future challenges facing the Argentine cotton sector are: (1) developing varieties adapted to different production regions; (2) reducing the negative impact of weevils and other pests that increase production costs; (3) implementing support, training, and policies for the sector; and (4) achieving greater interaction among chain members in regions where such collaboration is lacking.

BOLIVIA

Cotton has been commercially produced in Bolivia since 1950, serving as a key raw material for the textile industry. Up until the 1990s, cotton held significant socioeconomic importance in Bolivia.

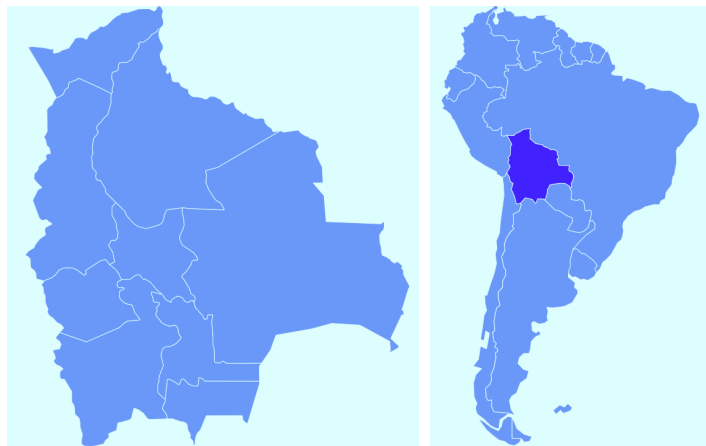


Figure-8. Map of Bolivia

Currently, however, cotton cultivation in Bolivia is at its lowest level. While the cultivated area reached 52,000 hectares in the 1990s, it now does not exceed 4,000 hectares. Between 1993 and 1998, approximately 700 families — comprising small, medium, and large farmers — were engaged in cotton cultivation.

Today, only 150 farmers remain in the Department of Santa Cruz, with 82% of former cotton farmers having shifted primarily to growing soybeans and corn. The decline in cotton production can be attributed to several factors: falling prices, increased competitiveness of international industries, low productivity of the varieties used, phytosanitary issues, and the strong competition from synthetic fibers. Consequently, the socioeconomic impact of cotton has become minimal, barely registering in the country's economic indicators (Carvalho and Aguirre, 2017).

A small portion of Bolivia's cotton is used domestically, while the majority is exported. It is primarily produced and harvested in the Pailón area of Santa Cruz Department and then transported to La Paz via Cochabamba. From La Paz, it crosses the border at Desaguadero and is directed to yarn factories in Lima, Peru, which accounts for more than 40% of Bolivian cotton exports.

In areas with low rainfall, such as the Bolivian Chaco, cotton serves as a viable alternative for family farmers due to its adaptability to water-limited conditions.

For a family, cultivating 2 hectares can be profitable, with 1.5 people required per hectare for manual harvesting.

Conventional and transgenic varieties from Argentina, the United States, and Brazil are utilized. Bolivia faces challenges in revitalizing its cotton sector, primarily concerning protective policies for small and medium-sized farmers.

BRAZIL

Brazil is one of the oldest cotton-producing countries in the Southern Hemisphere. Before Europeans arrived in the Americas, native inhabitants were already cultivating cotton and using it to produce fabrics, garments, and ropes. Europeans learned about cotton and its cultivation, and by the end of the 16th century, plantations had been established in the Bahia region. Between 1500 and 1781, numerous writers documented various uses of cotton throughout Brazil. However, cotton was not exported until the mid-18th century, and even then, exports were minimal until shortly before 1781, when it was shipped to England (Berger, 1969).

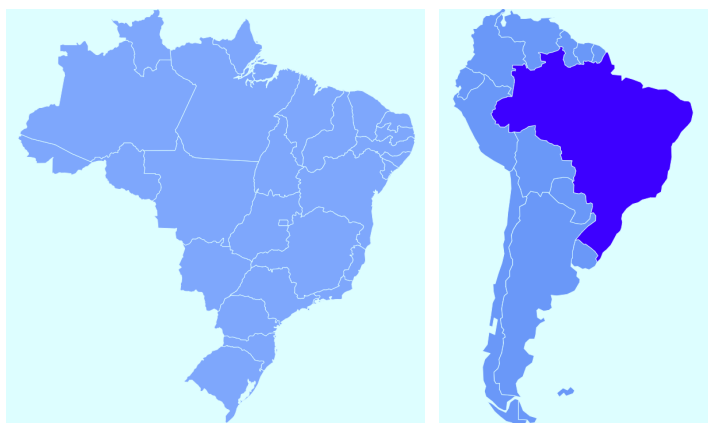


Figure-9. Map of Brazil

Until the 19th century, the “Quebradinho” variety of cotton held economic importance in Brazil due to its favorable agronomic characteristics. However, with the introduction of *Gossypium hirsutum* varieties from the United States in the early 1900s, the commercial cultivation of native varieties sharply declined. During the American Civil War, cotton production in Brazil surged, and the introduction of upland and Sea Island cottons, along with new cultivation methods, marked Brazil’s rise as an important producer and exporter of cotton. This growth was further supported by the development of the textile industry, with spinning mills primarily located in São Paulo.



Figure-10. During the American Civil War, cotton production in Brazil surged, and it soon emerged as an important producer and exporter of cotton.

By the mid-20th century, the cultivation of the “Brasiliensis” and “Quebradinho” varieties was largely confined to the humid zones of the states of Maranhão and Bahia (Boulanger and Pinheiro, 1971).

During the 1990s, cotton production in Brazil was concentrated mainly in the states of São Paulo and Paraná. This period was marked by traditional farming methods, characterized by labor-intensive practices and harvesting done by farmers on small plots, resulting in lower yields.

The arrival of the cotton boll weevil in the semi-arid regions of the northeast and in São Paulo and Paraná prompted a shift in the sector’s focus. To address these challenges, efforts were made to develop new regions in the central-western part of the country. This inland expansion over the past 30 years was part of Brazil’s broader agricultural expansion, opening new opportunities for cotton cultivation (Rubio, 2016).

This expansion into the “Cerrados” or tropical “Sabana” regions encouraged producers to invest in large-scale properties, where the topography, climate, and soil conditions are ideal for highly mechanized farming operations on scales of 1,000 hectares or more. Currently, more than 85% of Brazilian cotton is produced in the state of Mato Grosso and in western Bahia. These states lie within the “Cerrados,” which spans over 200 million hectares — about 23% of Brazil’s unexploited land that is expected to see continued agricultural expansion (Rubio, 2016).



Figure-11. The expansion of cotton into ‘Cerrados’ encouraged large scale farming, which prompted investment into highly mechanized farm operations on scales of 1,000 hectares or more.

Another significant development in the growth of Brazil’s cotton sector was the establishment of the Brazilian Association of Cotton Producers (Abrapa) in the late 1990s. Abrapa’s creation aimed to enhance the competitiveness of Brazilian cotton and promote its quality on both national and international levels.

Since the 1990s, strategies to improve cotton yield have been developed and continue to evolve. Since 2004, the adoption rate of cotton varieties using genetic tools has reached

70%, and as of now, 12 biotechnological events have been approved. Over the past decade, there has been a significant increase in average fiber performance and quality attributes.



Figure-12. A modern ginning factory in Mato Grosso.

From the 2003/04 season until 2016/17, Brazil was the fifth largest producer of cotton fiber. However, starting in the 2017/18 season, Brazil moved up to fourth place globally due to an increase in the cotton-growing area in the Mato Grosso region, which accounts for over 65% of the country's cotton cultivation. By the 2018/19 season, Brazil's cotton area expanded to 1.6 million hectares, and fiber production reached a record high of 2.65 million tonnes. The average fiber yield was 1,665 kg/ha, the second highest in the last decade. This surge in production allowed Brazil to surpass India and become the world's second largest cotton exporter for the first time (Ruiz, 2019). The country's main markets include Indonesia, South Korea, Vietnam, Turkey, Pakistan, and China, among others.



Figure-13. A transgenic cotton field in Mato Grosso.

Beyond Brazil's successful cotton development, the sector faces several current and future challenges, including: 1) high costs of transgenic seeds, particularly for small producers; 2) excessive use of inputs, which significantly increase production costs and have environmental impacts; 3) the need for ongoing control and eradication programs for the cotton boll weevil; and 4) promoting domestic use, consumption, and industrialization of cotton.

COLOMBIA

Cotton production in Colombia began with the first settlers on the North Coast (Caribbean coast) and along the Magdalena River. The initial exports occurred between 1834 and 1891 from the regions of Magdalena, Santander, and Bolívar departments.

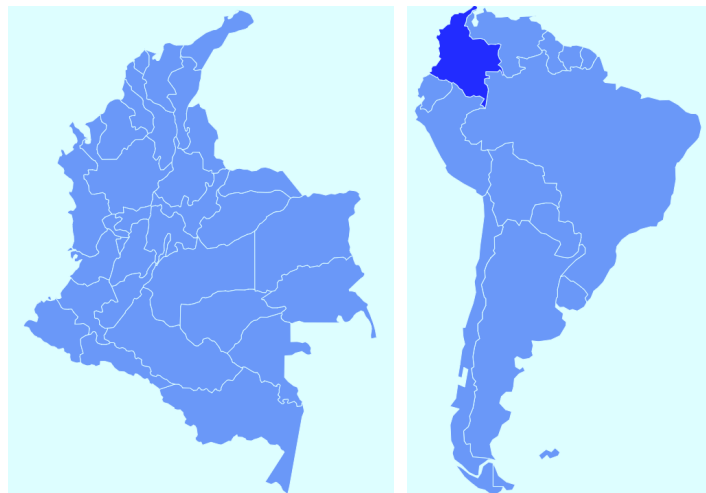


Figure-14. Map of Colombia

In Colombia, the cultivation of *Gossypium barbadense* cotton was significant in the Departments of Santander, Valle del Cauca, Antioquia, and Boyacá, with fiber exports to Europe peaking between 1858 and 1873. Subsequently, cultivation shifted to *Gossypium hirsutum* varieties (Raymond and Bayona, 1982).

Cotton cultivation emerged as one of the most remarkable successes of Colombian agriculture between 1950 and 1978, driven by the entrepreneurial spirit of Colombian farmers and the crop's profitability. In the 1960s, cotton, along with coffee, bananas, and sugar, accounted for 94% of agricultural exports (García, 1995).

