

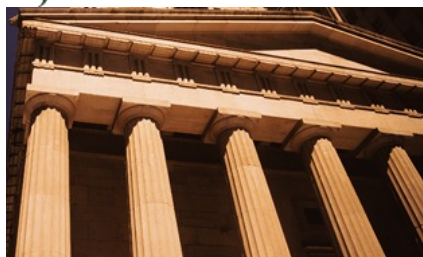


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RESEARCH

— KNOWLEDGE IS THE NEW CAPITAL —

INDIAN COTTON AT A CROSSROADS AS YIELDS STALL



RESEARCH

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HISTORY

India has a rich history in cotton reaching back to 5,000 BC and dominated World trade in the 18th Century.

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EXPANSION IN YIELD

1980 to 2000 time period improved yields and quality as hybrids were introduced.

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BT COTTON INTRODUCED

BT cotton seed was introduced leading to a improvement in average yields and an increase in cotton acreage.

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CRISIS DEVELOPS AS YIELDS STALL

India has entered a crisis period as yields have stopped advancing and have declined following a failure to introduce the latest BT Technology.

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THE PATH FORWARD

New innovative thinking is needed to bring the latest BT Seed Technology to India, modernizing growth practices



India's 2017 cotton season will be remembered in years to come for its lower-than-expected prices, poor yields and inferior quality in the country's largest cotton producing state, **Maharashtra**, and losses across the rest of the cotton belt. Millions of farmers planted cotton, many were unfamiliar with the crop, with high hopes of above average compensation, but for many the season turned from one of promise to a disaster. India has more than 118 million farmers and the agriculture sector dominates the economy, with about one in three workers involved in the sector. Agriculture development varies considerably from state to state. When Prime Minister Modi came into office in 2014 there was great hope that agriculture would receive a greater focus of the new administration's attention with an emphasis on the three pillars of growth: infrastructure, technology and trade. However, many in the sector

had been disappointed in the heavy state involvement by the government across most commodities; exports in some cases had been banned and in other cases increases in the minimum support price (MSP) occurred even though the infrastructure was inadequate to facilitate the necessary procurements. Now with the planting of the 2018 crops complete, the government has reacted to the problems of 2017 with one of the sharpest increases of MSP on record. The Cotton MSP for long staple was raised 26.1% to 5,450 Rupees per quintal. The increase was announced broadly across Ag products and ranged from 3.7% to 42.9%. The Modi government has failed to unleash free market forces at a time when the country's food demands continue to increase. Grant Thornton India, one of the largest assurance, tax, and advisory firms in India, estimates that in 2016 India's food demand was 250 MMT

and by 2030 it will increase to 355 MMT. Their research indicates a significant mechanization boom will have to occur across the agriculture sector if such an increase in demand is to be realized.

Cotton's importance to India is more than just a crop planted each kharif season, but a fiber that has greatly influenced the history of its people, its civilization and the founding of the nation. India accounted for 25% of global textile trade in the 8th Century at the height of the Mughal Empire with its textile and apparel exports reaching from the Americas to Japan. Cotton was the fabric of

independence. India has been at the heart of global cotton trade for centuries. India again finds itself at a crossroads as

being driven by a sharp increase in cost and price of polyester as a result of the environmental cleanup in China and widespread research that has revealed that MMF do great environmental harm through the lack of biodegradability and pollution of water supplies from the release of microfibers. Secondly the current trade-dispute between the US and China has revealed the dangers of a company having its supply chain too

heavily focused in one country. These events will reshape the Global Sourcing Map and India has the potential to benefit from the changes in a major way. For these benefits to occur



two major events reshape Global Textile/Apparel sourcing: First the Age of Cotton & Natural Fibers has begun, this turn back away from Man Made fibers (MMF) is

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however, India will have to boost cotton yields and grower income to assure industry the needed supply. Jernigan Global Research has prepared this Special Report to discuss the problems, opportunities and possible solutions, and hopefully trigger conversation between all parties about viable solutions.

EARLY HISTORY

India and Peru share the credit for the being the first confirmed regions to have discovered and used cotton in approximately 5,000 BC. One of Alexander-the-Great's Admirals in 327 BC recorded that he saw cotton cloth in India that was whiter than flax. Marco Polo in his travels visited India where he wrote about the cotton cloth he encountered describing it as the most beautiful in the world. He is said to have seen the famous giant cotton trees of Gujarat, which stood 18 feet tall. Along the Coromandel Coast, in what is now Tamil Nadu, it was reported there were entire villages where every man, woman and child were employed in the making of cotton cloth. This cloth became known around the world for its quality. Cotton continued to play a major role in India accounting for 25% of global textile trade in the 18th Century at the height of the Mughal Empire with its textile and apparel exports reaching from the Americas to Japan. During this period India

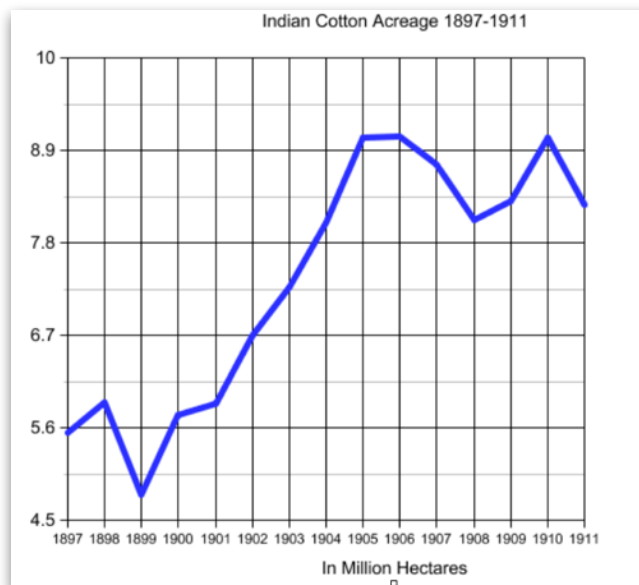
dominated the global cotton textile industry to the same extent China has in recent years. The center of the textile industry was in the region we know today as Bangladesh and the Indian states of West Bengal and Orissa. This period is known as "India's Last Golden Age" due to the fact the Mughal Empire controlled 24.4% of global GDP. The empire began in 1526 and lasted until the final remnants of the empire were taken over by the British government in 1858.

ERA OF COTTON EXPORTER

As the British East India Company rule over India expanded the impact it had on the cotton industry shaped every aspect. By 1878 it was observed that cotton trade had fallen almost entirely into the hands of European merchants, which included the establishment of European agents in farming centers with direct contact with farmers. The European and Japanese trading groups that moved in changed the process and pushed the long dominant

Indian cotton merchants to the margins of trade. In 1875 Indian companies controlled only 28% of exports. The East Indian Company's hold on large parts of India allowed it to introduce large centralized ginning operations which stopped the practice of separating the hundreds of local varieties that had been bred specifically for certain areas. These gins purchased cotton only on weight, which turned the focus to yield. Prior to the East Indian Company's gins, hand ginning was used which carefully separated the seed from the lint resulting in a good quality seed saved for sowing the following season. The company's large scale ginning practice mixed varieties, and damaged the seed, which lead to shortages of planting seed in some areas. In 1868 India grew an estimated 4.29 million hectares of cotton.

The entire process of shifting the Indian industry from growing cotton for its domestic industry to focusing on exports transformed cotton growing in India. The Indian varieties which had once produced the finest cloth in the world were now unsuited for the new textile machinery operating in English mills. Those changes meant cotton traits were needed to meet the requirements of the new machines and not for the type of cloth they produced. This began the push for longer staple cotton.



