

Textile Science and Clothing Technology

Hua Wang
Hafeezullah Memon *Editors*

Cotton Science and Processing Technology

Gene, Ginning, Garment and Green
Recycling

 Springer

Textile Science and Clothing Technology

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Foreword

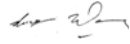
As the Editor-in-Chief of the Journal of the Textile Institute and a Professor in Fibre Science and Textile Technology, I am delighted to provide this Foreword for an important contribution to the textile literature.

Cotton is the most important natural fiber in the world. Cotton textiles played a key role in the first industrial revolution and will continue to play a significant role in the economies of both developed and developing nations. Worldwide, the livelihood of hundreds of millions of people depends on cotton production and trade. Cotton textile products are among the most comfortable textiles for discerning consumers.

The editor of this book, Dr. Hua Wang, started exploring textiles over 40 years ago. He has in-depth knowledge of cotton textile production, consumption, and trade. In this book, he has assembled top-notch scientists across the whole cotton value chain from cotton cultivation and harvesting to spinning and textile finishing. Dr. Wang himself authored the chapters related to cotton properties and testing using advanced instruments. The co-editor of this book is one of the emerging scientists, Dr. Hafeezullah Memon, who has authored more than 60 scientific papers and presented his research at many international and national conferences.

Most of the authors contributing to this book are from the top institutions in developing countries, including Pakistan, India, Bangladesh, Iran, Uzbekistan, Ethiopia, and Uganda. The choice of authorship was made considering the importance of the textile industry in developing nations and the need for a comprehensive reference book for their undergraduate programs in textiles. Moreover, this book has already been supported by the World Textile University Alliance.

I believe this book will serve as an excellent guide for anyone who is interested in understanding cotton production, textile processing, and commerce.



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Preface

The publication of this book is of considerable significance if we look at the significant changes in the pattern of the international cotton trade. Today, the global trade volume of textiles and clothing has reached \$425 billion. India and China have become the emerging world manufacturing powers. Asia produced a large number of colorful cotton textiles before the industrial revolution. After 1750, with cotton textiles leading the industrialization process of Europe, it also opened the transformation of the global economy. After the modernization of the textile industry, it is now back to Asia, and China has once again become the world's largest manufacturing economy. Brazil's cotton production is close to the threshold of 2 million tons, and it is possible to continue to increase in the future. The United States, India, and other countries have encountered specific problems in the planting period, making people worry about the production of cotton. For example, Texas in the United States has experienced long-term drought, diseases, and pests in India, and water shortage in Australian cotton.

American cotton accounts for about 40% of the world's cotton trade. U.S. cotton exports play an important role in the world cotton situation. As an important international bulk agricultural product, cotton plays an important role in the global commodity trade. More than 150 countries in the world participate in the cotton import and export trade. Moreover, cotton trade is frequent, and the scale of trade is large. The change in international cotton trade patterns has a profound impact on global cotton production and marketing patterns. Global cotton exports have formed a new pattern, i.e., the United States, Africa, and India as the core, Brazil, Australia, and Uzbekistan as the central three countries. Under the new pattern, global cotton consumption with China, India, and Pakistan as the core, Bangladesh, Indonesia, and other Southeast Asian countries as the leading players. In recent years, India and other South and Southeast Asian countries are very suitable for the development of labor-intensive industries (cotton industry) due to the low domestic labor price and other factors, so the cotton consumption shows a significant growth trend. However, in the new cotton consumption pattern, China's cotton consumption has declined in recent years, but it is still the world's largest cotton consumer. The overall decline of world cotton production has not caused a rebound in cotton

prices, so China should guarantee the sustainable and stable cotton production, to prevent farmers from blindly expanding or reducing the planting area to cause dramatic fluctuations in cotton production. At the same time, it should be recognized that the current world cotton production depends on not only the quantity but also the quality of cotton.

As we all know, China is the largest developing country in the world. In the past 70 years, China has become the largest textile and clothing manufacturing country, globally. Therefore, I would like to introduce the achievements of cotton research and technology and the experience of cotton textile technology and industry development to developing countries all over the world through this book, because the world textile history has proved that the industrialization of all developed countries in the world starts from the development of the textile industry. In recent years, China's cotton industry policy is gradually institutionalized and predictable. No matter how to increase the quota of sliding standard tax or carry out the rotation of reserve cotton, it will be announced in advance. The government pays attention to the accuracy and timeliness of market regulation. The price fluctuation of the cotton market is gentle, and there is no significant rise and fall. China plays a vital role in global cotton production, consumption, and trade. As far as the cotton market is concerned, the Chinese and global cotton market is stable. Because China is both a "world factory" and a "world market." At present, the population of China has reached 1.4 billion, the domestic demand market is enormous, and the consumption upgrading trend is obvious. From 2012 to 2018, China's retail sales of clothing, shoes, hats, and knitwear have maintained a steady growth trend, reaching 1523.1 billion CNY in 2018. There is no doubt that China will still be the largest textile and clothing consumer market, globally. In the last 2 years, the Chinese government has vigorously promoted the reform of tax reduction and fee reduction, encouraged innovation and optimized the business environment, introduced a series of policies and measures conducive to the long-term development of the industry, and formed strong support for the domestic demand market.