From 1950 to 1977, raw cotton production increased nearly 25-fold, fueled by its profitability and external markets, unaffected by the moderate growth of the Colombian economy. A significant boost occurred between 1958 and 1959 when a substantial devaluation of the peso made cotton exports highly profitable, stimulating production. By 1977, 380,000 hectares were under cultivation, with over 75% of the area on the Atlantic Coast and the remainder in the country's interior, creating more than 480,000 jobs.

Between 1978 and 1992, the cotton sector in Colombia faced a severe crisis due to a combination of factors, including ineffective government policies, pest outbreaks caused by improper pesticide use, falling international prices, reduced import taxes, and rising costs for pesticides and agricultural machinery (García, 1995).

The decline in national production continued from 1992 to 1999, driven by economic opening. The planted area fell from 260,000 hectares in 1992 to just 50,000 hectares by 1999. Starting in 1993, Colombia began importing subsi-

dized cotton from the United States, a trend that has worsened, with over 60% of national consumption now met by imports. By 2007, only 54,497 hectares were planted, while more than 50,000 tonnes of cotton were imported, leading to significant socioeconomic issues in affected regions due to job losses during the crisis (Espinal et al., 2005). In 1991, cotton cultivation covered nearly 89,000 hectares, but by 2008, it had dropped to just over 15,000 hectares (Espinal et al., 2005), and it has continued to decline since.



Figure-15. Cotton research is carried out at Corpoica which is Colombia's main agricultural R&D agency

In 2005, there were 4,204 cotton farmers in Colombia, primarily in the departments of Córdoba, Sucre, Bolívar, Cesar, and Tolima, organized into unions known as "agremiaciones." Of these, half—2,084 farmers—cultivated less than 3 hectares, and only 134 had farms larger than 50 hectares (Conalgodón, 2008). These numbers have continued to decrease in recent years.

In the Colombian region of the "Costa-Meta," the cotton season begins with sowing between July and August and is followed by harvesting from December to March of the following year. In contrast, in the "Interior" regions, which include the departments of Huila, Tolima, and Valle del Cauca, sowing starts at the beginning of the year, in January and February, with harvesting taking place from July to October. In Córdoba, the gross yield is 2.6 tonnes per hectare, while in Tolima, the average yield is 2.1 tonnes per hectare. Although Colombia's production costs per ton and cotton crop yields are comparable to those of the United States (2.1 tonnes per average hectare), it struggles to compete with current North American prices.

The most desirable characteristic of Colombian cotton fiber is its exceptional quality. Approximately 75% of the production is classified as high-grade fiber due to its length, resistance, and homogeneity. In recent years, the high quality of Colombian cotton has led to exports to other Latin American countries, such as Peru, Bolivia, Guatemala, and Ecuador, although the quantities remain modest, not exceeding 3,000 tonnes per year (Conalgodón and Ruiz, 2015). Since the onset of commercial cotton cultivation in the 1950s, pro-

ductivity has nearly tripled, currently reaching an average of 870 kilograms of fiber per hectare (Carvalho and Ruiz, 2018).

Cotton cultivation in Colombia is among the most expensive in the world. Contributing factors include the limited availability of irrigation infrastructure, inadequate soil preparation, poor agricultural practices, outdated machinery, a shortage of harvesting equipment, and a lack of seed suppliers (Conalgodón and Ruiz, 2015).



Figure-16. Roundup Ready (RR) Cotton was authorised by the Ministry of Agriculture in 2003.

The introduction of genetically modified (GMO) cotton into the country occurred during a period of cotton crisis, with seed companies hopeful that this technology would revive the sector. The Ministry of Agriculture authorized the commercial planting of Bt cotton in 2002, followed by Roundup Ready (RR) cotton in 2003. By 2006, the combined Bt and RR technology was also introduced, all of which are privately owned. Despite an increase in the area cultivated with transgenic cotton, the growth has not met the expectations of sector organizations. Seed and agricultural input companies maintain a monopoly, leaving farmers with limited options and often unable to obtain non-GM seeds.

GMO cotton seeds cost more than three times as much as conventional seeds. Additionally, for transgenic technology to be effective, farmers must invest in new expenses that further raise production costs. These include efficient irrigation systems, precision planting machinery, proper soil fertilization, and comprehensive pest and refuge management. Small and medium-sized cotton farmers struggle to adopt this new technological package, a challenge also faced by farmers in other Latin American countries such as Brazil and Argentina.

In the Caribbean region, the primary cotton pest is the boll weevil (*Anthonomus grandis*), which is resistant to Bt cotton. To control this pest, farmers apply approximately 70% of the total pesticides used during the season. In Tolima, key pests include *Spodoptera* spp. and the pink bollworm (*Pectinophora gossypiella*), which also necessitate additional pesticide applications.



Figure-17. Though boll weevil continues to dominate, pink bollworm necessitates additional insecticide applications (photo: Keshav Kranthi).

Recently, there has been a resurgence of the boll weevil in Tolima, an area where it was previously not a major concern and did not require chemical control. Farmers now need to make up to six insecticide applications to manage this pest. Furthermore, the whitefly has also reemerged in some parts of Tolima, reaching critical levels and driving up control costs.

Bt technology relies on the use of refuges — areas planted with non-transgenic cotton within the transgenic crop to reduce the likelihood of pests developing resistance to Bt toxins. However, it has been reported that many farmers in Tolima and the Caribbean are not effectively managing these refuges, creating a limited and risky situation.

Numerous indigenous communities are involved in the cultivation of transgenic cotton across Colombia. In these contexts, Bt technology often proves unfeasible and incompatible with traditional indigenous farming practices, culture, and food sovereignty, particularly without adequate technical support. By 2007, cotton planting had almost ceased in these areas. Following the failure of transgenic cotton in South Tolima, indigenous communities have become more aware of the risks and impacts of such crops on their lands and are vigilant about the potential introduction of transgenic maize.

Despite the significant reduction in cultivated area, the cotton industry remains a crucial component of Colombia's agricultural economy. With increased investment, technological advancements, and a growing demand for domestic fiber, the sector is showing signs of recovery and is poised for a resurgence. The Colombian Cotton Confederation projects that by 2020, the planting area could exceed 20,000 hectares nationwide. For the industry to regain its competitiveness, it is essential to invest in technology and high-quality, locally adapted seeds.

The current and future challenges for the Colombian cotton sector include: 1) adjusting production costs and addressing variable yields across different production regions; 2) implementing technologies related to irrigation, mechanization, and region-specific seed adaptations; 3) enhancing sector competitiveness through policies that address price-related issues; and 4) improving the organization of the national cotton supply chain.

ECUADOR

Historically, the textile industry has been deeply rooted in Ecuadorian society, particularly in the Andean region. Cotton cultivation in Ecuador, initially introduced to support the oil industry, played a significant role in agriculture, especially during the 1970s and 1990s. Cotton is grown in Pedro Carbo, Tosagua, Guayas, and Manabí — regions characterized by mountainous terrain with a dry to semi-humid climate, pronounced relief, and limited infrastructure. The growing season extends from January to harvest, which occurs between June and August (Carvalho and Aguirre, 2017).

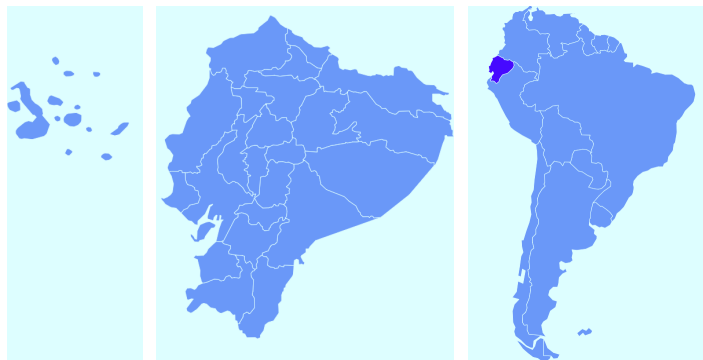


Figure-18. Map of Ecuador



Figure-19. Cotton field in Ecuador

According to the FAO, until 1997, national production met a substantial portion of domestic demand. However, due to a persistent deficit in national production, the textile industry has increasingly relied on imports, which grew at an approximate rate of 9% from 1990 to 2012. There has also been a rapid rise in imports of clothing made from various textile fibers.

Efforts to revitalize the cotton sector have been ongoing, with significant contributions from the Cotton Foundation (FUNALGODÓN), established in 1990. This foundation supports the entire cotton chain, from primary production to manufacturing and marketing. Most cotton producers are small-scale, family-run farms characterized by high labor intensity.

EL SALVADOR

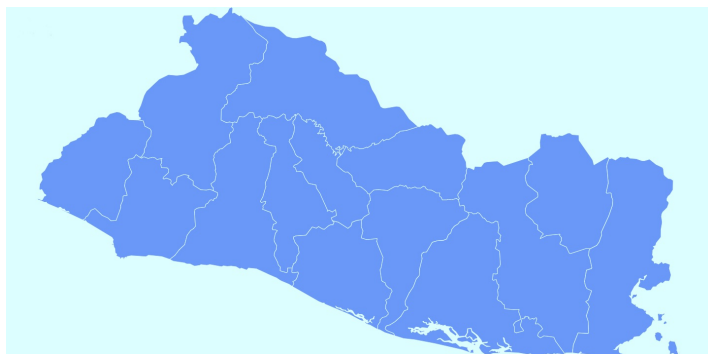


Figure-20. Map of El Salvador



In the 1950s, cotton became El Salvador's second-largest export crop, surpassing sugarcane. From 1956 to 1962, the area devoted to cotton cultivation expanded but then declined due to various issues, primarily

related to sanitation. During this period, cotton production was concentrated in regions along the Pacific coast, including Zacatecoluca, La Unión, and around Acajutla (Berger, 1969). In the 1970s, the department of Usulután accounted for 30% of the country's cotton production, followed by the departments of San Miguel, La Paz, and La Unión. Since then, the area under cotton cultivation has continued to decline.

GUATEMALA

In the 1960s, cotton and coffee together represented 70% of Guatemala's total exports, with the remainder comprising bananas, sugar, and meat. The expansion of cotton cultivation in the early 1970s was remarkably rapid, particularly in areas near the Pacific coast where conditions were ideal for cotton production (Berger, 1969). However, similar to

Nicaragua, the area dedicated to cotton cultivation in Guatemala has declined over the years.