British mills needed cotton and the rapidly increasing demand led to the transformation of India's entire agriculture sector as cotton was replacing more and more food crops. This, along with heavy taxes, caused Indian farmers to be short of enough food to eat and forced them heavily in debt. The British East India Company required all farmers to pay their taxes in cash. The importance of Indian cotton to the British economy resulted in attempts to change the type of cotton produced while also expanding cotton into areas where it was not suited. The introduction of non-indigenous cotton varieties by the British destroyed the biodiversity of the local Desi cottons. The focus on cotton for export was so great that in Berar, the center of the European merchant's investments, that the local government banned a cotton variety known as "Khandesi" which was only used by the local industry. The Colonial government banned it in 1872, which meant markets were unable to trade it and railways were not allowed to transport it. During the American Civil War, Berar was the center of an intense campaign to increase production to the point it would replace US cotton for the British mills. This effort took a significant toll on the soil, water, etc., and the legacy carries forward to today with six districts of the

Vidarbha region of Maharashtra still having the lowest cotton yields in India and the highest number of farmer suicides due to debt. The soils are extremely poor in this region.

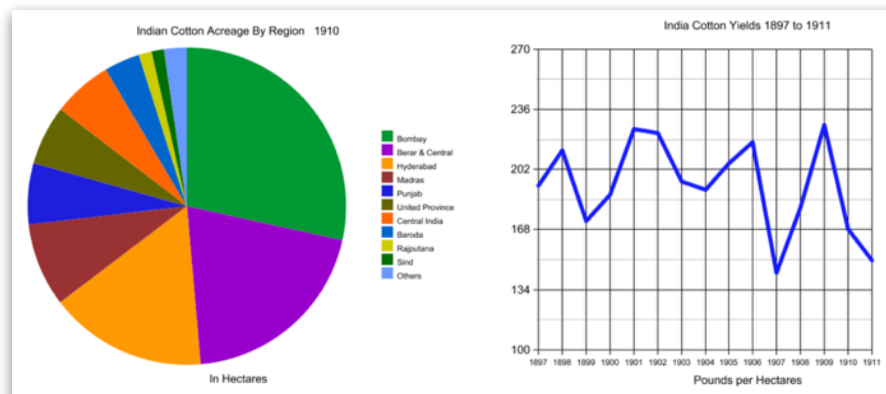
The British forced the introduction of the American Hinganghat and Dharwar cotton varieties and those styles did not like their new environmental conditions and had much lower ginning outturn than the traditional Indian Waradi cotton grown in the Khandesh region. Any farmer found to be growing Waradi had the cottonseed crushed and fed to cows to prevent future plantings. Manchester mill owners pressured the East India Company to improve the quality of Indian cotton, especially the staple length. To meet the demand for better quality lint they even imported American cotton gins, the first US saw gin arrived in Bombay in 1793, and actually hired US farmers to set up experimental farms to grow the US varieties. The experimental farms proved to be a failure, however, the expansion of the American varieties continued.

The East India Company's efforts to improve cotton quality

showed little, if any, real success so attention turned to reducing the contamination in Indian cotton. A Bombay Cotton Fraud Act was passed in 1863, which placed large fees and jail time for anyone altering a bale and required cotton presses to be licensed. The policy was quite expensive and resulted in a levy on each bale exported.

The British cotton textile industry reached its peak in 1912 producing 8 billion yards of cloth. As fabric production reached its peak there was tremendous pressure on India to supply the British mills. In 1897 India planted 5.539 million hectares, 13.683 million acres, of cotton and from that acreage it produced 2.123 million 500 lb. bales for an average yield of 192.74 lbs. a hectare or only 78 pounds an acre. From here the Colonial government would push hard to increase acreage and it had some success by taking acreage from food crops resulting in peak acreage in 1906 of 9.100 million hectares, 22.488 million acres, with an average yield of 217.45 lbs. a hectare, or 88 lbs. an acre. Production reached 3,926,400 500 lb. bales. During the entire period of increasing growth in acreage between 1897 and

1911 yields average from a low of 150.73 lbs. per hectare to a high of 227.34 lbs. per hectare with the lowest yield occurring in



1911.

Production in 1910 was concentrated over a wide area, with Bombay state accounting for 2.560 million hectares, or 28% of the total Indian acreage. This included much of the current cotton production areas of Maharashtra and Gujarat. The second largest cotton area was the Berar and central province, which contained 1,815,827 hectares of cotton followed by Hyderabad, which planted 1,441,492 hectares. This state was located in south central India in today's states of Telangana, Karnataka and the Marathwada region of Maharashtra. Madras state, which was southern India in the region of Tamil Nadu, planted 766,071 hectares. Modern day

Pakistan was then part of India with Punjab planting 560,490 hectares and Sind 112,907 hectares. The average yield in India in 1911 of 150.67 lbs. per hectare compared to the US average yield the same year of 514 lbs. per hectare. The irrigated fields of Egypt that same season suffered a decline in yields but still produced an average yield of 1,008 lbs. per hectare. The US and India dominated world production in 1911 with little cotton grown in Brazil, China or other locations.

World War I initiated another important phase in the history of the Indian cotton industry. The British cotton textile industry peaked just before the start of World War I, which began in 1914. At the time, the

British cotton textile industry supplied India with its domestic needs. Therefore, during the time of British rule India went from a dynamic exporter of cotton cloth to an importer of British made cotton goods and an exporter of the raw fiber. In 1913 the British had overstocked cotton goods to India, a poor monsoon and a credit crisis prior to the war caused a sharp slowdown in shipments. The exports were cotton piece goods and a small amount of yarn. As WWI intensified and expanded, ocean freight rates to/from India surged from around 22 - 25 Shillings a ton to 275 Shillings a ton in 1918. Between 1915 and 1918, British cotton imports declined by almost 50%. The war also allowed for a sharp increase in



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Indian domestic production of cotton goods. The war years saw new Indian mills begin to come online with both cotton spindles and looms. Second hand looms from English mills were dismantled and shipped to India. Between 1913/14 and 1918/19 domestic Indian cotton fabric production increased from 2189.7 million linear yards to 2518 million linear yard while imports from Britain fell by 75%. However, it was during this period that Japanese exports of cotton piece goods to India began to occur on a large scale.

In the 1920's, Mohandas Gandhi launched the Khadi movement, which called for the boycott of British cotton goods further damaging imports. The period between World War I and World War II was a boom period for the Indian cotton industry. In 1932 India had 340 mills with 9.5 million spindles and 186,407 looms; domestic cotton fabric production increased by 54% between 1918 and 1931. India still had a cotton quality problem and it was during this boom period they tried again to find a solution. The answer was an American type of cotton grown in Indo-China called "Cambodia" which was adapted for India and introduced. This cotton became the basis for several new varieties and hybrids.

WORLD WAR II

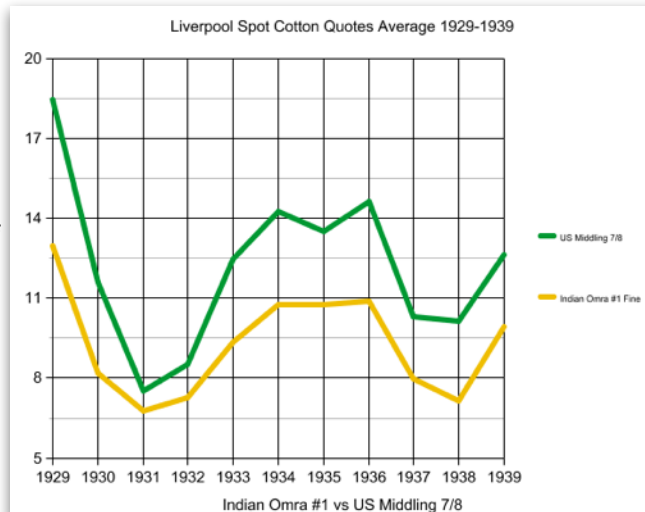
Between 1929 and 1948 India's cotton acreage ranged from 8.5 - 10.5 million hectares, however, production ranged from a low of 2.840 million 500

lb. bales to a high of 5.217 million bales with yields ranging from 165.82 lbs. per hectare to 294.27 Lbs. The spread between Indian yields and US yields widen further during the mid to late 1940's, in 1948 the average yield in the US was 765 lbs. a hectare compared to 228.2 lbs. per hectare in India. The monsoon, or lack of it, was a big factor regarding low yield as only 21.7% of the farm acreage was irrigated in 1930/31. To address the increasing need for food crops the Indian government in 1944 launched a "Grow More Food" program, which reduced cotton acreage. In 1929 India exported 3.293 million bales of cotton, in 1940 exports had fallen to only 1.891 million bales and by the end of the war exports in 1948 totaled a mere 943,000 bales. During this period international trade changed dramatically and India's domestic mill consumption increased. In 1942 India was consuming 4.026 million bales of cotton and had 401 mills with 10,131 spindles and 200,000 looms.