Furthermore, this book reflects the current situation of cotton breeding and planting technology in the world. Modern cotton planting is emerging technology formed by information, precision, intelligence, and modern equipment, including information technology supported by satellite data service, precision sowing, precision fertilization, and growth monitoring and early warning, as well as controlled-release fertilizer, drip irrigation fertilizer, high-efficiency foliar fertilizer, rapid nutrient diagnosis and nontoxic green pesticides, *Bacillus thuringiensis* (Bt) cotton. Satellite navigation makes it possible to plow and sow the land day and night, reducing the agricultural manipulator's tension and the scheduling pressure of sowing season time. With agrarian plant protection, unmanned aerial vehicles, i.e., such as flying hand as a tool, are applied with pesticides, plant growth regulators, and defoliant, and many "new farmer" faces appear in the cotton field management. The mechanical cotton picker is the top modern agriculture equipment for mechanized harvesting that can reduce labor intensity and labor quantity per unit area and improve production efficiency, significantly.

The research of cotton cultivation clarifies the high-yield cultivation of cotton by the utilization of cotton nutrients; control of plant diseases and insect pests; salt, alkali, and drought-resistant cultivation; prevention of disasters; and physiological, biochemical, and ecological research. Cotton cultivation has been twice (double cropping) at the same time. However, the biological yield has been thrice economically because the number of bolls per unit area, boll weight, and crop yield have increased along with improved fiber quality, due to high photosynthetic efficiency during boll development artificial light and heat sources (warm water).

Breakthroughs have been made in the field of basic cotton research. In recent years, cotton scientists have made significant breakthroughs in cotton genome sequencing and functional genome research and made substantial contributions, and systematically reported the sequencing of diploid A and D genomes, the sequencing of tetraploid AD genomes as well as the assembly of high-quality heterotetraploid upland cotton and island cotton genomes. At the same time, based on the high-quality assembly sequencing, re-sequenced each ecotype and studied the gene locus of various character control. The completion of these achievements marks that cotton scientists are at the forefront in the world of the genome and functional genome research.

Besides, this book shows the latest achievements of cotton textile processing technology. The labor productivity of spinning has significantly increased with the continuous improvement of the textile manufacturing industry's efficiency through the constant breakthrough of the automated technology of cotton textiles using of a series of advanced equipment. The average 10000-spindle labor force of ring spinning has decreased from 300 in the 1980s to 200 in 2000, and nearly 70 in 2015. Among them, more and more enterprises use the whole process of digital, automation, information, intelligent production lines, and use robots instead of personnel. The advanced production lines employ only ten people per 10000 spindles. The textile enterprises have improved the requirements of yarn quality and raw cotton quality. The new type of cotton textile equipment put new requirements for cotton quality forward. Different spinning equipment has different requirements for fiber quality index. Besides, rotor spinning, air-jet spinning, and friction spinning all require raw cotton to be clean, without or only allow a small number of impurities.

In the future, the first main direction of the world's high-quality raw cotton production would be to improve basic quality, i.e., the cleanliness and consistency of raw cotton. Second, to improve the genetic quality, improve the fiber length and reduce the micronaire value, coordinate the length, strength, and fineness (micronaire value) indexes, and match the high quality with the early maturity. The third is to improve the quality of machine picked cotton to improve the early maturity to improve the defoliation effect and reduce the impurity content of seed cotton. Fourth is to improve the primary processing of seed cotton level, to minimize the damage of length during ginning.

As the Editor-in-Chief of this book, I am much honored to invite so many famous experts to complete this book together. I also thank Dr. Hafeezullah Memon for his assistance throughout the process. I am indebted to many world-famous

cotton-breeding experts, cotton-planting experts, and textile experts who jointly contributed to this book for the World Textile University Alliance. This program is to prepare teaching materials, establish cotton-planting and textile training centers, train cotton researchers, cotton planting personnel, and textile engineering faculties for cotton-producing countries in Asia, Africa, and South America, to develop their economy, and improve their ability to working population. Finally, I would like to thank Springer, a prestigious international academic publishing institution that has published this book globally with full of academic and application value. I believe that this book will bring knowledge, technology, and development for the cotton and cotton textile industry of developing countries in the world and help all developing countries embark on industrialization.

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Chapter 1

Introduction



Hua Wang and Hafeezullah Memon 

Abstract Cotton is one of the most prominent fibers of the world that have been used for many years around the world. This chapter highlights the important history of cotton fiber and cotton trade. Also, the potential of this natural and eco-friendly fiber has been highlighted. Moreover, this chapter discusses some leading disputes of this century over the cotton trade. Finally, the potential financial attributes of cotton fibers are highlighted, and it is believed that cotton would keep its place in the world textile and clothing consumption.