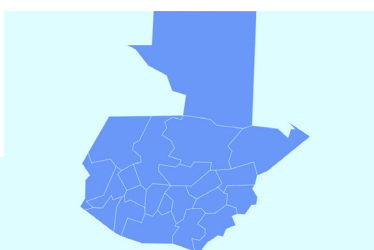
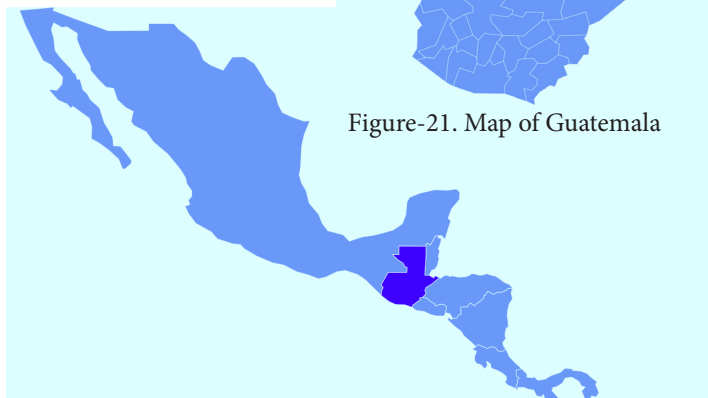


Figure-21. Map of Guatemala



HONDURAS

Cotton production in Honduras has consistently been minimal, contributing less than 5% to the country's total export value. Banana production, followed by coffee, dominated exports, especially from the Second World War until the 1970s.

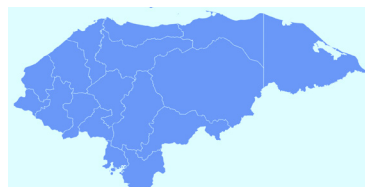


Figure-22. Map of Honduras

During this period, Honduras's natural conditions were less favorable for cotton cultivation, which was better suited for banana and other tropical crops.

Approximately 80% of the cotton was produced in the semi-arid tropical departments of Choluteca and Valle on the southern coast, with the remainder grown in the central highlands of El Paraíso and Olancho (Berger, 1969).

NICARAGUA

Cotton production in Nicaragua experienced rapid growth starting in the 1950s, driven by rising prices, the Korean War, and increased global consumption. By the 1960s, Nicaragua had become the leading cotton producer in Central America. This success was bolstered by favorable returns relative to production costs, improved access to interior regions through new roads, and the availability of credit through a National Bank program.



Figure-23. Map of Nicaragua

Between 1960 and 1965, half of the planted area was on newly cultivated lands, a shift from competitive crops like corn and sesame. During this period, cotton production was concentrated in the plains along the Pacific coast, extending from the city of Rivas in the south to nearly the Gulf of

Fonseca in the north, and including Somoto in the northeast and Boaco in the southeast. The rest of the country, including the central mountainous region and the humid jungle of the east coast and Caribbean, was unsuitable for cotton cultivation (Berger, 1969).

The primary production area was the department of Managua and the surrounding districts to the south. By the late 1960s, Chinandega emerged as the leading producer, followed by León and Managua. Together, these three departments accounted for 85% of national production in 1967/68. However, in the years that followed, the area sown with cotton has continued to decline.

MEXICO



Figure-24. Map of Mexico

Central-west and southern Mexico are considered primary centers of diversity for the *Gossypium* genus, with 18 identified species (Gene Technology Regulator, 2008). Veracruz is believed to be one of the first regions where cotton was cultivated, with production reaching 116 million pounds in the sixteenth century. However, production declined with the arrival of the Spanish. Interest in cotton cultivation revived around 1860, particularly in northern regions near the United States (Sagarpa, 2011).

Matamoros, located in the state of Tamaulipas on the banks of the Rio Grande, is the oldest cotton-producing region in Mexico. Until the early 1960s, it was the largest production area in the country. Cotton production in Matamoros relied heavily on irrigation due to scarce and unpredictable rainfall, and soil salinity issues. Persistent diseases and insects, which were difficult to control, led producers to shift towards crops such as corn, wheat, and sorghum (Berger, 1969).

In the 1960s, the largest cotton-producing region in Mexico was in the northwest, including the West Coast (Sonora and Sinaloa), Mexicali (Baja California), and La Paz. This area accounted for 50% of Mexico's total cotton production and 38% of the national area. The region benefited from extended irrigation practices, producing high-quality, exportable cotton (Berger, 1969). Other notable cotton regions included Altamira in Tamaulipas, Apatzingán near Mexico City, Tapachula in Chiapas near the Guatemalan border, and Laguna in Coahuila and Durango. Earlier established cotton-producing areas also included Delicias, Juárez, Monterrey, and Nuevo Laredo.

In the 1960s, the primary cotton seed planted in Mexico was of the American Upland type. Until the end of the 1980s, Mexico was a significant exporter of cotton fiber. However, cultivation began to decline in subsequent years due to falling international prices, rising production costs, and challenging pest control issues.

Mexican cotton production dropped from 353,000 tonnes in 1980/81 to 24,000 tonnes in 1993/94. Since then, the country's cotton fiber supply has recovered, reaching levels similar to those observed four decades ago. In the 2017/18 season, following two consecutive years of decreased planting, the cotton area rebounded to 212,000 hectares, double the area sown in 2016/17 (Ruiz and García, 2018).

Recent decades have also seen significant challenges due to difficult-to-control pests, including the whitefly (*Bemisia tabaci* and *B. argentifolii*), the caterpillar complex (*Helicoverpa zea* and *Heliothis virescens*), the cotton boll weevil (*Anthonomus grandis*), and the pink worm (*Pectinophora gossypiella*). The cotton boll weevil, a native species to Mexico, can account for up to 40% of production costs.



Figure-25. Boll weevil

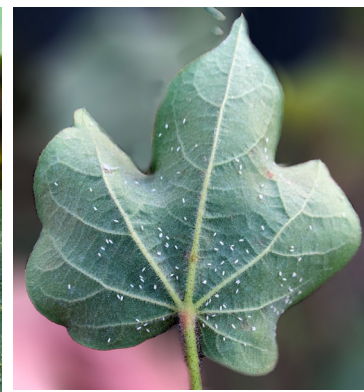


Figure-26. Whiteflies

Cotton production in Mexico is concentrated primarily in five states. Chihuahua dominates, with 70% of the country's cotton area. Baja California follows with 13%, Coahuila with 7%, Tamaulipas with 6%, Sonora with 3%, and Durango with 1% (Ruiz and García, 2018).

Beginning in 1996, the Mexican government approved the introduction of biotechnology into cotton cultivation, leading to the adoption of genetically modified seeds. Currently, imported transgenic varieties resistant to pest insects and tolerant to herbicides are predominantly used, mostly under irrigation systems. These varieties support the rational use of insecticides and are compatible with Integrated Pest Management (IPM) and conservation agriculture practices.

There are two primary planting systems in Mexico: the traditional system, which accounts for 37% of the planted area, and the narrow-row, high-density system, which makes up the remaining 63%. The choice of system depends on the climatic conditions of each region.

Cotton in Mexico is grown in two production cycles. The autumn-winter cycle, contributing minimally to national

production, is limited to the state of Tamaulipas. In contrast, the spring-summer cycle is crucial, involving states such as Sonora, Baja California, Chihuahua, Tamaulipas, and the Lagunera Region, which together account for nearly 100% of national production. Most of the cotton is harvested mechanically, with the majority using stripper harvesters, though some farmers prefer picker harvesters.

The recovery of cotton cultivation in Mexico is attributed to significant technological innovations, particularly the adoption of genetically modified seeds and the narrow-row planting system. These advancements have led to reduced phytosanitary control costs, improved water use efficiency, and increased fiber production yields. Despite these improvements in the primary production sector, there are still articulation issues. The textile industry often prefers cotton imported from the United States due to its certified quality and established marketing system (SAGARPA and FAO, 2014).

In the 2018/19 season, a total of 7,216 cotton producers and 69 ginning plants were active (Ruiz, 2019). Fiber yields in Mexico surpass the world average and vary significantly by state, with Chihuahua achieving the highest yields. For the 2017/18 season, the national average fiber yield per hectare is estimated to be around 1,600 kilograms (Ruiz and García, 2018).

According to the International Cotton Advisory Committee (2018), Mexico's fiber production is insufficient to meet the national industry's needs. Approximately 50% of the fiber required by local textile companies is imported, primarily from the United States. Over the past five years, the average annual import of fiber has been around 230,000 tonnes. In contrast, Mexico exports about 35,000 tonnes of fiber annually, with key destinations including China, Vietnam, Indonesia, and Taiwan.

All cotton fiber production in Mexico undergoes HVI analysis and is barcoded, with bales averaging 225 kilograms. Over the last forty years, national fiber consumption has more than doubled, increasing from 165,000 tonnes to approximately 440,000 tonnes. Since 2015, the Federal Government has implemented a comprehensive support strategy for the textile and clothing industry to enhance its competitiveness and address rising competition and imports from countries like China and Vietnam.

Mexico is currently (2024) the twelfth largest cotton fiber producer in the world. Fiber production in the country is in the process of recovery, driven by several factors and contingent on the implementation of effective official measures for the sector.

Among the current and future challenges facing cotton cultivation in Mexico are: 1) reducing production costs, which are often elevated due to the impact of the cotton boll weevil; 2) promoting effective public policies to support producers; 3) incorporating technological innovations into production systems; and 4) improving coordination between the various segments of the cotton supply chain, including both primary production and the industrial sector.

PARAGUAY

Cotton cultivation has played a significant role in Paraguay's history. The Guaraní people, who originally inhabited the region now known as Paraguay, were early adopters of cotton cultivation. They used it to produce yarns and fabrics for making clothing, including "ponchos," hammocks, baskets, bags, and nets for hunting and fishing.

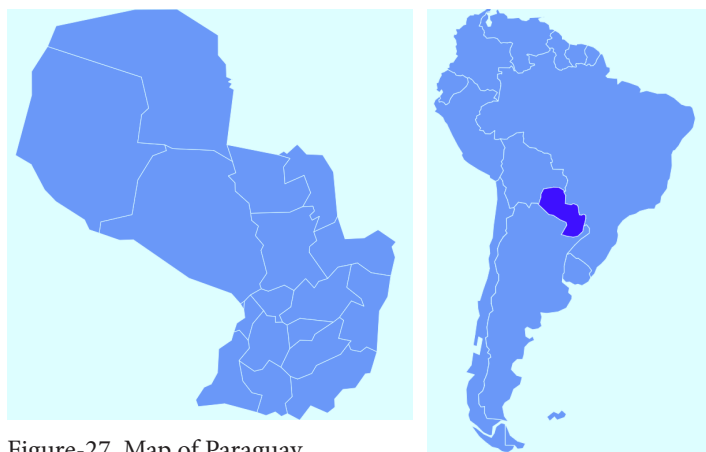


Figure-27. Map of Paraguay

In 1556, cotton emerged as a form of currency in Paraguay. Instead of metal coins, the locals used cotton canvas, measured in sticks, as a medium of exchange. This form of payment, which had been used by the Guaraní before European contact, quickly became the standard currency for commercial transactions throughout the region. During the Triple Alliance War in the mid-1800s, cotton was a highly valued product within the Paraguayan economy (Mora Mérida, 1973).