World War II brought significant and long lasting changes to the global cotton trade. Prior to the war, the Liverpool market was the world leader, but it was forced to close as the war in

Europe expanded and all trading ended in 1940. Indian cotton at the time was a major force in world trade, along with American cotton. Due to quality differences, Indian cotton was always quoted at a discount to US cotton, and in the period from 1929 to 1939 the discount ranged from close to 1 cent a lb. to over 5 cents. These were very large discounts considering the price of cotton during the 10-year period was always below 19 cents per lb.

INDEPENDENCE



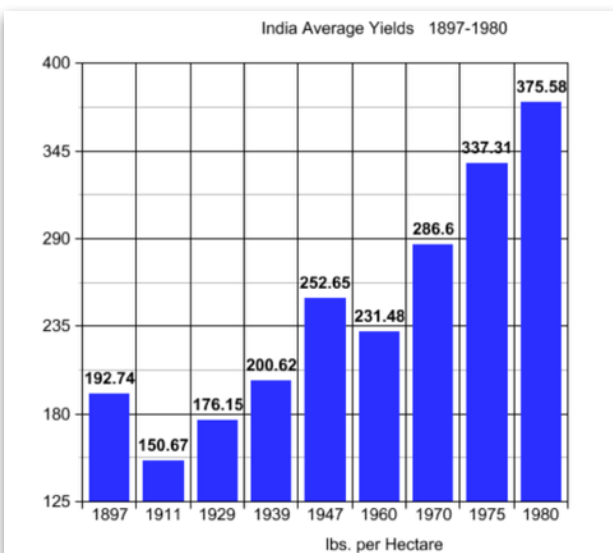
On August 15, 1947 India and Pakistan were separated and granted independence from Britain after 190 years of colonial rule. At the time of separation Pakistan had approximately 65,000 bales of textile consumption and a million bales of cotton production while India had the balance of the textile industry and approximately 3.5 million bales of cotton production. Pakistan took with it a large block of the irrigated acreage. At this time medium staple cotton accounted for 67% of

the acreage and short staple the balance of India's cotton production. The area planted to cotton in the first year of independence was estimated to be 4.3 million hectares and production of 1.724 million 500 lb. bales. By 1961 acreage had expanded to 7.78 million hectares with a yield of 105 kilograms a hectare, 231.48 lbs. and in 1969

acreage had expanded slightly to 7.810 million hectares and yields had reached 120 kg a hectare, or 264.55 lbs. The yields were a significant improvement of about 20% from the average yields of the 1940's. The All India Coordinated Cotton Improvement Project (AICCIIP) was launched in 1967, which brought about new seed variety research. Approximately 150 new seed varieties emerged from AICCIIP, including the H-4 variety.

During the decade of 1970 to 1980, cotton acreage changed little remaining near 7.7 million hectares. However, the average yield did experience another significant improvement averaging 164 kilograms, 361.58 lbs. per hectare in 1979/80. The increase in yields was a major improvement from the 1910 levels with yields doubling during this period.

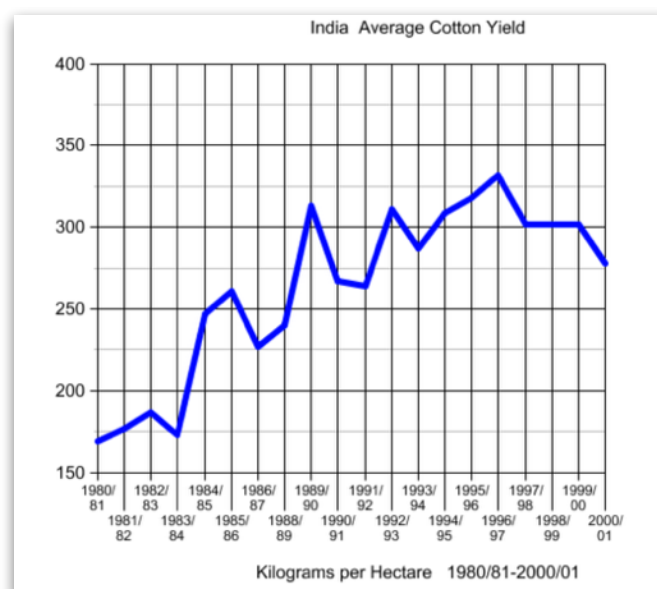
1980-2000 PERIOD OF NEW EXPANSION IN YIELDS



The period between 1980 and 2000 saw limited expansion in cotton acreage but another significant increase in cotton yields. By 1985 average yield

m o v e d above 200 kg, 440.92 lbs., per hectare before then making a dramatic jump from that level. It was during this period that new hybrids were introduced; the first was in 1970 in Gujarat. The new hybrids significantly changed and improved the fiber traits of Indian cotton. By the end of the period the crop was 69% long staple, 25% medium staple and 6% short staple compared to 67%

medium staple and 33% short staple at the time of independence. This change in quality had an important impact on India's cotton textile industry. In 1947, Indian cotton could only be used to spin 24 - 28 count yarn, but some 50 years later, staple length had increased to the point that Indian cotton was capable of spinning the finer 120 count yarns. Yield continued to increase, exceeding 300 kilograms, 661.38 lbs., a hectare by 1994/95 and in 2000 the hybrids were producing seed cotton yields of 40 quintals per hectare compared to 15 in 1947. Improved farmers' income, along with advancements in disease resistance, is a result of the success of the hybrids in enhancing yields and fiber



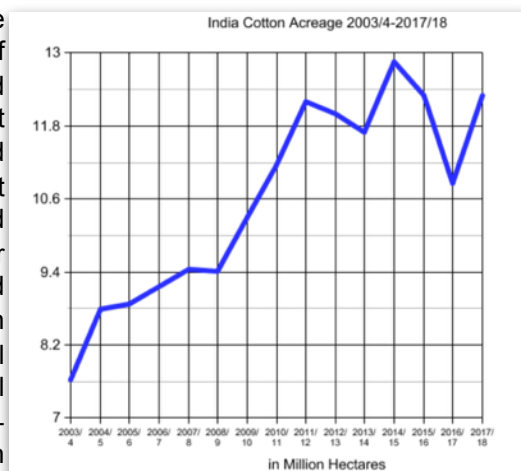
quality.