Keywords Cotton trade history · Cotton returns · Cotton trade disputes · Cotton economics · Cotton financial attributes

1.1 History of Cotton

Cotton is one of the oldest natural fibers under human cultivation, with traces over 7,000 years old recovered from archaeological sites [1]. Though it is going through difficult times these days yet the cotton has a long history for human use, as early as 5000 BC or even 7000 BC. It has been used in Central America and the South Asian subcontinent for 5000 years [2]. Cotton cultivation first appeared in the Indus Valley civilization of 5000–4000 BC [3]. In the first century AD, Arab merchants brought fine cotton cloth to Italy and Spain. Around the ninth century, the Moors—Muslim inhabitants of the Maghreb, introduced cotton farming methods to Spain [4]. Cotton was introduced to England in the 15th century, and then to British colonies in North America [5].

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At least 2000 years ago, cotton fibers were used as textile materials in Guangxi, Yunnan, Xinjiang, and other regions in China [6]. At first, people did not realize its economic value. Suleiman, a famous Arab traveler in ancient times, wrote in his “Suleiman Travels” that the cotton seen in today’s Beijing area was viewed as a “flower” in the garden during his travel in the 9th century [7]. According to the legend of Gaochang in the book of Liang [8],

草，实如茧，茧中丝如细纆，名为白叠子

grass is really like a cocoon with the silk in the cocoon is like a thin silk which is called Baidiezi.

It can be seen that cotton, an important raw material of the textile industry, was initially regarded as something like flowers and grass.

There are about three different ways for cotton by which it was introduced into China. According to the analysis of flora and historical data, it is generally believed that cotton spread from south to north to central China. The South Road was the earliest Asian cotton from India, which was spread to Hainan Island and Guangdong and Guangxi regions through Southeast Asia. According to historical records, it was introduced to Fujian, Guangdong, Sichuan, and other regions, at least in the Qin and Han Dynasties. The second way was from India to Yunnan through Myanmar, about the Qin and Han Dynasties. The third way is that African cotton was introduced into Xinjiang and Hexi corridor through western Asia, about the time of the southern and Northern Dynasties. During the Song and Yuan Dynasties, cotton spread to the vast areas of the Yangtze River and the Yellow River Basin is the north road in the ancient book, i.e., The Great Tang Dynasty Record of the Western Regions [9, 10]. By the 13th century, the North Road cotton had reached the Weishui basin of Shaanxi Province.

Historical documents and unearthed cultural relics prove that the cultivation and utilization of cotton by the people of all ethnic groups in China’s border areas were far earlier than that of the Central Plains. Cotton textiles in the central plains were still rare and precious until the Han Dynasty. During the Tang and Song Dynasties, cotton began to be transplanted to the Central Plains. At present, the earliest cotton textile relics in the central plains are found in an ancient tomb of the Southern Song Dynasty. That is to say, from this period on, cotton cloth gradually replaced silk and became the main clothing material of Chinese people. In the early years of the Yuan Dynasty, the government set up the Department of picking up the kapok and collecting the cotton goods from the people on a large scale, up to 100,000 pieces per year. Later, it took the cotton as the first one in the summer tax, i.e., Fabric, silk fabric, silk fiber, and cotton (布, 绢, 丝, and 棉). It can be seen that the cotton cloth has become the main textile material. After the Yuan Dynasty, the government strongly collected cotton cloth published technical books on cotton planting and urged the people to plant cotton. It can be seen from the records of “cotton cloth is everywhere (棉布寸土皆有)” and “looms must be everywhere (织机十室必有)” in “Tiangong Kaiwu” written by Song Yingxing of Ming Dynasty, that cotton planting and cotton spinning were all over the country at that time [11].

Due to the poor quality and low yield of African cotton and Asian cotton, China introduced the improved varieties of upland cotton from the United States in succession in the 19th century, and now all the varieties of upland cotton grown in China are from all countries. In the 1960s, many countries carried out the research and experiment of color cotton. In the 1990s, the United States took the lead in making a breakthrough in the transformation and utilization of naturally colored cotton. Colored cotton is naturally grown cotton with color, because of its natural color, without printing and dyeing, bleaching, and other processes [12]. Not only it avoids the pollution of dyes to water quality and the harm of fabrics but also reduces the industrial cost. Therefore, color cotton fabric has become an environmentally friendly product, the favorite of the market in the future, and is favored by consumers.

1.2 The Cotton Would Retain Its Importance Even in the Future

Cotton is a kind of natural fiber which can keep company with nature and human. Scientists have found a small number of cotton bolls and cotton fragments in caves in Mexico, proving that cotton has a history of at least 7000 years [13]. Cotton has maintained a strong vitality regardless of the vicissitudes and species changes. Cotton, as a gift from nature, is used to create a comfortable, healthy, and environmentally friendly, high-quality life. All living things need to absorb nutrients from the environment. Cotton, as a kind of “natural selection”, consumes less and gives back more.

The cotton is comfortable as well as environmentally friendly; thus, cotton products should be used to replace chemical fiber products to the greatest extent. Planting cotton fields consumes only 2.6% of total agricultural water and less than 3% of entire cultivated land, but provides 36% of textile fibers for the global textile industry [14, 15]. Cotton is resistant to drought because its roots have a stem-like a water reservoir [16]. Through scientific management, at present, the unit water consumption of cotton planting and the area occupied by cultivated land are still declining. Cotton can also survive in saline and alkaline land, where it is difficult to grow crops and maintain a yield of 90% [17].