Considering the significant socio-economic importance of cotton, the Paraguayan National Government launched the Cotton Research and Experimentation Project in 1967, managed by the Directorate of Agricultural Research (DIA). The initiative was designed to plan, execute, and evaluate cotton production with the assistance of CIRAD experts from France, in collaboration with ginning companies, agrochemical importers, and seed companies within the country.

The project encompasses a broad range of activities aimed at generating and disseminating knowledge and technologies. This includes developing new cultivars, improving production practices, and creating communication materials. Key activities are conducted at the National Agronomic Institute (IAN) and various experimental fields such as San Juan Bautista, Choré, Natalicio Talavera, and Tomás R. Pereira, as well as in the primary cotton-growing regions across the country (Álvarez Luís Alberto, 1989).

According to Carvalho and Ruiz (2018), in the late 1980s, Paraguay's cotton area was approximately 530,000 hectares, involving around 200,000 families and producing about 200,000 tonnes of fiber. Currently, only 10,000 hectares are under cultivation, with an average yield of 420 kg/ha and an estimated fiber production of 5,000 tonnes. Key factors contributing to this decline include the substitution

of well-adapted national varieties with poorly adapted imported ones, the impact of boll weevil infestations similar to those affecting neighboring Brazil and Argentina, and fiber contamination due to the use of polypropylene bags in harvesting, exacerbated by a shortage of appropriate machinery.

Among the current and future challenges for the Paraguayan cotton sector are: 1) proposing and implementing public policies that support cotton production among small producers, and 2) adopting production technologies such as adapted seeds, improved machinery, and technical support.

PERU

Cotton has been a significant crop throughout Peru's history. Archaeological evidence indicates that cotton was present in Peru as early as 2,500 BC (Bird and Mahler, 1952). The northwest of the Andes is considered one of the centers of origin for New World cotton (Hutchinson, Silow, and Stephens, 1947).

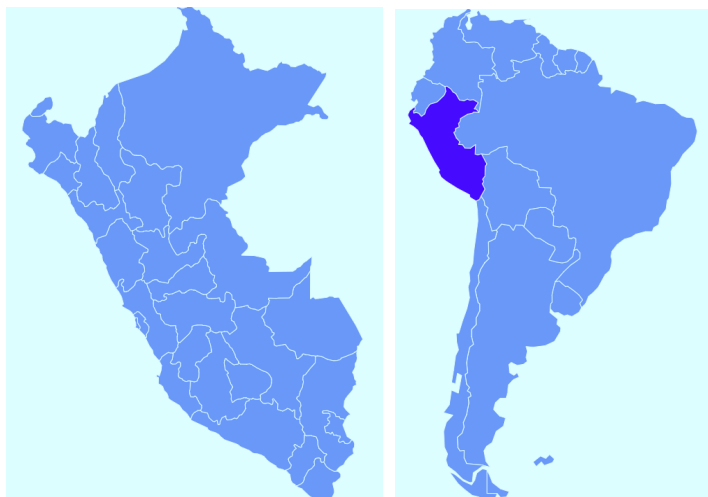


Figure-28. Map of Peru

Hutchinson (1947) suggests that the evolution of cotton species in Peru involves an ancient separation of the original tetraploid cottons into two main groups: South American (*G. barbadense*) and Central American (*G. hirsutum*). These species' primary distribution aligns with the regions where major ancient civilizations developed: the Incas in western South America and the Aztecs and Mayans in Central America.

The Incas cultivated cotton from the *Gossypium barbadense* genus for practical and artistic purposes. Their advanced weaving techniques and the quality of their textiles impressed Spanish conquistadors, although many of these traditional textile techniques were lost during the Spanish conquest of Peru.

Characterization studies suggest that *Gossypium barbadense* originated from the northwest of South America, with notable wild species and high phenological diversity found in this region. Recent research on enzymatic variability supports the hypothesis that the region between northern Peru and southern Ecuador is a probable center of origin for *G.*

barbadense (Smith and Cothren, 1999).

Wild cottons found in northern Tumbes and southern Ecuador are characterized by capsules with small seeds, short fibers, and a strong adherence to the shell, with a high frequency of dressed seeds. These wild varieties are typically associated with xerophytic vegetation near the sea, in coastal zones, and in the Galapagos Islands. They thrive in dry, warm climates and are often found in isolated or small populations far from human settlements (Smith and Cothren, 1999).

In the initial stages of domestication, the focus would have been on harvesting wild plants with spun fibers. Selection for higher fiber yields likely involved choosing plants with larger capsules and seeds, which made fiber ginning easier. The significance of *G. barbadense* lies in the superior quality of its fiber, which is used in specialized high-quality yarns and fabrics.



Figure-29. *Gossypium barbadense*

In the current domesticated species, *Gossypium barbadense* has shown extensive adaptation to diverse ecological niches, often in association with human communities. It thrives in areas near the sea, up to 1,500 meters in elevation in the valleys of the western Andes slopes. In the Amazon, these cottons have adapted to open areas along riverbanks, where high average temperatures and significant rainfall prevail.

Cotton cultivation of *G. barbadense* in Peru was practiced domestically until 1830. Between 1831 and 1874, the focus shifted towards commercial production for export. By the late 19th century, native cottons were largely replaced by introduced varieties. At the beginning of the 20th century, the cultivation of improved varieties such as "Tangüis" and "Pima" became significant in Peru's economic development (Eguren and Fernández, 1981). In 1862, approximately 154 tonnes of cotton were exported to Liverpool. From the late 19th century until the 1960s-70s, Peru was one of the leading cotton producers in South America, following Brazil and Colombia.

The initial selection of commercial varieties of *Gossypium barbadense* began in the 18th century in the United States (Carolina and Georgia), stemming from semi-domesticated cottons introduced from the Antilles. These early selection efforts led to the development of fine-fiber cottons. The Sea Island variety, resulting from these initial selections, was noted for its high fiber quality but had low yields and fiber percentages. In 1820, through crosses with Jumel cotton (of Peruvian origin), the first Egyptian varieties were developed (including Ashmouni, Mit Afifi, and Sakel, between 1868 and 1900). These varieties exhibited characteristics similar to perennial cottons, such as late flowering cycles. From the early

20th century onward, varieties with significantly improved fiber quality were developed in the United States (Yuma and Pima) and in Egypt (Giza and Karnak). These improvements included better fiber length, uniformity, toughness, and fineness, forming the basis for the long and extra-long fiber cotton group (Hutchinson, Silow, and Stephens, 1947).

Gossypium barbadense was named Pima cotton after the Pima Native Americans who first cultivated this cotton species in the United States. Many of the Pima people worked on an experimental farm established by the United States Department of Agriculture (USDA) in Sacaton, Arizona, in the early 1900s.

Gossypium barbadense, or Pima cotton, is classified as extra-long staple (ELS) cotton. The fibers of Pima cotton can be more than twice the length of standard cotton fibers, which imparts unique and desirable qualities. The combination of softness, strength, and durability has established Pima cotton as a luxury fiber on the global stage. Peruvian harvesting techniques also enhance the final product's quality. Although modernization has impacted the cotton growing process in Peru, many Peruvian Pima plantations still use manual harvesting methods. This traditional approach leads to fewer thread imperfections and a smoother finish.

Beginning in 1926, Peru focused on improving the “Tangüis” variety for better tolerance to pests and soil diseases (such as nematodes and *Verticillium* wilt), increased yield (including fiber percentage, capsule weight, and fiber indices), and enhanced fiber quality (particularly length and color) (Hutchinson, Silow, and Stephens, 1947). Both the “Tangüis” and “Pima” varieties on the coast and the “Aspero” variety in the northeast have been cultivated since the early 20th century. Current selection efforts aim at earlier maturity, photoperiod neutrality, and improved fiber quality.

The Pima quality of cotton from Peru belongs to the long and extra-long fiber group. It is cultivated in a desert region in northern Peru, within an area of about 40 km that features a microclimate ideal for producing one of the world's finest cottons, known for its exceptional fiber length and maturity. This cotton is primarily used for knitted fabrics, hosiery, and blends with wool in fabric production.

Today, Peruvian Pima cotton is mainly grown in the coastal valleys of northern Piura and Chira, continuing a tradition that spans thousands of years. The unique combination of seed, soil, and microclimate has established Peruvian Pima cotton as one of the finest and longest fibers globally, comparable only to Egyptian cotton. The fibers reach full maturity during a collection period of 4 to 6 weeks, with 3 to 4 manual harvests carried out by migrant workers who travel from the southern highlands of Peru to the coastal valleys, including Cañete Valley.

Cotton cultivation in Peru has declined from an average of 220,000 hectares in the 1960s to around 74,747 hectares in the 2000s. Despite being declared a national priority by the Peruvian government in 2012, the cotton area remains below its historical average of 130,000 hectares (Carvalho and Ruiz,

2018). Field yields have fluctuated between 390 and 980 kilograms per hectare, and national fiber production is at its second-lowest level in the last five seasons. This decline in national production has led to an increase in fiber imports from the United States, which now account for 70% of national consumption, estimated at 60,000 tonnes (Carvalho and Ruiz, 2018).

Among the current and future challenges facing Peruvian cotton are advancing the genetic improvement of available varieties to enhance yield potential and competitiveness with other major crops in the country, such as corn, rice, and sugar cane. Additionally, it is essential to develop public policies that support the cotton sector and provide targeted assistance to producers through financing and technical advice.

VENEZUELA

Throughout contemporary history, cotton cultivation in Venezuela has primarily been characterized by the country's role as an importer of textile fibers, reflecting a relatively small and underdeveloped textile industry.