BT COTTON IS INTRODUCED

For all the positive benefits of the new cotton hybrids there were sizeable challenges as

well. Growers were experiencing new diseases and pests which they had little experience dealing with and the government extension service aiding the small, uneducated rural farmers were inadequately trained and poorly equipped. The government's solution was principally to encourage treating the problems with a host of chemicals. Yields and quality had improved but farmers now found they had a new and costly input structure that jeopardized those benefits. The grower must purchase the hybrid seed each year and then the increased chemical usage requires additional credit from the local moneylenders which then increases the hold on the farmer. For farmers, such as those in Maharashtra, these conditions create a tremendous burden as they were used to the Desi varieties, which were resistance to many diseases and pest, therefore, requiring less input cost. The extra cost associated with the hybrids and lack of training in the use of inputs created a crisis situation for many growers, which in turn meant a problem for state and national governments, and to some extent the Indian textile sector. Agriculture problems of this scale do not happen in a vacuum. The hybrid seed issues joined the list of difficulties farmers already had to deal with: erratic rains, poor monsoons, lack of credit and needed irrigation. Only 27% of the acreage in Maharashtra is irrigated. The local agriculture retailers, which supplied

cottonseed and chemical inputs, were also the local moneylenders. Many of these were small one hectare farmers who saw their indebtedness soar due to overuse of chemicals. Prior to the introduction of BT cotton 54% of all pesticide use in India was applied to cotton.



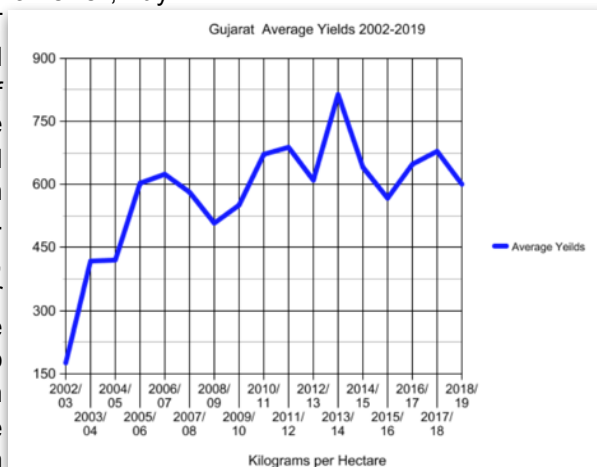
With the introduction of BT cotton in 2002 the average yield in India began to increase. In 2004/05 BT cotton accounted for only 5% of the acreage with average yields increasing to 471 kg, 1,038 lbs, per hectare, however, by 2013/14 BT cotton had reached 90% of the acreage. The record yield occurred in 2013/14 reaching 577 kg, 1,272 lbs, per hectare. The arrival of BT also resulted in cotton acreage increasing from 7.630 million hectares in 2003/4 to a peak of 12.850 million hectares in 2014/15. Gujarat, Maharashtra and Andhra Pradesh experienced

the largest increases in acreage.

No state benefited more from the introduction of BT seeds than Gujarat, which also has lead in the adaptation of more modern farming techniques. In 2002/03 the State had a average yield of only 175 kilograms per hectare, in 2013/14 it reached a record 815 kilograms which remains a record to this day. Since the stagnation of the introduction of the latest BT technology average yields have fallen to the 650-680 Kilogram per hectare level.

2014/15 TO TODAY; CRISIS DEVELOPS AS YIELD GAINS STALL

In 2013 Mayee & Choudhary conducted a comprehensive survey of Indian cotton farmers and found that BT seeds had been a overwhelming success responsible for yields nearly doubling on both irrigated and dryland acreage. Seed cotton



yields achieved the same level of success. The survey revealed a reduction in losses from bollworm, high vigor on cotton genotypes and an

improvement of cropping practices. The number of insecticide sprays was reduced by 82.8%. The survey showed that up to 50% of the farmers received their primary information on BT cultivation from input providers, retail dealers and seed companies. Due to poor training, and other causes, farmers did not plant the mandatory refuge areas, which led to the beginning of problems the next season.

The 2014-2015 season began with Indian cotton farmers excited and optimistic, planting a record 12.850 million hectares with more than half that acreage in Gujarat and Maharashtra. That season the crop encountered new pests, including a comeback of the Pink Bollworm. The average yield fell to 500 kilograms, 1,102.31 lbs. a hectare

accompanied by a slight decline in acreage the following season to 12.3 million hectares followed by a further fall to 458 kg per hectare in 2015/16. The lower yields hit farmers particularly hard as cost had



risen sharply since 2003/4, with labor, seed, fertilizer and insecticide cost increasing by more than 3 fold. In 2015/16 a whitefly outbreak in the Northern Zone (Punjab, Haryana, and Rajasthan) caused significant losses for growers, which caused many

growers not to plant BT cotton in 2016/17 fearing another attack. The traditional Desi varieties were not affected with acreage temporary increasing. Cotton acreage dropped to 10.850 million hectares in 2016/17 but the average national yield recovered to 542 kilograms per hectare. This, along with a surge in local prices, resulted in farmers increasing acreage in 2017/18 back to 12.3 million hectares.

Yields in 2017/18 declined, the full extent is not yet clear as arrivals continue to slowly come in, following a major outbreak of Pink Boll Worm in Maharashtra, Telangana, and, to a lesser extent, in other states. Some areas experienced a 50% loss in yields, while a 10 - 15% loss is common. The reduction in overall yields reduced the

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Cotton Association of India (CAI) estimate of production to 36.5 million 170 kg bales in their last estimate. Arrivals had only reached 34.845 Million bales by the end of June and daily arrivals suggest that the crop may fall short of the CAI estimate. If the crop can reach 36 Million 170K bales then this would place the average yield at 497.56 Kilograms a hectare or 1,096.93 pounds. This the second lowest yield in ten years and much lower than the average yield.

THE PROBLEMS

The Seed

One of the factors that has become clear over the past several years is that the beginning of both cotton quality and yields is the “seed”. This requires a new way of thinking as compared to many of the traditional thought processes. Over the past five years among the major cotton producing regions, both cotton quality and yields have made major strides

in Australia, USA and to a lesser extent, Brazil. Australia has long been the world leader and now it has set new records as yields have reached 15-17 bales a hectare compare to the common budget of 8-10. The reason is that Australian growers treat cotton farming as a science taking advantage of every technical tool to boost efficiency. Its seed production and distribution is extremely controlled and it was the first to deploy the Bollgard 3 technology, which provided a further boost to yields, with irrigated yields in 2018 a new record. The quality was also excellent, at right below those of Pima. Many factors played a role in the success but it all started with the quality of the seed and its BT technology. US production has been strong as much of the Mid-South, South Texas, Texas Irrigated acreage and the Southeastern belts have produced not only record yields but also cotton quality that is now challenging Australia. This success is also tied to a host of factors but here it also started with the quality of the seed and the application of the correct technology for its maximum benefit. In both countries, new more advanced seed technology is applied annually and a strong rule of law assures good compliance with the requirements required for BT cotton to perform. In the US, there is almost no noncompliance, with some compliance issues potentially in very poor yielding regions of West Texas. In both countries seed companies have spent millions of USD and an

extended development time to produce the new high technology seeds. The ability to be paid for this work has resulted in a good partnership. Growers have learned that the strict controls and technology fees are now paying off with major quality and yield advances.

In regions where this partnership breaks down, yields suffer. BT cotton was introduced in India with great fanfare. However the govt. and private sector appear to have been ill prepared with the other requirements that came with its introduction. This has now become evident. First the sharp jump in yield was greeted with great excitement as farmer's incomes increased, production increased allowing new gins and ginners to profit. However the industry soon forgot the importance of the roots of that success. From the very beginning, the true market forces were never able to work unencumbered by the Government or local politics. For example, the pricing of BT seed is set annually by a Government that has set limits / caps on the trait fees that can be collected by technology developers. This set the stage for disaster, as the producers and owners of BT technology were exposed to potentially not being able to cover expenses associated with the development and introduction of new innovation. Simple economic logic dictates that if the seller of an innovation has no chance to recoup the costs of creating its product, it no longer has the

incentive to bring its innovation to market – this is the unfortunate situation that government interference has created in India. Furthermore, patent protection of seeds and traits is also threatened due to a landmark court case that has been moving from the Low to High Courts over the past couple of years. The case has now advanced to the Supreme Court (set to be heard toward the end of September of this year), and will be critical in setting precedence for investment in India relative to agricultural (and other industries for that matter) innovations reliant upon patent protection. Such a ruling would severely harm the incentive to innovate and India's access to innovation in agriculture, and the true victims will be the domestic farmers and industry who most need these innovations.