The planting of modern cotton can reduce soil erosion and prevent soil particles from flowing into rivers and lakes by increasing the organic matter in the soil. Meanwhile, it can improve the desertification and protect the local water quality. After several years of cotton planting, the soil composition has been improved, and it can also be used to grow corn. So in the desert and Gobi area, cotton planting makes more barren land to an oasis. Nowadays, environmental protection is more important than many years ago, but it has not reached all levels of production and life. The chemical fiber, which is often used to make clothes, needs to be extracted from a large amount of oil, and it will take hundreds of years for waste into the soil to degrade. Brown et al. [18] reported that every time one wash chemical fiber clothes, more than 1900

microplastic fibers are produced. They quickly enter the ocean through drainage, and part of them are returned to the food we eat with the food chain. Compared with man-made fibers, cotton products can be naturally degraded within a few months after being buried in the soil, become organic fertilizer, and returned to nature without burdening the earth. Thus, cotton is the only fiber that offers environmental protection as well as comfort, making it an ideal choice for people as well as the choice for a sustainable future.

People feel comfortable on wearing cotton fabrics because cotton fiber has the following two characteristics. First of all, cotton fiber is naturally hollow, with a natural moisture content of about 8%. When wearing cotton fabric, cotton fiber can automatically adjust dry skin humidity through evaporation and absorption, making people feel fresh and ventilated. At the same time, cotton fiber also has the characteristics of porosity and permeability. A large amount of air can be accumulated between the fibers since air is a bad conductor of heat and electricity. Therefore, cotton fabric is heat insulated and non-conductive, and the human body feels warm and comfortable.

The cotton fabric has no stimulation to the skin and has a good hygienic performance. It is a good choice for skin-sensitive people and infants. Since 1993, Bremen cotton exchange in Germany has carried out a global tracking test on the chemical substances of raw cotton fiber. The results show that all tested cotton meets the EU eco tex standard (product Class 1), and cotton performs well in agriculture, medicine, heavy metal, and other chemical residues. In addition to pure cotton clothing, soft cotton tissues are also gradually becoming more and more people's choices because of their comfort and strength. Soft cotton tissues are not easy to break and crumb that complements its corresponding use over other paper towels, and also supports multiple and multi-purpose applications. For example, after washing the face by soft cotton tissue, no need to discard it, and it can be used to wipe the desktop and shoes for the second time. The use of paper is increasing day by day. To date, only China consumes nearly ten million tons of paper for daily use every year. Pure soft cotton tissue has the potential to replace the paper towel with them. Since soft cotton tissues can be used several times, which would ultimately reduce cutting the trees and, thus, protect the forests.

1.3 Global Trade History of Cotton

Cotton was first planted in the western part of India about 5000 years ago. Cotton and cotton fabrics of India were exported until the 19th century. At the end of the 15th century, European explorers entered the Indian Ocean, and they started to export Indian cotton fabrics and spices to Europe in large quantities. The Indian cotton fabrics were popular in the European market, which caused the cash inflows into India, a big challenge for Europeans, until the industrial revolution. After the industrial revolution, new machines such as flying shuttles and Jenny spinning machines were invented and, thus, promoted Britain's cotton production significantly. However,

until the early 19th century, Britain’s cotton production was still lower than that of India, and it was mainly exported to West Africa and other places. Britain’s cotton textile industry won the final victory over Indian textile products by Britain’s successful construction of a new cotton textile industry system. The British established plantation agriculture in their North American colonies, and following Portugal started planting in Brazil, the Netherlands in the Caribbean islands, and France in Haiti. They farmed cotton and sugarcane in large quantities and then transported cotton raw materials and sugar to their suzerain. The combination of mechanization, plantations, and long-distance ocean transportation eventually led to the collapse of India’s long-standing cotton textile industry.

The issues and disputes related to international trade are not new throughout global history. According to Sven Beckert, author of “Empire of Cotton” and Professor of History at Harvard University, capitalism, which shaped the current global political and economic pattern, has nothing to do with “fair competition” from the beginning, but is full of naked national plunder, exploitation, and theft. In the book, “Empire of Cotton”, Beckett points out that the history of the cotton industry is closely connected with the history of modern capitalism [19]. The geographical discovery at the end of the 15th century and the subsequent establishment of the transatlantic trade network put Europeans in the center of the global cotton trade. In the era of “War Capitalism”, European countries established trade networks connecting America, Europe, Asia, and Africa through land plunder and slavery. The innovation of cotton textile industry technology and war capitalism ended in the 19th century [20]. The former controls core technology and the largest share of profits, while the latter provides raw materials and consumer markets. In this hierarchical cotton imperialist order, the top Western countries always master the most core technology and reap the most significant proportion of profits.