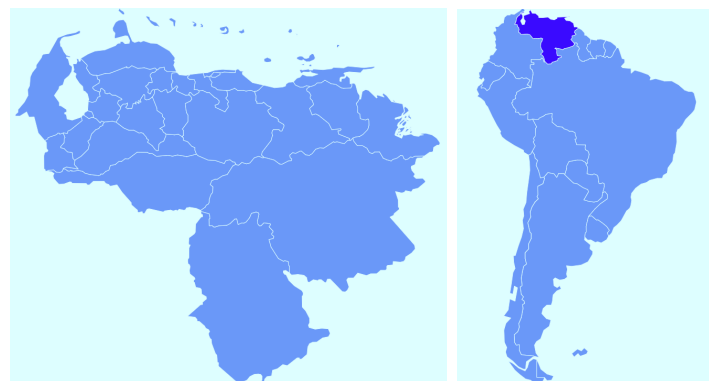


Figure-30. Map of Venezuela

In the 1980s, commonly used cultivars included Del Cero, Central, and Cabuyare, known for their long fibers. In the 1990s, varieties such as Delta Pine 16 (medium fiber), Delta Pine Acala 90 (medium-long fiber), and Stroman 254 (long fiber) were introduced. By 2010, the most prevalent varieties were Delta Pine 16 (DP16), FA90, SN290, Unellez, and a common material called “Llanera,” all medium fiber types that lacked adaptability testing for local climatic conditions. Recent cotton plantings in Venezuela have primarily occurred in the flood zones of the Orinoco River and its branches, particularly in southern Guárico state (Navarro et al., 2010).

The cotton planting system in Venezuela is mechanized, with technological advancements dating back to 1949. This progress was facilitated by the development of uniform growth varieties and government efforts to supply the sector with appropriate machinery for mechanized planting and harvesting (León Díaz, 1980).

In the 1990s, the opening of raw material and fabric imports from China and India negatively impacted the domestic

market and cotton cultivation. Between 2003 and 2008, a lack of coordination between the state and the private sector led to the closure of many spinning mills.

Comparing historical data, the harvested cotton area of 37,191 hectares in 1998 has dramatically decreased, with only 10,446 hectares harvested by 2010, and a continued decline to the present day.

The main challenge for Venezuela is to implement policies that enhance the competitiveness of cotton cultivation and domestic processing, alongside incorporating modern technologies.



Figure-31. A ginning factory (Photo: Lorena Ruiz)

General current situation, trends, and future challenges of cotton in latin america and the caribbean

Cotton has a rich history across the American continent, with varying degrees of importance in different regions. In some areas, cotton has lost prominence, while in others, it continues to drive economic processes and regional development.

According to the ICAC and the Food and Agriculture Organization (FAO), the cotton sector in Latin America and the Caribbean has demonstrated stability over the past decade. The cotton area has remained steady at around 1.5 million hectares, with an average fiber production of approximately 1.8 million tonnes. The region's average fiber yield stands at 1,200 kg/ha, which is 35% higher than the estimated global average of 780 kg/ha for the 2018/19 season (Carvalho and Ruiz, 2018).

Textile industry consumption of fiber in the region has been around 1.4 million tonnes in recent years. Exports, predominantly driven by Argentina and Brazil, account for 96% of the region's cotton fiber exports. Over the past 20 years, regional exports have doubled, increasing from an average of 350,000 tonnes in 1998/99 to 760,000 tonnes in 2018/19 (Carvalho and Ruiz, 2018).

Major Challenges for Achieving Competitive and Sustainable Cotton Production in Latin America and the Caribbean

1. **Public and Sectoral Policies:** Develop and implement targeted public policies that support agricultural producers across all scales, including small, medium, and large operations. These policies should cover access to credit, tax reductions, agricultural insurance, minimum prices, and financing for machinery (planters, harvesters, sprayers). Legislation on seed use and multiplication is also crucial.
2. **Organizing Cotton Clusters:** Establish sectoral organizations to unite cotton clusters within each country. These organizations should advocate for the interests of the entire cotton value chain, including primary production, processing, industrialization, and textile manufacturing.
3. **Research and Development Networks:** Foster research and development collaborations between producer and consumer countries. This should involve creating information exchange platforms, providing training, and advancing technological innovations.
4. **Sustainability Indicators:** Integrate environmental, social, and economic sustainability indicators into the cotton sector. This includes implementing models, surveys, and pilot tests to gather statistical data and inform policy discussions.
5. **Good Agricultural Practices:** Adjust production systems to include good agricultural practices such as soil management and conservation, integrated pest management, and proper use of biotechnologically improved seeds.
6. **Local Germplasm Development:** Promote the development and adaptation of local germplasm for each country and region. Facilitate the exchange of genotypes between countries in Latin America and other continents to enhance genetic improvement, yield, fiber quality, and ecological adaptability.
7. **Market Niches and Value Addition:** Identify and develop market niches and production approaches, such as organic cotton, agroecological cotton, colored cotton, artisan fabrics, and value addition at origin. Implement traceability systems to track cotton from the field to the finished garment.



Figure-32. Cotton field (Photo: Lorena Ruiz)



Figure-33. Field training session (Photo: Marcelo Paytas)



Figure-34. Setting up pivot irrigation (Photo: Lorena Ruiz)

CONCLUSION

Cotton cultivation in Latin America and the Caribbean has demonstrated a rich historical significance and varying levels of importance across different countries. From the ancient uses of cotton by the Guarani in Paraguay to the prominence of Peruvian Pima cotton and the evolution of Mexican cotton production, the region's cotton industry has faced numerous challenges and advancements. Despite historical highs and lows, current trends show a stable area under cultivation and increasing fiber production, though still below consumption needs. Major challenges moving forward include the need for targeted public policies to support producers, the organization of sectoral clusters, and the establishment of research and development networks. Emphasis on sustainability, good agricultural practices, and local germplasm development are crucial for enhancing competitiveness. Identifying market niches and adding value at origin will further contribute to the sector's growth. Addressing these challenges through coordinated efforts and innovations will be key to achieving a sustainable and competitive cotton industry in Latin America and the Caribbean.

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Competitive Advantages of the Latin America and the Caribbean Region in Cotton Production and Processing

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Ms. Lorena Ruiz

Ms. Lorena Ruiz has more than 20 years of experience in the cotton sector. She has a deep understanding of cotton market dynamics and human elements behind the statistics, having worked extensively in the field with cotton growers. Lorena has held the position of economist at the International Cotton Advisory Committee since July 2014, where her primary responsibilities are projecting global and regional textile fibre demand; analysing current policy and trade issues across re-

gions and products involving fibres, textiles and apparel; estimating government support to the cotton sector; tracking trade data on cotton, yarn and fabric; and analysing factors affecting world cotton prices. Lorena also serves as a coordinator of the ICAC's Expert Panel on Social, Environmental and Economic Sustainability of Cotton Production. Before joining the ICAC, she worked as statistician and then as economist at the cotton growers association in Colombia.

Historical Background and Current Situation

The Latin America and Caribbean (LAC) region has a rich agricultural history, with cotton playing a key role in its economic development. Indigenous populations cultivated and utilized cotton long before European colonization. Over the years, the region transitioned from traditional methods to modern agricultural practices, becoming a significant player in the global cotton market.



Figure-1 Latin America

Today, cotton remains vital for many LAC countries, significantly contributing to their economies. However, the region faces various challenges and opportunities in both cotton production and processing.

Until the late 1980s, cotton area in the LATAM region accounted for about 15% of

the total world area. By the early 2000s, this share had dramatically declined to just 4%. Several factors contributed to this decline, including shifting agricultural policies, increased pest incidence, a lack of research and development, competition from other crops, limited seed availability, and higher production costs.

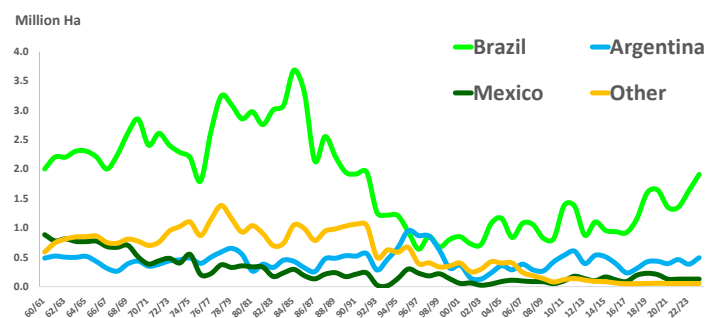


Figure-2. Cotton area in the LAC region

Despite this decline, recent years have seen a historic high in cotton production in the LAC region, reaching 4.2 million tons in the 2023/24 season, primarily driven by Brazil. Brazil has achieved an impressive fiber production yield of 1,845 kg/ha, which is more than double the global average of 770 kg/ha.

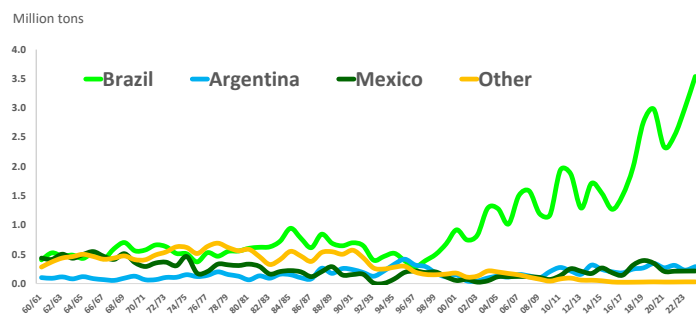


Figure-3. Cotton production in the LAC region

In terms of domestic cotton demand, the LAC region has reduced its cotton mill use by 30% since its peak of 1.9 million tons in the 2006/07 season. Brazil and Mexico remain the primary consumers, accounting for 50% and 24% of total mill use, respectively. Additionally, cotton imports have significantly decreased, falling by over 60% over the past 25 years to just 360,000 tons. This decline is driven by reduced domestic consumption and intense competition from imported products from Asia.