If the technology investments of companies in agriculture are not protected, then no companies will invest in the extended research needed for the latest in seed and BT technology. The Indian market has an active free press, this also means lots of false news and unconfirmed rumors. In this atmosphere, it's easy to make the global multinational companies as the enemy and taking advantage of the Indian farmer. The reverse has happened, the limited sense of

order broke down in 2018/19 as the BT technology that was released was older and ineffective against the Pink Bollworm. Seed companies went their own direction, while counterfeit operations were set up as the marketplace went wild to meet the farmers demand for seed that would fight the bollworm. Attempts to enforce rules against such seed found ginners and others had produced false seeds and labeling. Others turned to the internet to buy the latest BT seed, this seed was not bred for India and its quality is not known.

The govt. turned a blind eye to the need of the farmers to obtain quality BT seed, instead focused on keeping the cost low and then raised the MSP. This is the wrong strategy for cotton to be a profitable crop. It is about yields, and price alone will very seldom ever solve the problem. It will not be possible to raise the MSP 25% annually, so what happens in 2019/20 if Indian yields average 450 kilograms a hectare and prices decline, while a 1100 kilogram yield would change the entire economics even at a lower price? The increased yields in the US and Australia have played a crucial role in expanding the profitability of cotton, this was especially true in the US where the USDA Cotton program benefits were greatly reduced. The 2018/19 MSP at the current exchange rate (71.56) and average ginning outturn equals around near 78 US Cents a lb. If one assumes a farmer has a 2

hectare farm at 450 kilograms yield this would equal a 1547.64 USD gross income, while at 1100 income would reach nearly 3,664 USD. The difference is the difference a good basic income or just paying input cost.

Thus the first pillar of moving the Indian Cotton Industry forward is establishing a firm structure for the investment in the latest BT cotton and seed technology, protecting those that produce it and also to provide the farmers with uncorrupted assistance in the proper growing practices that go with the new technology.

MAHARASHTRA



The state of Maharashtra has the largest cotton acreage in India with 3.9 - 4.2 million hectares planted. It also has the longest history of growing cotton going back to the days of the East India Company and, in general, the condition of the growers has shown limited improvement since then. It also has the record for the lowest yields in India and continues to maintain said record year after year. Maharashtra's troubles begin with its lack of infrastructure as only 6% of the cotton acreage is irrigated in the large production area of Vidarbha and around 18% in the balance of the state. This means the crop is always subject to the behavior of the

monsoon. Maharashtra has four key regions; the capital Mumbai is located in the coastal region of Konkan and Goa, which grows little cotton, Madhya Maharashtra, Marathwada and Vidarbha. A major mountain range, Western Ghats Mountains, separates the other districts from the coast, which acts to restrict the flow of moisture. Rain producing systems moving inland from the coast become depleted by the time they reach Marathwada. Marathwada is a very drought prone area, which has no major river running through it making even the simple supply of drinking water difficult. The district suffered serious droughts in 2012, 2014 and 2015 and even in the good monsoon of 2013 rainfall was never in excess. Marathwada weather is much too volatile for a high input crop such as cotton to be grown there. Despite the weather Marathwada contains the largest cotton districts in the state with acreage in 2016/17 reaching 1.88 million hectares in this district alone. In 2016/17 yields within this district ranged from only 238 kilograms in Beed up to 779 in Parbhan. The region to the east in Vidarbha also is drought prone and extremely poor. Both Marathwada and Vidarbha have been overlooked in development. Erratic yields within the state illustrate the issues with rainfall, limited irrigation and poor soils in many areas.

Cotton has been grown in these regions for more than a century, and its attraction as a

cash crop has, however, resulted in cotton being grown in areas not suitable for it as well as areas that are. The problem starts with the fact that on paper the area indicates adequate rainfall to produce a great crop of cotton but the rainfall can occur in short heavy downpours leaving long periods of dry weather. The landscape is unsuitable for surface irrigation leaving farmers dependent on wells. In addition, the lack of food crop production causes a crisis when cotton, or the other cash crops, like soybeans, fail. While cotton as a cash crop can produce boom years the erratic nature of their rainfall, and thus yields, has created a long history of indebtedness which has left farmers in very poor shape. The increased cost associated with producing the crop has added to the problem.



In both of these regions farmers live and die for cotton as their economic livelihood depends on it. Soybeans have become the only alternative crop. In Vidarbha cotton acreage in 2013/14 amounted

to 700,400 hectares in the Yavatmal district with total acreage in Vidarbha reaching 1,012,700 hectares of cotton and 1,438, 600 hectares of soybeans.

Maharashtra's long history of growing cotton has taken a toll on the soil due to the fact there is little if any crop rotation taking place. The average yield has ranged from 293 to 323 kilograms a hectare, which is far below the other major cotton producing states. Maharashtra's total cotton producing areas averages near 30% of the Indian acreage, which places it in a key role. Cotton has become quite a complicated crop to grow, especially in regions of the world, which experience erratic rains and high humidity, which are conducive to pests. The inputs and management skills required to grow cotton today compared to those 25 years ago are dramatically different. Moreover, the quality demanded by the global textile and apparel industry is increasingly requiring a higher quality cotton fiber, which can compete and perform or out perform, with the man-made fibers. India faces a real challenge in adapting to these changes.

The Maharashtra continues unable or unwilling to address the major issues confronting their cotton industry, but instead relies on subsidy schemes, which do not address the underlying problem. In 2017 the crop was hit by catastrophic losses from the Pink Bollworm, which caused

yield losses of 50% in large blocks of the state. The situation in Maharashtra is so dire that the state government announced it was seeking payments from insurance and input suppliers for a special aid package. Cotton growers could receive a onetime payment of 30,800 Rupees, just below 480 USD, per hectare for dryland acreage and 37,500 Rupees, 584 USD, per hectare for irrigated acreage. Payments will be limited to 2 hectares. Moreover, a bonus on seed cotton will be paid at 200 rupees per quintal of seed cotton on a maximum of 50 quintals.

The state lacks an agriculture extension service that is well trained, well paid and ready to help solve the problems. Because the state experiences no freezing temperature the cotton stubble in the heavily affected areas must be destroyed and time given for the pests to die. This preventive action is not occurring even though the state has declared it must be done because it has no enforcement power or ability to carry it out. The plants are still standing in the fields as growers are attempting to pick up to 5-6 times as a means of boosting their terrible yields. The stubble needs to be destroyed in December for maximum success.

Growers in the state face few alternatives other than cotton, and soybeans, the major alternative crop, has its issues. Because stubble was not destroyed on time, the 2018/19

crop will face a Pink Bollworm problem as well. The lower crop in 2017/18 has resulted in better prices, which along with the higher MSP may lead growers to give cotton another try.