Now, the many countries of the world are following this set of logic that once helped the western countries to obtain the advantageous position of the world division of labor. From this point of view, Sino US trade friction is not so much a clash of civilizations as a clash of interests. Figure 1.1 represents the major cotton producing

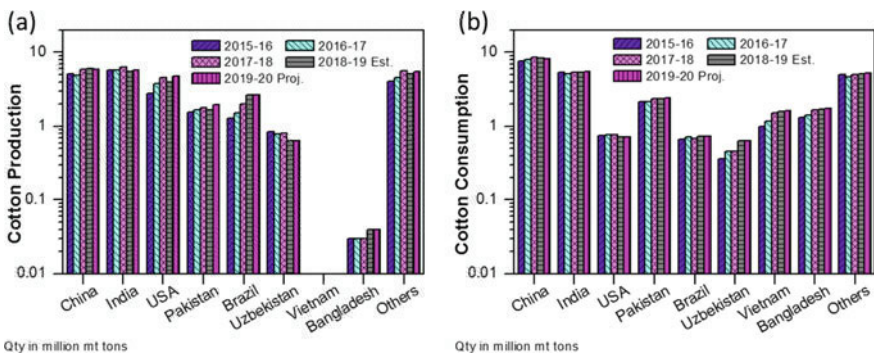


Fig. 1.1 Production and consumption in major countries [21]

and consuming countries for last five years. In the “cotton Empire”, every country is trying to defend interests and occupy the dominant position as much as possible. This is the internal power of the current global economic order.

1.4 International Trade Disputes over Cotton

1.4.1 Global Trade Disputes over Cotton Are Continuing

Cotton has become a strategic material related to the national economy and people’s livelihood and an important raw material of the cotton textile industry, which plays a significant role in the national economy of many countries. According to statistics, there are 75 cotton-producing countries on five continents. As a natural fiber economic crop, cotton industry chain from production, circulation, processing to consumption has an important impact on the development of the national economy, especially the employment and income of cotton and upstream and downstream industries. Cotton is also an important international trade product, with the global trade volume reaching the US\$18 billion per year, which attracts the attention of all countries in the world. Both developed and developing countries have taken various measures to protect their cotton farmers and the cotton industry and expand their export markets to gain more benefits in the cotton trade. Therefore, cotton has aroused world trade disputes.

1.4.2 WTO Agricultural Negotiation for Development

It is a hot topic of cotton. At the end of 2001, the WTO began a new round of negotiations, namely the Doha round. The most prominent feature of this round is to emphasize the development of developing countries. In 2003, four least developed countries in Africa, Benin, Burkina Faso, Mali and Chad, which take cotton cultivation as an important basis of their national economy, jointly launched the cotton sector reform initiative of the Doha Agricultural Negotiations of the WTO. They put forward that the cotton production and export of the least developed countries have been plagued by trade distortions, requiring cotton to be in the trade and development sectors. Other issues have been thoroughly resolved before the agricultural negotiations. In the “four cotton countries”, cotton is the main economic crop and also the main export of agricultural products. In 2004, they exported 218.1 thousand tonnes of cotton to China; and 11.5% of China’s total cotton imports [22]. Among them, Benin, Burkina Faso, and Chad account for more than 70% of total export revenue. The international cotton subsidies, mainly from developed countries, have seriously impacted the cotton industry in Africa, and also severely hit the economies of these least developed countries. In response to the strong demands of the four

cotton countries, since 2004, the WTO agricultural negotiation has set up the cotton issue for regular discussion, which is the only issue aiming at a single product in the agricultural negotiation.

After more than ten years of arduous negotiations, the cotton issue has made periodic progress. In December 2015, at the Nairobi ministerial conference, the Ministerial Decision on cotton was adopted [23]. Developed members and developing members who announced their ability promised to provide “duty-free and quota-free” market access to cotton in the least developed countries. Developing members who were not able to provide double exemption also had to bear the responsibility of promoting the import of cotton from the least developed countries. The decision also called for the immediate elimination of cotton export subsidies by developed countries and implementation by developing countries no later than January 1, 2017. The Nairobi decision also acknowledged the efforts of some WTO members to reform their domestic cotton policies, but stressed that more efforts are needed. Finally, the members also agreed to improve the transparency of the cotton trade and strengthen the monitoring of trade policies. However, the root cause of the problems faced by the developing cotton industry is the distortion of international cotton trade caused by the domestic support of developed members (including yellow box and blue box). It is still a long way to go to solve this problem fundamentally.

1.4.3 Dispute Settlement Mechanism to Promote Fairness (Brazil vs. US Cotton Subsidy Case)

The large-scale subsidies of developed members of cotton also have a negative impact on the interests of other cotton-producing countries. For this reason, Brazil sued the United States to the WTO in 2002 on the ground that the United States cotton subsidies violated the WTO rules, and the WTO dispute settlement agency ruled that the United States lost the lawsuit in 2004 [24]. Brazil sued the US government for providing up to seven types of subsidies for cotton production, including direct payments that are not linked, countercyclical payments that are related to prices, and “second step subsidies”. Between August 1999 and July 2003, American cotton producers received 12.47 billion US dollars in subsidies. During the same period, the output value of American cotton was 13.94 billion US dollars, with a subsidy rate of 89.5%. The Appellate Body of WTO decided that “the second step subsidy” has the nature of export subsidy and domestic content subsidy. In violation of the WTO commitments of the United States, the United States was forced to cancel the “second step subsidy” and adjust the export credit plan. Also, the appellate body found that the “production flexibility contract payment” and direct payment notified by the United States, as the green box may stimulate production, which does not meet the criteria that green box has no or only slight distorting effect. Brazil believes that the US multi cotton support subsidy program has increased US cotton production

and exports, thereby lowering world cotton prices, causing damage to Brazil and other members.