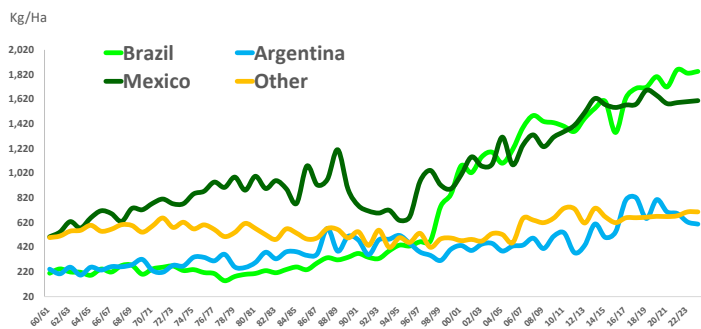


Figure-4. Cotton lint productivity in the LAC region

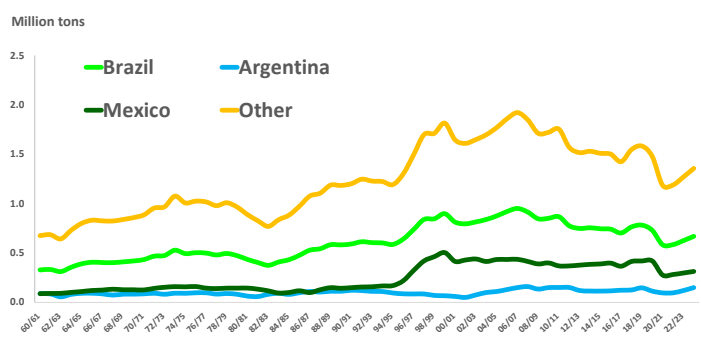


Figure-5. Cotton mill use in the LAC region

Textile and Apparel Imports from LAC Countries

The LAC region's textile and apparel imports have seen a steady rise, growing from \$18.4 billion in 2004 to \$50.1 billion in 2022. The COVID-19 pandemic caused a significant dip in 2020, with imports falling to \$30.6 billion. However, the market rebounded strongly in 2021, reaching \$39.4 billion, and continued to grow in 2022. The market share of apparel imports in the region increased from approximately 30% in 2004/05 to 40% in 2022. Mexico leads the region's imports of textile and apparel products, accounting for 27% of the total, followed by Brazil at 12%, Chile at 9%, Honduras at 7%, and Colombia at 6%.

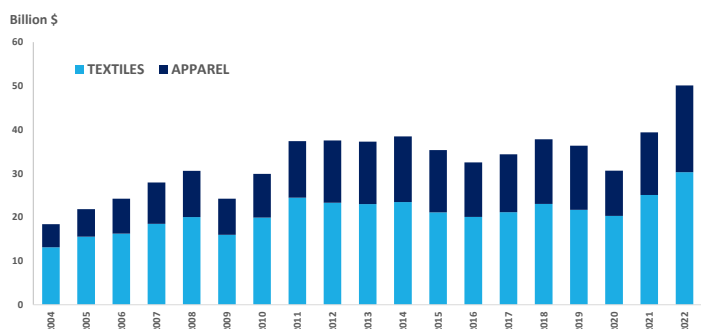


Figure-6. Cotton mill use in the LAC region

In 2022, the main exporters of textile and apparel products to the LAC region were China (39%), the USA (18%), India (5%), and Bangladesh (3%). Over the last two decades, China has significantly increased its market share from 12% in 2004 to 39% in 2022. Asian countries, particularly China and India, dominate the global textile and apparel industry due to their cost-effective manufacturing capabilities and advanced

technologies. These countries export large volumes of finished textile and apparel products to the LAC region, creating stiff competition for local industries. The scale and variety of Asian products make it challenging for LAC manufacturers to compete on price and diversity.

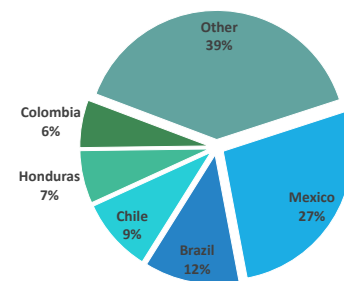


Figure-7. Textile and Apparel: Major importers in the LAC region - 2022

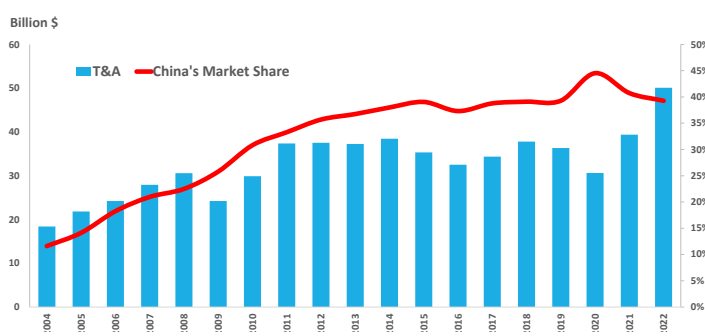


Figure-8. Textile and Apparel imports from LAC countries

Competitive Advantages of LAC in Cotton Production and Processing

Despite the increase in textile and apparel (T&A) imports from Asian countries, the LAC region maintains several competitive advantages that bolster its position in the global market. Among these competitive advantages are:

Favorable Climate

- One of the primary advantages of the LAC region is its favorable climate for cotton cultivation. Countries like Brazil, Mexico, Argentina, Colombia and Peru have regions with ideal growing conditions, including warm temperatures, ample sunlight, and suitable rainfall patterns.

Cost-Effective Labor

- Many LAC countries benefit from a labor force that is both abundant and cost-effective. This lowers production costs, making cotton production and processing more affordable compared to developed countries.

Proximity to Major Markets

- Geographically, the LAC region is strategically positioned near major consumer markets, especially the United States. This proximity reduces transportation costs and delivery times, making LAC cotton and textile products more attractive to international buyers who prioritize speed and cost-efficiency in their supply chains.

Growing Textile Industry

- The textile and apparel industries in the LAC region are expanding, driven by increased export opportunities and domestic demand. Countries like Mexico have developed robust textile sectors capable of processing raw cotton into various finished products.

Trade Agreements

- Many LAC countries benefit from trade agreements with major markets, such as the United States-Mexico-Canada Agreement (USMCA) and various agreements with the European Union. These agreements often provide preferential access to key markets, reducing tariffs and other barriers to trade, which enhances the competitiveness of LAC T&A exports.



Figure-9. Cotton bales for export in the LAC region

Success Stories in LAC's Textile & Apparel Industry

The LAC region has become a thriving hub for the textile and apparel industry, with many success stories showcasing its potential. These examples highlight how LAC countries leverage their unique strengths to achieve significant growth and global recognition.



Brazil's Cotton Boom

Brazil has transformed its cotton industry through significant investments in technology, research, and sustainable practices. The Brazilian Cotton Growers Association (ABRAPA) has played a pivotal role, leading to improved yields and higher quality cotton. Brazil's cotton exports have increased from 339,000 tons in 2004/05 to a projected 2.5 million tons in 2023/24.

Colombia: A Rising Star in Fashion

Colombia's fashion industry has experienced significant growth, driven by a combination of skilled labor, high-quality raw materials, and strategic promotional campaigns. By focusing on niche markets such as lingerie and swimwear, Colombian companies have gained a unique space in the global fashion scene.

Honduras' Textile Industry Growth

The establishment of industrial parks and the growth of apparel exports to the US market have created jobs and boosted the country's economy. The country's focus on improving labor conditions and sustainability has also attracted international buyers and investors.

Mexico: A Key Player in Apparel Manufacturing

Mexico's proximity to the United States, coupled with favorable trade agreements such as the United States-Mexico-Canada Agreement has positioned it as a crucial player in the apparel manufacturing industry. Mexico's skilled workforce and modern production facilities further boost its competitiveness.

Challenges Facing LAC's Cotton Industry

Nevertheless, the textile and apparel industry in the region faces numerous challenges, including the cost of doing business, market access, supply chain disruptions, and lack of governmental support. Additionally, the



industry struggles with smuggling and the increase of undervalued Asian products. While some of these issues are specific to certain countries, several global challenges, such as sustainability and traceability, affect the region's textile and apparel industry as a whole. Addressing these challenges is crucial for the industry to maximize its potential and maintain competitiveness on the global stage.

Infrastructure Limitations

One of the most significant challenges is inadequate infrastructure. Many LAC countries face issues with outdated or insufficient transportation networks, storage facilities, and textile manufacturing facilities. Poor infrastructure can hinder the efficient movement of raw materials and finished goods, increase production costs, and cause delays. To overcome this, substantial investments are needed to upgrade transportation networks, build modern storage facilities, and improve processing capabilities.

Technological Gaps

Limited access to advanced agricultural technologies and modern textile processing equipment is another major challenge. Many producers in the LAC region still rely on traditional methods, which can be less efficient and result in lower quality products. Investing in modern technologies, such as precision agriculture, automated machinery, and advanced textile manufacturing techniques, is essential. These technologies can enhance productivity, improve product quality, and reduce costs, helping LAC farmers and textile and apparel producers compete more effectively with their global counterparts.

New Environmental Policies

As important textile and apparel markets like Europe develop new environmental regulations and policies, the LAC region must adapt to these changing requirements. Compliance with stringent environmental standards can be costly and challenging, especially for smaller producers and SMEs. However, adopting eco-friendly practices and obtaining sustainable certifications are critical for the long-term viability of the industry.

Imports of Second-Hand Clothing

The surge of second-hand clothing into the LAC region from developed countries presents a challenge to the local textile industry. Imports of second-hand clothing have more than doubled in the last decade, rising from \$239 million in 2013 to nearly \$600 million in 2022. Affordable second-hand garments can undermine demand for locally produced textiles, affecting local manufacturers and employment.

CONCLUSION

Latin America and the Caribbean region hold significant potential in cotton production and processing. Understanding the competition from US cotton exports and Asian textile and apparel products, along with the impact of second-hand clothing imports, is crucial for developing strategies that support the growth and sustainability of the cotton and textile industries in the region. With targeted investments and strategic policies, Latin America and the Caribbean can build a robust and competitive cotton value chain that benefits both producers and manufacturers.

The Ninth Asian Cotton Research and Development Network Meeting (ACRDN)

Sundaramoorthy Chandrasekaran

Principal Scientist (Agricultural Economics)

ICAR-Central Institute for Research on Cotton Technology

Adenwala Rd, Matunga East, Mumbai, Maharashtra 400019, India



Dr. C. Sundaramoorthy

Dr. Sundaramoorthy, C is Serving in the Agricultural Research Service (ARS) of Indian Council of Agricultural Research (ICAR), India since 2003. Presently working in the capacity of Principal Scientist (Agricultural Economics), at ICAR-Central Institute for Research on Cotton Technology, Mumbai. Has more than 20 years of research experience in the field of post-harvest processing and value addition of cotton and its by-products working in individual capacity

as well as in a team comprising multi-disciplinary scientists. Has international exposure of working for development of Cotton based development activity and capacity building in selected African Countries under Cotton Technical Assistance Programme of Government of India and also in association with UNCTAD. He is recipient of Young Scientist Award (ISCI), Team Award (ISAE), and Letter of Merit from UNCTAD among others for his contribution.

INTRODUCTION

The Ninth Asian Cotton Research and Development Network Meeting (ACRDN) took place at the ICAR-Central Institute for Research on Cotton Technology in Mumbai, India, from December 6 to 8, 2023, with the theme, "Innovations for Resilient and Sustainable Cotton Production and Viable Value Chain." Organized by the Indian Society for Cotton Improvement (ISCI), International Cotton Advisory Committee (ICAC), ICAR-Central Institute for Research on Cotton Technology (ICAR-CIRCOT), ICAR-Central Institute for Cotton Research (ICAR-CICR), and Indian Fibre Society (IFS), the event brought together stakeholders from across the globe.