In the near-term, cotton acreage in 2018/19 in Maharashtra will decline but for now cotton remains the main cash crop by default. Another year of poor yields due to the Pink Bollworm would likely spell the bankruptcy of large blocks of growers. It is unclear how effective the government's aid package will be in reducing debt. Another issue Maharashtra must address concerns cotton quality - the lack of grower education regarding crop management practices and incentives focusing on the importance of quality - which can result in the lint being damaged before it is even ginned. Growers have rushed to pick when the moisture content of the seed cotton is excessive and when stored for short periods in farmer's homes results in yellow seed cotton, which impacts the quality of the products it is used in. The practice causes a range of issues, e.g., the government in 2010 banned a product, which killed mites that got into the seed cotton and caused rashes on people who handle the cotton. A large volume of seed cotton from Maharashtra normally crosses the border and is sold in Gujarat. In 2017/18 large discounts are being applied to poor quality seed cotton from Maharashtra by Gujarat ginners. Ginning

practices are also an issue with contamination an ongoing problem from the state. Most of the production will have to be used domestically. In 2017/18 the discount of Maharashtra cotton to Gujarat cotton further reduced farmer incomes.

EXTENDED PICKING

In the US, Brazil and Australia the planting and harvesting periods are tightly controlled. In India the arrival of the hybrids resulted in an extension of the harvest period. Research has shown that prior to 2013/14, farmers in most areas picked their crop only 2 - 3 times and then terminated the crop by December or January. Since that time growers increased the number of pickings to 4-5 times or more which extended harvest into March. Given that 60% or more of the cotton crop is strictly rain fed and farmers stop applying plant nutrients in November the cotton plants do not get the proper nutrients late in the season. This opens the way for the Pink Bollworm to attack. Also, late season rains can impact the quality of any crops still being picked. Even though the 3rd or 4th pickings are poorer quality some growers have added a 5th picking.

A strict control system needs to be in place to limit the number of pickings and establish a hard schedule for the destruction of crop stubble. In addition growers need to follow instructions on the refuge areas of fields. In the past most seed was distributed in units of 25 grams of non -BT seed in a separate package along with

450 grams of BT seed. Farmers in many cases have ignored the Non-BT refuge plots. Some areas have required the official seed to be mixed together which means that the growers will have to plant the refuge seed. What is not clear is will this be effective, the BT technology was designed for the refuge plots to be located at certain distances and in certain locations, how it works in side by side plots is a different environment. The small plots of the farmers in India generally need special adaptation to suit the small plots of growers. Growers also need education and maybe an incentive to follow guidelines.

QUALITY IMPROVEMENT AND INCREASED MILL INVOLVEMENT

The Indian mills that were established after the 1920's for a long period of time used older, used-equipment, which allowed Indian consumption to include a much lower quality of cotton than that of many other textile producing countries. Some mills still acquire cotton in the loose form and some manage small gains in order to purchase seed cotton directly. Because the Indian mills have traditionally been slow to improve the quality of cotton needed this has allowed the ginning industry to continue to operate with older equipment while maintaining practices which keeps continuing a

problem and lowers quality. Gujarat has led the way in innovation and also the modernization of its ginning industry. However, this has begun to change with a major shift noted in 2016/17. New Mill groups have invested millions in new mills and complete operations. In addition, these mill groups have worked hard to win contracts with US and European retailers, that have certain quality standards; the old practices will not work for these groups. This has put a new emphasis on the cotton used and have increased the volume of cotton imports, especially in the longer staple upland and ELS styles. Several mill groups lost millions of dollars in export contracts in 2016 after they were found to



Cotton, 100% crafted in nature, not in a lab.

"For me, it's all natural, and it's cotton every time."

- Ed Jernigan



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be making false claims about the origin of the cotton used in their products. New technology with the ability to verify the type of cotton used was developed to prevent such fraud in the future. The technology has become very popular with those dealing with US Pima. We expect the process to spread to other cotton as well.

The type and quality of cotton a spinning mill uses plays an important role in the quality of the end product, therefore, brands and retailers are increasingly requiring a way to verify the use of the correct quality and type of cotton. The days of using the lowest quality, cheapest cotton possible to meet the minimum fabric specifications are limited and coming to an end. India imported a record volume of cotton in 2016/17 and is on track to import a large volume in 2017/18 and much of that was US and Australian high-grade upland, in addition to the ELS imported.

India's cotton textile and apparel industry faces a major opening from the trade dispute that has erupted between the US and China. As of this date, the US will begin to impose a special duty on China's textile and apparel imports. The exact implementation of the duty or its duration is currently unknown. The sheer risk of a 25% or more US duty on Chinese imports has exposed a key risk to the global textile and apparel chain of the over dependence on a single country's supply chain. We see a major upheaval in the textiles

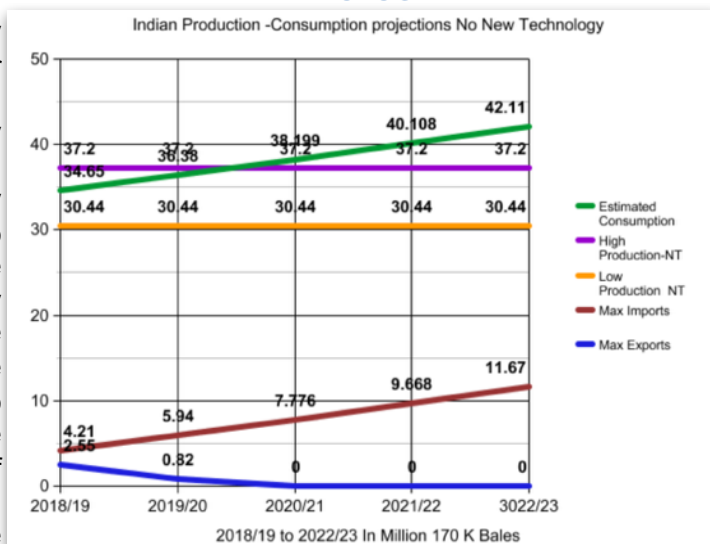
and apparel chain now beginning with the event reshaping the global consumption maps. China will remain an important consumption base but they will increasingly focus on their rapidly expanding domestic market. The size of the Chinese domestic market alone is the base for a significant industry. As the supply chain changes from China centric, it will mean a higher cost structure. The world is aware of the environmental toll the industry has taken on China so the key candidates for the investment outflow are keenly aware of the risk to the environment of the fabric, dyeing and finishing industries. The relocation or new investment will have a much higher cost base. This will put considerable pressure on the Fast Fashion industry and those focused on cheap apparel. The relocation of the supply chain will also reduce the role of polyester. China is home to 80% of the global polyester production.

Now the Indian cotton industry has a major opportunity. The opportunity will be lost, however, if they are not able to better manage their supply chain. To be competitive India needs to reduce the percentage of contamination and produce

better quality cotton. Currently the industry removes contamination at the mill by using human labor to actually clean seed cotton by hand. To accomplish this India's mills will need to develop new supply chains directly to ginnerers and maybe even to growers or to some level of cooperative effort. Gujarat has proven a leader in, first, quality improvement of its cotton, secondly, the establishment of modern gins and finally, an expansion of new spinning operations in its new textile parks. The effort in Gujarat has been led by private ginnerers, and an aggressive, efficient state government. Unfortunately the model will not be able to be repeated in many of the other states, as they will require more innovation.

This will be important in helping Indian mills secure the cotton supply they need to meet the expanded demand.

INDIAN COTTON PRODUCTION HAS PEAKED WITHOUT NEW TECHNOLOGY



Indian cotton production cost has risen sharply over the past 5 to 10 years primarily due to recent increases in pesticide use and labor cost. The average farm size in India is 1.23 hectares but the average cotton plot is estimated slightly larger at 2 hectares. In Maharashtra the average farm size has actually shrunk 22% to 1.46 hectares, which illustrates the stress agriculture is in. The small plots have made **mechanized** agriculture difficult but tractors have become widespread in the states with the larger farm sizes. Gujarat, Rajasthan, Haryana and Punjab appear to have the largest cotton plots. The fact that 60% or more of all acreage is dryland adds to the woes. The greatest expansion in Irrigation is in Gujarat where new schemes have been introduced by the state government. Without new technology to control pests and better growing practices the pressure to turn to varieties, which require cheaper inputs will grow. If growers experience another significant problem with pests in 2018/19 many will be forced to give up on cotton all together.