Brazil versus the US cotton subsidy case is the only dispute case related to the cotton industry in the WTO at present and has great significance in the history of WTO. The ruling of this case increases the opportunity for developing members to use the WTO dispute settlement mechanism to challenge the developed members' huge agricultural subsidies and safeguard their interests, which causes great pressure on the developed members who provide a large number of agricultural subsidies. At the same time, the clarification of the WTO Dispute Settlement Mechanism on the fuzzy terms of WTO is conducive to the development of trade liberalization and the improvement of relevant rules, especially in the time and field where members are difficult to reach a compromise and collegiate. Since 2004, cotton, as a subject involving trade, economy and other fields, has attracted special attention of the world. WTO has been committed to promoting the reform of cotton trade, trying to solve the problems of cotton subsidies and trade barriers.

Cotton is an active product in international trade as an agricultural product of processing raw materials. Although the planting industry is relatively small, it embodies the reality of deepening potential economic relations and highlighting interest conflicts between countries under the background of global economic integration. To resolve the contradictions and achieve win-win results, one should maintain the position and authority of the multilateral mechanism of international trade to create a benign trade environment and follow the rules first. At the same time promote the reform of agricultural trade of WTO, especially solve the internal defects of multilateral rules, to ensure that trade rules take reasonable care of the interests and concerns of different members.

1.5 Financial Attributes of Cotton

Cotton is one of the international commodities, and its financial attribute is increasingly prominent. With the rapid development of the financial derivatives market, the financial attributes of commodities, especially international bulk commodities, are more and more obvious. When commodity exchange develops to a particular stage, money is used to measure the value of commodities, and then the price comes into being. With the development of the commodity economy, the importance of price is self-evident. All commodities have prices, which are the core elements of the market economy and the basis of all economic activities. The value of goods is expressed by price, and the fluctuation of price reflects the scarcity of goods or the relationship between supply and demand. However, with the development of society, supply and demand information and other factors that can affect the price are difficult to be fair to all people, and the phenomenon of price deviating from value inevitably appears. Especially when some people realize that this kind of deviation may bring huge benefits, speculation will follow. According to the N. Gregory Mankiw, Professor of Economics at Harvard University—the author of the book,

“Principles of Economics”, commodity prices are determined by the relationship between market supply and demand [25]. But once the price does not reflect the relationship between supply and demand, or even deviates significantly from the value, the commodity becomes the medium or carrier of speculation, and the financial attribute of the commodity determines the price of the commodity market. Under normal circumstances, the necessary attributes of commodities play a leading role in the price of commodities, and the trend of market prices is determined by the relationship between supply and demand. However, under particular circumstances, the financial attributes of commodities can play a leading role.

Cotton is still one of the dominant fiber of the textile industry, and its economic downturn will lead to global demand reduction. It can be said that the textile industry is one of the sectors prone to be affected by the global economic recession. To be saved from the economic downturn, the first thing is to achieve reasonable expansion based on combining the existing cotton business. This primary consumer industry would still guarantee success despite the intense competition. Those enterprises that do not adapt to the development and will not follow careful strategies would be eliminated. At the same time, an e-commerce platform should be established for international textile products based on the cotton trade that may integrate advanced technology and traditional ways of production trade, covering the information of all well-known fibers, i.e., cotton, wool, cashmere, linen, man-made fibers, and others. This platform would provide a professional, safe, and efficient textile production information system and one-spot trading platform for fiber producers, value-added product manufacturers, traders, consumers, warehousing and logistics centers, transporters, and bankers. In the next few years, China is also planning to establish submarkets in the United States, India, Uzbekistan, and other major cotton-producing countries to centralize cotton prices and returns. Furthermore, bringing innovations in business models might offer ways to cope with the current situation. Experts believe that the business which combines financial innovation is a business with excellent development potential in the current environment.

The most basic function of the cotton stock market is price discovery, which leads to avoiding loss, getting projected profit, and other functions. In addition to the impact of macro and commodity supply and demand, the price relationship between stock and goods in stock, related to stock markets, contract periods, and stock varieties, also has an obvious impact on stock prices. At present, “basis trade”, which is widely used in the cotton market, is the most important indicator of the relationship between the stock and the prices. In the aspect of cross month arbitrage, the stock market has a wide range of extended trading and inter-month forward and reverse trading, with a high degree of attention to the inter-month accounts. In terms of cross-market arbitrage, cotton import business, and cross-market forward and reverse arbitrage transactions widely exist in the stock market, which pays great attention to the cross-market price difference. The cotton-growing areas in the United States are mainly distributed in a large area from west to east in the south of the United States. The four main cotton growing areas are Southeast, South Central, Southwest, and West. More and more attention has been paid to the cotton stock price, which has become the primary reference basis for the US government to formulate relevant cotton policies,

and also the central place for cotton farmers and cotton related enterprises to hedge other major cotton-producing countries except for China.