The ISCI, Mumbai, spearheaded the organization of the conference in collaboration with key entities like the ICAC from Washington, DC, USA, and local research institutes including ICAR-CIRCOT and ICAR-CICR. Notably, the Ninth ACRDN conference coincided with the centenary celebrations of ICAR-CIRCOT and the golden jubilee of ISCI, enhancing the significance and grandeur of the event. Held in the vibrant city of Mumbai, Maharashtra, India, the conference aimed to foster collaboration, innovation, and knowledge exchange in the realm of cotton research and development.

Throughout the three-day event, attendees from various countries and institutions engaged in discussions, presentations, and workshops focused on advancing cotton production practices and ensuring a sustainable value chain. The convergence of esteemed organizations and experts underscored the collective commitment towards addressing challenges and harnessing opportunities for the cotton sector's growth and resilience.

Approximately 218 registered participants attended the 9th ACRDN Meeting and International Conference. Researchers and experts from India, Bangladesh, Iran, Egypt, France, Australia, Turkey, Uzbekistan, and the USA were among the attendees. The participants comprised researchers from public and private institutions, government officials, stakeholders from trade and industry, startups, and students.

Four plenary sessions, two special sessions, fourteen concurrent technical sessions, and two poster sessions were organized during the three-day meeting. A total of ten plenary lectures and four special lectures, which include the Dr. B.R. Barwale Memorial Lecture and the Suresh Kotak International Lectures, were organized. A total of 160 abstracts were received for the conference, 108 for oral presentations, and 52 for poster presentations.

INAUGURAL SESSION

Dr. S. K. Shukla, Director, ICAR-CIRCOT, Mumbai, welcomed the esteemed gathering and outlined the major achievements of the institute. Notable accomplishments included the establishment of various basic properties of cotton fibers and their testing protocols, modernization of ginning industries, application of nanotechnology for value addition to cotton textiles, natural dyes & eco-friendly dyeing techniques for cotton, improved cotton ginning machinery, and value addition to cotton biomass and byproducts.

Dr. Himanshu Pathak, Director General (Indian Council for Agricultural Research), New Delhi, inaugurated the 9th ACRDN Meeting and the International Conference on December 6, 2023. The event was hosted by ICAR-Central Institute for Research on Cotton Technology (ICAR-CIRCOT), Mumbai, in commemoration of its centenary year celebration. In his presidential address, Dr. Pathak highlighted the challenges faced by the cotton value chain and emphasized

the importance of partnerships among public institutions, private organizations, peasants, and policymakers to have a lasting impact on agriculture in general and the cotton sector in particular.

Mr. Eric Trachtenberg, Executive Director, ICAC, Washington DC, USA, briefed the gathering about ICAC's diverse activities, including knowledge sharing, innovation, partnerships, and providing a forum for discussion on cotton issues of international significance for the benefit of the entire cotton community.

Ms. Roop Rashi, Textile Commissioner, Ministry of Textiles, Government of India, expressed gratitude to all cotton scientists for strengthening the cotton value chain and emphasized the need for improvement in efficiency and sustainability.

Dr. C. D. Mayee, President, Indian Society for Cotton Improvement (ISCI) & Former ASRB Chairman, elaborated on the need to address various issues related to cotton cultivation. He assured the textile industries that the supply of cotton would be assured due to the adoption of efficient water management systems, integrated pest management for pink bollworm and whiteflies in cotton, high-density planting systems, and other agronomic techniques required to enhance cotton yield.

Dr. P. G. Patil, Vice-Chancellor, MPKV, Rahuri, mentioned that this is an auspicious occasion as it marks the confluence of three major events: the centenary year of ICAR-CIRCOT, Mumbai; the golden jubilee year of ISCI, Mumbai; and the inauguration of the 9th ACRDN meeting. He encouraged researchers to focus on the latest developments like efficient ginning systems, tracer fibers for cotton, and sustainability practices in cotton cultivation and processing.

Dr. S. N. Jha, Dy Director General (Agri Engg), ICAR, New Delhi, emphasized the need to have a joint project to develop cotton varieties suitable for mechanized harvesting. Also, he stressed the importance of educating farmers about carbon-positive agriculture and the effect of carbon emission on the environment.

Shri. Suresh Kotak, Chairman, Kotak Group of Companies & Chairman of Textile Advisory Group (TAG), applauded the continuous efforts of scientists of the institute in carrying out cutting-edge research in the field of cotton technology. He considered the 9th ACRDN meeting as an accelerator for the ideas coming out of the 81st Plenary meeting of ICAC. He also mentioned that the textile value chain has to be integrated backward till the farm level so that all stakeholders of cotton get benefited. He urged scientists to work in a collaborative mode for better and faster outcomes in advanced research areas.

Innovative farmers, eminent researchers, and faculty were awarded ICAR-CIRCOT awards, ISCI awards, and Honorary fellowship of ISCI. Dr. A.J. Shaikh, Chairman, ISCI, Dr. R.P. Nachane, President IFS, Dr. Keshav Kranti, Chief Scientist, ICAC, Dr. Mohamed Negm, Chairman ICRA, and Dr. Y. G. Prasad, Director, ICAR-CICR, Nagpur, shared the dais.

PUBLICATIONS RELEASED

During the inaugural session, seven publications were released, and the technology of the Pre-grooved Leather Roller was unveiled. The publications included "Century of Research at ICAR-CIRCOT," "ICAR-CIRCOT: Promising Technologies and Consultancies," "Souvenir of 9th ACRDN Meeting & International Conference," "Book of Abstracts—9th ACRDN Meeting & International Conference," a special issue of the "Cotton Research Journal," "Technology Leaflet: Deep-Grooved Leather Roller," and the "SMART Resource Manual."

AWARDS

The contributions of scientists, farmers, startups, and industrial stakeholders were recognized by bestowing them with awards (5 ICAR-CIRCOT Awards, 6 ISCI Awards) and honorary fellowships (16 Honorary ISCI fellowships).

ICAR-CIRCOT Awards

Several awards were presented to honor outstanding contributions in various fields. The Best Industrial Collaborator Award was given to Dr. M.K. Sharma, CEO, and Whole-Time Director of Bajaj Steel Industries Limited, Nagpur. The Best Start-up Award was awarded to Dr. Santhosh Sahane, CEO of Forecast Agrotech Innovations, Pune. Shri K.G. Bhat, Proprietor of Precision Tooling Engineers, Nagpur, received the Best Technology Licensee Award. The Best Extension Support Award went to Mr. G.H. Wairale, former General Manager of Mahocot. Lastly, the Best Cotton Farmer Award was presented to Shri Amrutrav Deshmukh.



Dr MK Sharma receiving the Award



Dr Santosh Sahane receiving the Award



Dr Wairale receiving the Award



Mr KG Bhatt receiving the Award

ISCI Awards

Several prestigious awards were presented to honor exceptional contributions in cotton science and agriculture. The Suresh Kotak Global Outstanding Cotton Scientist Award was bestowed upon Dr. Keshav Kranthi, Chief Scientist at the International Cotton Advisory Committee (ICAC) in Washington, D.C. Dr. Dharminder Pathak, Professor at Punjab Agricultural University, Ludhiana, received the Dr. Rao Bahadur Ramanatha Iyer Award. The Prof. R.H. Dastur Award was awarded to Dr. M.V. Venugopalan, former Principal Scientist at ICAR-CICR, Nagpur. The A.B. Joshi Young Scientist Award went to Dr. C. Sundaramoorthy, Principal Scientist at ICAR-CIRCOT, Mumbai. Shri Suresh Kotak, Chairman of the Textile Advisory Group (TAG) under the Ministry of Textiles, was honored with the Cotton Man of India Award. Lastly, the Krishi Maharshi Samman was presented to Dr. C.D. Mayee, President of the Indian Society for Cotton Improvement (ISCI).

Award of Honorary Fellowships of ISCI

A group of distinguished experts was acknowledged for their significant contributions in various domains of cotton research and technology. Dr. B.M. Khadi was recognized for his work in cotton breeding, while Dr. Sandhya Kranthi was honored for her expertise in crop pest management. Dr. V. Kumar contributed notably to cotton physiology, and Dr. K.R. Krishna Iyer made advancements in cotton technology. In the field of fiber physics, both Dr. S. Sreenivasan and Dr. R.P. Nachane were acknowledged for their valuable research. Dr. P.G. Patil was recognized for his work in cotton ginning, while Dr. R.H. Balasubramanya, along with Dr. A.J. Shaikh, was honored for their contributions to cotton by-products. Dr. G.R. Anap made significant strides in ginning and pressing, while Dr. Muntazir Ahmed was acknowledged for his expertise in cotton spinning and knitting. Dr. T.P. Rajendran was recognized for his work in crop protection, and Dr. P.K. Chakravarty for advancements in biotechnology. Dr. M.S. Kairon contributed to the field of agronomy. Additionally, Shri G. Chandrasekaran was acknowledged as a cotton commodity expert, and Shri Shirish Shah for his expertise in the cotton value chain.



Shri Suresh Kotak receiving the Award



Dr CD Mayee receiving the Award



Dr BM Khadi receiving the Award



Dr V Kumar receiving the Award



Dr KR Kranthi receiving the Award



Dr Dharminder Pathak receiving the Award



Dr S Sreenivasan receiving the Award



Dr PG Patil receiving the Award



Dr C Sundaramoorthy receiving the Award



Dr MV Venugopalan receiving the Award



Dr Balasubramanya receiving the Award



Dr RP Nachane receiving the Award

Award of Honorary Fellowships of ISCI



Dr AJ Shaikh receiving the Award



Dr Muntazir Ahmed receiving the Award



Dr TP Rajendran receiving the Award



Dr PK Chakraborty receiving the Award



Dr MS Kairon receiving the Award



Dr Sandhya Kranthi receiving the Award



Mr Chandrasekharan receiving the Award



Mr Shirish Shah receiving the Award

The Chief Guest also inaugurated the exhibition displaying the products of the sponsors and the startups working in the domain of the cotton value chain.