The Indian cotton industry faces a monumental challenge in its battle to find an effective way to control the Pink Bollworm. Without technology growers will seek shorter season varieties that allow for the cotton to mature before the worm strikes. Such varieties would offer a trade off for growers; lower yields, but also lower input cost. Against that backdrop cotton acreage has

peaked near 12.5 - 13.0 million hectares until a major surge in world prices occurs or new technology is introduced. Average yields also face difficulty in moving past 550 kgs per hectare without a near perfect monsoon. The current situation suggests that over the next five years India's cotton production will find it difficult to break the 36 - 37 million 170 kg bale level without new seed technology. We expect cotton acreage to stabilize near 11.0 million hectares with production ranging from 30.4 to 37.2 million 170 kg bales in future years with no new technology.

Indian cotton consumption is increasing led by new spinning capacity coming online in Gujarat. 2017/18 consumption is expected to exceed 33 million 170 kg bales, which mean consumption will exceed production during poor yielding periods. Consumption is expected to grow by at least 5% on average over the next five years which means by 2022/23 domestic mill use will reach 42.11 million 170 bales. India has never produced a crop that size and does not have the ability to do so anytime in the near future.

COTTON ACREAGE FAILS TO INCREASE IN 2018/19 DESPITE RECORD MSP



A sharp decline in cotton acreage in 2018/19 was averted by a record rise in the minimum support price and a greater effort by the Govt. to assure growers receive as much of the MSP as possible. However a higher MSP is not the answer to assuring cotton acreage in the future. First the MSP is based on a grower achieving a normal yield and then covering the total cost of production and achieving an acceptable income. First What happens when yields falls?. Also what happens if the need to fight a pink bollworm outbreak sharply increases the pesticide cost? A Farmer could experience a negative income from cotton if yields fall sharply. Another issue is that India faces major budget constraints in funding the record MSP's across the commodity complex. As this report goes to press the Rupee/USD has fallen to a record low of 72.44 per USD following a sharp increase in the Indian trade deficit driven by crude oil imports.

Once the acreage is established, the next issue will be that of yield. Recent yields have ranged from 458 to 577 kilograms or a range of only 2.10 to 2.60 480 lb. bales per hectare. This compares to 4.67 bales a hectare in the US last season and an expected 7.65 bales per hectare in Brazil in 2018. There is strong evidence supporting the need for better seed technology and improved growing practices; cotton is not an economical crop at such yield levels when the average farm size is 1 - 2 hectares. Assuming an excellent

monsoon the poor quality of the seed suggests that average yields should fall into the 500 - 525 kilograms per hectare. However, a medium monsoon with uneven rainfall distribution could push average yields back to the 450 - 475 kilogram level. Before you appear shocked by such an average, yields in West Africa, where BT cotton has also experienced poor adoption, the average yield in the Ivory Coast in 2016/17 reached only 394 kilograms per hectare.

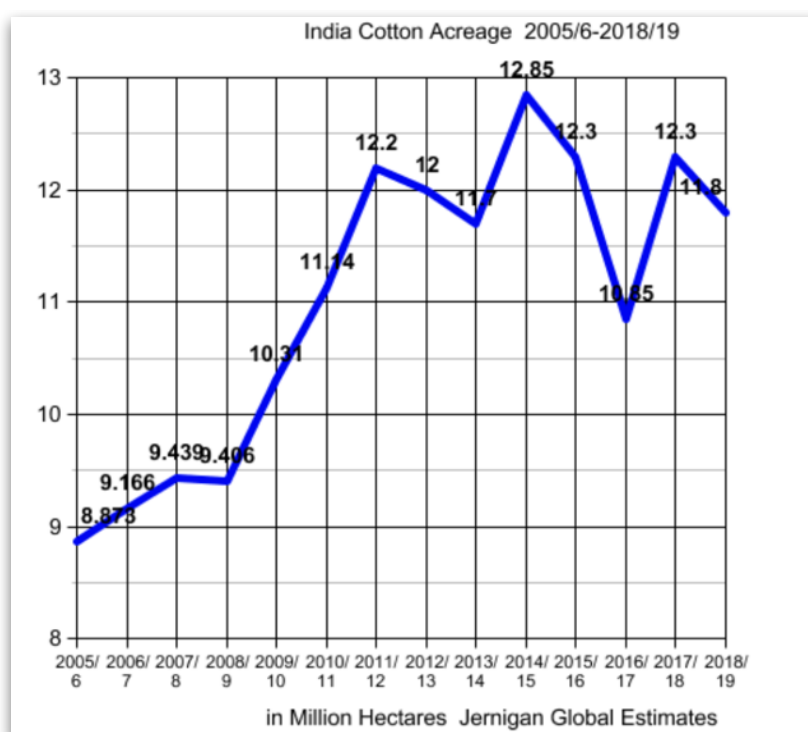
Maharashtra and Telangana planted more than 6 million hectares to cotton in 2017, which is almost half of India's cotton acreage. Maharashtra is a very large state with a large number of very poor farmers. The Vidarbha region of the state is one of the largest cotton producing regions and it is also home to an estimated 3.4 million cotton farmers. It also has one of the highest farmer suicides rates in the world due to a large number of its farmers being extremely poor and one bad season, just one crop failure, away from financial disaster. The farmers are not educated on modern crop management or the proper use of many of the pesticides they spray on their crops, which in many cases causes a host of problems, including severe health issues. Middlemen have also preyed on these farmers with poor quality inputs and high debt services. We expect cotton acreage to difficult to maintain over the long term without a sharp increase in yeild in Maharashtra with farmers

turning to food crops which are much easier and cheaper to grow require fewer inputs. The state has historically been controlled by the Congress Party, but today the Modi's BJP party is in power and will be under pressure to aid the farmers.

The economics strongly suggest food crops are more suitable for many of the growers of Maharashtra. In 2016/17 the state had an

averaging yields in 2016/17 of 579.13 kilograms per hectare or 2.66 bales per hectare.

As of this time total planted acreage in 2018/19 reached near 11.8 Million Hectares which is down slightly from the previous year. Despite the higher MSP acreage in Telangana declined as expected following the heavy losses from the pink bollworm in 2017.

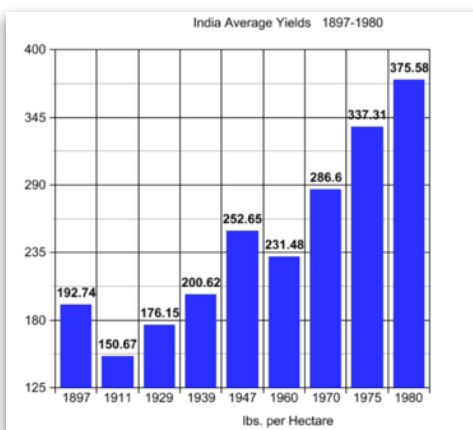


average yield of only 395.92 kilograms per hectare, which was nearly 50% of that of Gujarat, which had a yield of 671.52 kg. Converting this to bales, Maharashtra had a yield of only 1.8178 480 lb. bales per hectare or 353.27 lbs. per acre. Cotton simply cannot provide an income or living wage on 1 - 2 hectare plots at such yields. Telangana has had much higher yields in the past

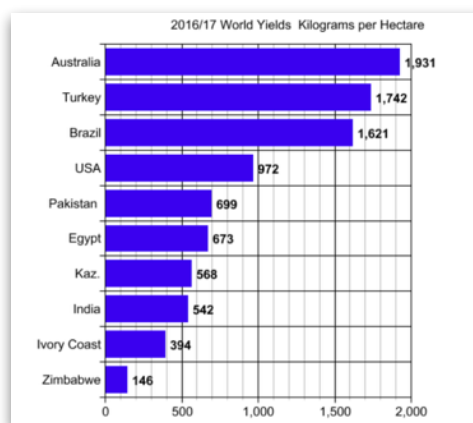
As we attempt to forecast production over the next five years without new technology we estimate production will be confined to a range of 30.44 million 170 kg bales to 37.20 million 170 kg bales and that average acreage will be no more than 11.5 million hectares level in most years which may be a challenge without a great monsoon and strong prices. India's increasing consumption

will outpace its largest production area by 2019/20 creating a need for additional record imports. We have projected the growth in Indian consumption at only 5% annually – it could easily exceed that level. It is our belief that “The Age of Cotton” has returned and this places India in a prime spot to expand cotton apparel exports. However, to do so will require modernization, change in labor laws and new stimulus for the needed investment in the most modern fabric operations. Even today the country’s industry is under pressure from imports from Bangladesh made from Chinese fabric.