China's cotton price index (CC index) is becoming more and more influential in the market. China's cotton trading market, after more than one year's research and preparation, was jointly discussed and confirmed to timely and genuinely reflect the price level of China's cotton market [26]. Department of economic construction of the Ministry of Finance, the Department of Economic and Trade Circulation of the National Development and Reform Commission, the Rural Economic Research Center of the Ministry of Agriculture, and the Cotton and Hemp Bureau of the Domestic Supply and Marketing Cooperative discussed it together. The outcome was released in early May 2002. In June 2002, the "China cotton price index" was officially released, which is abbreviated as "CC index" in English.

The release of China's cotton price index has not only been widely welcomed and concerned by domestic and foreign cotton related industries but also become an essential basis for China's national macro-control departments to grasp the local cotton price trend. At the beginning of the publication of the China cotton price index in June 2002, the daily quotation of 105 textile enterprises was calculated and generated by the national cotton trading market. Since June 2003, China's cotton price index has been published more frequently, instead of at 10:00 a.m. on Monday and Thursday. The number of quoted enterprises has increased to about 180. In November 2003, to ensure the fairness and authority of the release of China cotton price index, China cotton price index was managed by China Cotton Association and released simultaneously on the website of China Cotton Association and China cotton information network.

1.6 Conclusion

Cotton is a vital natural fiber for human beings, and it is an environment protecting textile and clothing material given by nature. Cotton is a fiber which pays to nature more than it gets from nature. Cotton is an international agricultural product or a financial instrument. The cotton fiber would retain its place in the world textile and clothing consumption. There is a necessity to follow suitable strategies for cotton production and cotton business.

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Chapter 2

Status and Recent Progress in Determining the Genetic Diversity and Phylogeny of Cotton Crops



Altaf Ahmed Simair  and Sippy Pirah Simair 

Abstract The significance of plant genetic diversity (PGD) is predictable as an exact part since the public explosion of urbanization, and the decline of cultivable land is the severe issues subsidizing to food security in underdeveloped countries. Agricultural researchers realized that plant genetic diversity could be apprehended and deposited, such as gene bank, DNA library, etc. In the biorepository that preserves genetic material for a long time. However, the preserved plant genetic resources should be used to improve crops to meet upcoming universal challenges related to food and nutrition security. This article reviews the most significant areas related to cotton crops; (i) the importance of plant genetic diversity (PGD) mainly arable crops; (ii) investigation of existing PGD analysis methods in the pre-genomic and genomic age; and (iii) modern tools available for PGD analysis. This review will help the plant science researchers to use the available modern resources and latest tools for a better and quick assessment for the use of germplasm from gene banks to their ongoing breeding programs. By introducing new biotechnological practices, the management of the genomic alteration process is now enhanced and accepted with more accuracy than old classical breeding skills. It should also be noted that gene banks are investigating several problems to improve the levels of distribution of germplasms and its use, especially replication of plant uniqueness and access to the databanks for research accomplishments. Therefore, as plant breeders and crop developers are essential components in successful food production, accessibility and approach to different genetic sources will guarantee that the universal demand for food and livelihood becomes maintainable. Molecular methods have a severe and unavoidable leading role in the challenges of phylogeny and speciation. In recent times, there is a new class of cutting-edge practices that has materialized, mainly an amalgamation of earlier and more basic techniques. Most advanced cutting-edge

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marker-based procedures tend to combine beneficial topographies by several basic methods to detect genetic gap and quirkiness. Most innovative, cutting-edge marker-based techniques are used with a new class of DNA components, such as chloroplast microsatellites, to depict variation in the genetically altered genome. Furthermore, the latest technologies, such as RAPD and AFLP, also apply to cDNA-based patterns to study gene expression and blur the impression of biological responses. Furthermost imperative and latest improvements made indent for molecular marker techniques are discussed in this review, which improves the understanding of weather kegs and its practical usefulness for scientists.

Keywords Cotton · Genomic tools · Phylogeny · Diversity · Classification

2.1 Introduction

Human resources are closely linked to the outcomes of the economy. However, an exhilarating and crucial element is that the situation of the population is dual, i.e., on the one hand, it is used for the production of goods, and on the other hand, all production is intended for the population. Individuals are not only manufacturers but also consumers. A more significant population may be needed as it offers more employees, but it may be unwanted because it will need a large number of products to satisfy the increasing demands for the population. The demand for commodities is increasing rapidly due to overpopulation while the supply does not match it, and consequently, prices are growing too fast. So we need to increase the number of industries to regulate the amount because the industry is now producing goods that not only meet consumer needs but can also be cost-effective. Industrial expansion is a privilege of emerging countries, but at the same time, all possible preventive techniques must be adopted so that contamination of the atmosphere cannot make any problem for the international community. The biome is greatly affected by human activities and industrial growth. Numerous industrial chemical substances are going to be used in various industries in the name of development without checking a harmful effect on the environment. No doubt, there is no question that the use of chemicals is necessary for better performance of products, but on the other hand, the use of such chemicals has created problems for man force, environment and also increased the cost of items. To improve the circumstances and succeed global magnificence, we must use the best knowledge of natural resources, intensely change our performance, improve our economies, and regulate emissions and high-price goods used in our everyday life. Knowing new technology would be a must for those who want viable goods for a prosperous future [1]. The garment industry is mainly engaged in the pattern, manufacture, and selling of wool, fabrics, and garments. Produced or manufactured products used in the chemical industry may be raw materials. Throughout the twentieth century, with the relentless technical advancement in machines, synthetic fiber, logistics, and business globalization, the textile industry has undergone significant changes. The business model, which has been dominating the industry for decades,

is facing radical changes. Cotton and fur manufacturers are not the only sources of fiber, as chemical factories have manufactured DuPont discovered contemporary synthetic fabrics of superior quality for many applications, such as the rayon found in 1910 and Nylon in 1935 low-cost silk alternatives for items ranging from women's stockings to sportswear.