PLENARY SESSIONS

First plenary session:

The session was chaired by Dr. Himanshu Pathak, Director General of ICAR, with Mr. Eric Trachtenberg, Executive Director of ICAC in Washington, serving as Co-Chair. Four plenary speakers presented during the session. Dr. Michael Bange, Commercial Research Manager at CSDL, Australia, discussed an integrated approach to improve and sustain the cotton production system. Dr. Fakhre Alam Ibne Tabib, Executive Director of the Cotton Development Board in Bangladesh, highlighted sustainability issues in cotton value chain development and utilization. Dr. S.N. Jha, Deputy Director-General (Agricultural Engineering) at ICAR, elucidated the issues and prospects of mechanizing cotton cultivation in India, emphasizing the need for suitable processing systems for mechanically harvested cotton. Lastly, Dr. S.K. Chaudhari, Deputy Director-General (Natural Resource Management) at ICAR, focused on research and policy imperatives for adapting to climate change in cotton and other field crops, sharing insights from the National Initiative on Climate Resilient Agriculture (NICRA).



Dr Michael Bange felicitated



Dr Fakre Alam Tabib felicitated



Dr SN Jha delivering the lecture



Dr SK Chaudhary delivering the lecture

Second plenary session:

The second plenary session was chaired by Dr. K.R. Kranti, Chief Scientist at ICAC, and co-chaired by Dr. Y.G. Prasad, Director of the ICAR-Central Institute for Cotton Research in Nagpur. Two plenary lectures were presented during this session. Dr. Dharminder Pathak, Professor at Punjab Agricultural University, presented on behalf of Dr. Vasu Kuraparthi, Professor at North Carolina State University, USA, a paper on new breeding tools for harnessing the genetic po-

tential in cotton. Dr. Marc Giband, a Research Scientist at CIRAD in France, emphasized the challenges in breeding for resilience in cotton during his presentation.



Dr Dharminder Pathak and Dr Marc Giband felicitated as speakers of the plenary session



Dr Meghparajulee felicitated

Dr Mohamed Negm felicitated

Third Plenary Session:

The third plenary session was chaired by Dr. C.D. Mayee, President of ISCI, and co-chaired by Dr. Y.G. Prasad, Director of the ICAR-Central Institute for Cotton Research in Nagpur. Two plenary lectures were presented during this session. Dr. Megha Parajulee, Regents Fellow at Texas A&M University, USA, covered the history of integrated pest management of cotton in the United States and discussed the livelihood and technological advancements in this domain. Dr. Mohamed Negm, Chairman of ICRA and Head of the Spinning Research Department at the Cotton Research Institute in Egypt, elaborated on the impact of climate change associated with the processing of cotton fabrics.



Dr Mirzakamol Ayubov receiving the ICRA Young Scientist Award from Dr CD Mayee

Fourth Plenary Session:

Two plenary lectures were presented during this session. Dr. K.R. Kranthi, Chief Scientist at ICAC, elaborated on the “Hate Stories of Cotton,” focusing specifically on the greenhouse gas (GHG) emissions associated with the cotton value chain. Dr. Ayubov Mirzakamol, Deputy Director of the Center of Genomics and Bioinformatics at the Academy of Sciences of Uzbekistan, discussed modern genomic technologies for improving fiber quality in upland cotton.

ICRA YOUNG SCIENTIST AWARDS 2023

Dr Mirzakamol Ayubov and Dr Tehseen Azhar received the ICRA Young scientist Awards

SPECIAL LECTURES

Several special lectures were presented by distinguished speakers during the session. Dr. Ram Kaundinya, Director-General of the Federation of Seed Industries in India, delivered the Dr. B.M. Barwale Memorial Lecture, in which he elucidated the agenda for cottonseed research in the current decade. Shri Dashrath Thambale, Director of Agriculture (ATMA), shared his experiences on the cotton value chain initiatives in the Maharashtra State. The Suresh Kotak International Lectures were delivered by Dr. Bhagirath Choudhary, who discussed field-level scientific approaches to improve the cotton production system in India, highlighting a case study of Project Bandhan, and Dr. Mohamed Negm, who spoke on cotton fabrics and climate change.



Shri Dashrath Thambale and Dr Ram Kaundinya delivered special lectures



Dr Mohamd Negm and Dr Bhagirath Chaudhary delivered special lectures

CONCURRENT TECHNICAL SESSIONS

A total of 14 concurrent technical sessions were organized across seven thematic areas during the conference. These thematic areas, which also included poster sessions, were:

1. Best Management Practices (BMP) for climate resilience, soil health, and sustainable cotton production.
2. Advances in cotton genetic improvement, molecular biology, biotechnology, and genomics.
3. The changing pest and disease scenario in the cotton agro-ecosystem.
4. Precision cotton farming, mechanization, sensors, AI, IoT, and robotics.
5. Ginning, spinning, fiber processing, and textile technologies.
6. Cotton by-product utilization, value addition, and the circular economy.
7. Innovations in cotton trade, testing, traceability, technology transfer, and socio-economics.

Over the course of the three-day conference, 90 oral presentations were delivered.

POSTER SESSION

Two poster sessions were organized under the seven thematic areas. During the conference, 38 posters were presented. Under the poster presentation category, six posters were bestowed with the best poster award.

RECOMMENDATIONS

Plenary Sessions:

- Overcoming the capital intensiveness of mechanization is crucial, and adopting a fractional ownership model may help de-risk the intensive capital investment for complete mechanization.
- Promote academic and scientific exchange on climate-resilient cotton production among national and international institutions.
- Focus research on enhancing resource use efficiencies, breeding for multiple stress tolerance, and deploying cutting-edge tools for trait discovery to achieve climate-resilient cotton production.
- Harness the interaction of genetics, environment, and management to achieve higher yields.
- Introduce a pilot carbon credit initiative in cotton.
- Conduct “seed to shirt studies” to ensure desired fiber quality across the value chain.
- Adopt a multidisciplinary approach to overcome disjointed efforts in varietal development and mechanization.
- Embrace new digital technologies to improve input use efficiencies and decision-making processes.
- Implement adaptation strategies like climate-adaptive intercropping practices and the Nutrient Expert system for smart nutrient management.
- Bridge genomics with breeding and genetic resources to harness the genetic potential in cotton for crop resilience and sustainability.
- Focus on breeding for water deficit tolerance through the selection of suitable Root System Architecture.

Special Lectures:

- Prioritize improving productivity in rainfed areas through sustainable farming systems and conserving resources, along with end-to-end value chain development.
- Encourage public-private partnerships in a consortia approach, sharing infrastructure, capabilities, and germplasm to ensure the supply of quality seeds.
- Improve the Intellectual Property Rights (IPR) environment to stimulate more innovations, benefiting farmers.
- Ensure Indian farmers have access to internationally available seeds.
- Increase funding substantially in the seed industry to address fragmented research and sub-optimal funding.

Concurrent Session on Thematic Area I: Best Management Practices (BMP) for Climate Resilience, Soil Health, and Sustainable Cotton Production:

- Introduce early maturing compact varieties amenable to High-Density Planting System (HDPS) to improve productivity under changing climatic conditions.
- Incorporate legumes into cotton-based cropping systems to enhance soil health.
- Promote an integrated approach to nutrient management and conservation agriculture for improving soil organic carbon and water-holding capacity in rainfed semi-arid regions.
- Sensitize ginners about pink bollworm incidence in ginnery wastes and subsequent spread to cotton crops.
- Create awareness among organic cotton producers and exporters about basic requirements for organic cotton production.

Concurrent Session on Thematic Area II: Advances in Cotton Genetic Improvement, Molecular Biology, Biotechnology, and Genomics:

- Harmonize data developed and approved in the regulatory systems of different Asian countries.
- Formulate policies to promote the cultivation of specialty cotton in India, defining areas and fixing premium prices.
- Develop breeder-ready molecular markers for disease resistance traits and sucking pest tolerance in cotton.
- Accelerate marker development for resistance genes against cotton leaf curl disease.

Concurrent Session on Thematic Area III: Changing Pest and Disease Scenario in the Cotton Agro-ecosystem:

- Implement integrated pest management strategies for successful pest management.
- Strictly adhere to crop termination and crop residue management to reduce pink bollworm menace.
- Explore microbial volatiles for sucking pest management and investigate their interaction with plant volatiles.
- Study the role of proteolytic enzymes in the activation of Bt protoxin for developing sustainable strategies for transgenic cotton usage.

Concurrent Session on Thematic Area IV: Precision Cotton Farming, Mechanization, Sensor, AI, IoT, and Robotics:

- Establish a task force for cotton mechanization.
- Develop integrated sensor-based applications like AI smart traps, drones, and robotic harvesters for application in cotton farming.
- Focus on developing effective defoliants suitable for Indian climatic conditions and cotton varieties.
- Modify currently available mechanical harvesters using AI, sensors, and robotics for cotton harvesting in Indian farms.

Concurrent Session on Thematic Area V: Ginning, Spinning, Fibre Processing, and Textile Technologies:

- Test technologies developed on a large scale and certify them through third-party validation.
- Initiate toxicology studies on the use of nanomaterials in textiles and agriculture.
- Develop BIS standards for different natural dyes and establish their fastness properties.
- Adopt fiber blending technology for commercial exploitation of natural fibers like hemp and jute to develop innovative products.
- Explore sustainable textiles from recycled cotton waste.

Concurrent Session on Thematic Area VI: Cotton By-Product & By-Product Utilization, Value Addition, and Circular Economy:

- Focus more on value addition to by-products, which account for two-thirds of raw cotton by weight.
- Develop technology for efficient extraction of value-added products from biomass.

ue-added products from biomass.

- Develop torrefied biomass-based pellets for cofiring in thermal power plants as a substitute for coal.

Concurrent Session on Thematic Area: Innovations in Cotton Trade, Testing, Traceability, Technology Transfer, and Socio-economics:

- Prioritize technology forecasting before technology development.
- Develop user-friendly and easily adoptable technology for traceability in the cotton value chain.

VALEDICTORY SESSION:

During the valedictory function, Prof. J.B. Joshi, Former Director of the Institute of Chemical Technology, Mumbai, congratulated the organizing team for successfully organizing the event. He emphasized the importance of utilizing science and technology for the benefit of society.

Technical Tour: After the valedictory session, a technical tour was arranged for the participants. One group visited The Bombay Textile Research Association, Mumbai, while another group went on a local sightseeing tour to explore South Mumbai.

ELECTION OF NEW CHAIR OF ACRDN

Dr. S. K. Shukla, Director of ICAR-Central Institute for Research on Cotton Technology, Mumbai, was elected as the new chair of ACRDN until the next ACRDN meeting.

Dr. K.R. Kranti congratulated the new chairman and handed over the charge during the valedictory session.





WCRC-8

WORLD COTTON RESEARCH CONFERENCE-8

3-7 October 2024

International Hotel Tashkent, 107A, Amir Temur Street, Tashkent, Uzbekistan