There is a long cycle of chemical and nonchemical handling in the production phase of textiles. Tissue finishing involves pretreatment, tinting, printing, and finishing. Several textile chemicals include exceptionally engineered chemicals such as fungicides, fire retardants, water-repulsive, and distort sizes. These are reasonably necessary chemicals, including emulsions and fats, starches, sulfate oils, waxes, and certain surfactants. More than 60 different textile chemicals are used in wire forming, pretreatment and finishing, lamination, fabric covering, and various other uses.

2.2 Origin and Distribution

The cotton industry has had to suffer variations in the fabrication and usage of this natural product worldwide over the last few years. As we all know, cotton in textile fabrics is linked to all levels. Cotton is now grown in almost 100 countries worldwide. However, only three countries India, China, and the United States of America compete with new lines on the market by producing two-thirds of the world's cotton. Recently, China has become the world's largest importer and producer of cotton. Though, their government has approved to introduce a program to help local farmers grow their farms. As a result, the Asian giant cut the material's imports, dragging prices down to 2009 rates. It rebounded to some degree when the United States chose to limit acreage. Through this sense, India has been a significant producer of cotton and a demanding leader. However, the government is looking at the prospect of withdrawing any of the world's reserves, which might further drive prices down. The fluctuation in world production in natural cotton fiber and the demand for supplies contributes to the textile industry's move to synthetic fiber. Those are cotton, polyester, polypropylene, or acrylic. There is no doubt this conquest is directly associated with expenses. Nevertheless, this is not the only reason; we must note these products are chosen in addition to mass manufacturing for the reason that of their other benefits, such as longevity and ease of use in specific uses.

The best knowledge of natural resources must be used, our behavior drastically modified, our economy improved, and the emissions and high price goods used in our everyday lives regulated to improve the living conditions and achieve universal strength and awareness of natural sources of biomaterials and fibers would be necessary for those who want cost-effective products to achieve their successful future [1].

2.3 Adaptations for Natural Habitat

Cotton is a kind of sustainable and environmentally friendly fabric that has significant advantages in your life. Cotton has been cultivated for more than 6000 years as seed, fiber, and even fuel; that's why everyone calls it living material. Cotton can be used in clothing, bedsheets, and towels, but it can also be used for making currency notes, pulp, cooking oil, animal feed, packaging, and biofuels. The benefits and durability of cotton are enormous.

Cotton (*Gossypium spp.*) yields natural soft single-cell trichomes on the various parts of the plant and provides the textile industry with the primary source of natural raw materials. It is considered economically one of the most important crops globally and is also useful as an exemplary method for thorough evolutionary scientific investigation [2]. Annual or annual shrubs, up to 2 m long with leaves up to 10 cm thick, cordate at the base. The flowers turn yellowish-white and slowly pink-violet. Fruit capsule 4 cm long; wide ovoid to subglobose; beaked apex; 3–5 cells. Each was holding up to 11 hairy seeds. The cotton that we use is made from this plant's seed fiber, which can be up to 2.5 in. thick, and has developed to help plants disperse seed.

Cotton is the world's most extensive non-food product, accounts for half of the world's textiles, explosives, gasoline, livestock feed, and toothpaste. This defied the war for new goods, but at the expense of using vast quantities of fertilizers and chemicals, and scandalous antiquity of workers misuse. This beautiful, sleek, and trendy material costs more than the wool, linen, and nylon competitors do. The trade-in cotton was the driving force of the industrialized insurgency, helping to fund the British Empire. This became the slave-trading backbone that became influential in the American Civil War. Growing up, this "white gold" today needs to use many pesticides to kill life. As Britain was a large manufacturer of cotton in the 18th and 19th centuries, it was driving local cotton weavers into factories or working-class households. The Luddite term has come to mean for those people who dislike technology. The Luddites were cloth craftsmen who opposed the advent of computers by killing them, which left them homeless. One of the most critical developments in cotton ginning history was the invention of the 1793 cotton ginning machine.

2.4 Evolutionary History

Cotton is coated with more organic compounds than other crops. Cotton currently occupies less than 3% of the world's arable land, but it uses a fifth of the world's pesticides! New and healthier chemicals are being produced, but they are costly. As a result, in developed nations, the use of cheaper and more dangerous chemicals causes about 20,000 accidental fatalities per year. Humans started growing cotton in Indus Valley (Pakistan) seven thousand years ago; even today, cotton is cultivated in many parts of Pakistan. The cotton crop in lower Sindh, Pakistan, is shown in