The new spindles are requiring higher-grade cotton fiber, which is also placing a burden on the production side to improve practices. Mills are beginning to take it upon themselves to meet this demand by becoming more involved in the supply chain, which takes a major effort after years of a combative relationships. In Gujarat this is already underway with the development of modern ginning companies. Transportation/logistics has been a cotton supply chain impediment for years and remains so today. Southern mills are looking at a very cheap cost to import cotton versus purchasing central Indian cotton with high shipping cost. In past seasons West African, East African and US cotton could be landed in southern India at prices below the landed price of Maharashtra cotton.



INDIAN YIELDS 79% BELOW USA BUT EXCEED WEST



AFRICA

Indian average yields in 2016/17 reached 542 kg, which was the second highest level on record. However, it was 79% below the US average yield and only 28% of the Australian average yield of 1,931 kilograms. When compared to countries with similar conditions it is above West Africa and far above some of the depressed levels of East Africa. If average Indian yields could be increased to 600 kilograms then domestic production would reach 40.59 million 170 kg bales while 625 kg would equal 42.28 million 170 kg bales. These estimates are

based on acreage of 11.5 million hectares. It will take new seed technology, educated growers and improved growing practices to reach this kind of increased yield.

GUJARAT LEADS NEW EXPANSION OF COTTON CONSUMPTION

The implementation of the Gujarat textile incentive package launched in 2012 with a 5 year target has changed the face of the Indian textile and apparel industry forever. The special package was renewed for a year in September 2017 and it is responsible for major new fixed asset investment in Gujarat's textile operations. Gujarat has been called the “Manchester of the East” and “Denim Capital of India”. The program seems to be a success resulting in a large increase in new cotton spinning capacity being installed. By the end of 2018 the state is expected to have a cotton spinning capacity of 4 million spindles, which marks a doubling of the capacity in 2012. The plan is centered in five regions; first, an investment in cotton spinning in the Sureenrangar, Manavadar and Gondal regions, second, hand printing and processing units in Saurashtra, third, denim production in Ahmadabad, fourth, technical textile production in Ankaleshw and Tapi and, fifth, the Surat region would focus investments on silk and man-made fiber.

The aid package included funding for 10 textile industrial parks and five special economic zones. The scheme

provides a 5% interest subsidy on new plant and equipment, 7% interest subsidy on the purchase of new cotton spinning equipment, a refund of the VAT, power tariff concession on new cotton spinning investment and funds for training. In September the program was extended for an additional year. The Cotton

Association of India in its February 2018 supply and

demand estimates raised domestic consumption one million 170 kg bales because of the new spindles coming online. Another one million bale increase in consumption is expected over the next several months as additional capacity comes online.



The Path Forward

India's rich history of cotton production and its role in global textile and apparel trade suggest their cotton industry can adapt to the challenges. Today's challenges offer significant opportunities for public/private partnerships to address key industry problems in the face of government inaction, which has the potential to move cotton production to a new level and to positively impact millions of farmers. Despite the many benefits BT Cotton has offered, it cannot be expected to address all the problems facing cotton production in India. The failure of BT cotton to address all the problems of the industry is understood by most in the India's cotton trade. However, for those farmers who saw their yield momentum stall, experienced very limited or no actual improvement in income from BT cotton or have limited information sources, the perceived inability of the traits to continue to kill new pests and eradicate the Pink Bollworm is an easy target on which to focus the blame. Most farmers have received their advice on the use of BT from the service providers who are quick to avoid blame. The increased cost of BT cotton production and the continued risk of dryland farming have left the small farmer in extreme debt and no access to

credit. The local money lending system, which has been in place since colonial times, is antiquated and needs to be replaced.

Moreover, the heavy concentration of cotton acreage in Maharashtra is a real dilemma; farms have grown cotton there for more than 200 years without any innovation or improvement in infrastructure during that period. Maharashtra has been plagued with socialist governments, which have attempted to address the farmer's needs via centralized buying and floor prices. Each such effort has failed as corruption and other problems have left the farmers empty handed and further in debt. New innovative ideas are needed to actually improve grower income.

As the 2018/19 season advances, it is clear the Industry is in crisis. One government-funded study found that 15% of all seed distributed in 2018 had been illegal Herbicide Tolerant BT cotton that contained the unreleased Roundup ready flex trait. No report has indicated how this could have occurred or where the black market seed companies obtained the seed. In areas hit last year by the Pink

Bollworm, private reports suggest over half the acreage could be planted with illegal seeds.

The crisis has come at a bad time for the country's Textile/Apparel supply chain. The Indian textile and apparel sector is poised for a new period of consumption, growth which will shift India from an exporter of raw cotton to mainly an importer without a sharp increase in cotton yields poised for a new period of consumption, growth which will shift India from an exporter of raw cotton to mainly an importer without a sharp increase in cotton yields. The Gujarat state government has been one of the most innovative states in India for many years and it has paid great dividends for the textile and apparel industry.

Our team has in-depth experience in India dealing actively with the Indian cotton trade and the Indian cotton textile and apparel industry. In preparation for this research we held informal discussions on possible paths forward for the Indian cotton industry. Several themes emerged from these discussions which could form the basis for much more extensive research. These include Private sector involvement

and interaction between textile and apparel leading companies, ginneries and growers, increased involvement of Agriculture universities, public/private partnerships, education campaigns, and finally establish a firm legal framework for the reintroduction and maintenance of the latest BT technology.

1. Private sector involvement in promoting interaction between textile and apparel leading companies, ginneries and growers. Identify 3 to 4 large groups to anchor a group to explore the development of full supply chain and the enhanced use of technology.
2. Establish a relationship with the primary agriculture universities in 2 or 3 of the main cotton producing states. Many have a history of cotton research and have an farm/village extension service department. The universities have excellent contacts with the state and national government and many have *ICAR research facilities. The university extension services departments have a long history working with the villages and are well respected in local communities. Work with these

groups on several possible methods to develop growers into working groups. In such states as Maharashtra for cotton technology to really work an entirely new distribution and training program will be required.

3. Develop a sample model for a public/private partnership to teach the correct use of BT technology and offer unbiased feedback on how to improve performance.
4. Launch an education campaign on the outlook for the Indian cotton industry if new technology is not forthcoming - illustrate the inability of the current seed varieties to increase yields which causes a domino effect from the field to the spinning mill to the retailer. Without increased yields cotton acreage will decline.
5. The education campaign could be two-fold. First, the "Age of Cotton" returns which presents a new opportunity for India to recapture its role from the 8th Century as a dominant force in cotton apparel trade. Secondly, the stigma of India moving

from a cotton exporter to cotton importer.

6. An education campaign could be launched in conjunction with textile and apparel industry groups and cotton groups. India, and the Modi government, is very nationalistic and obviously proud of their history so the threat of becoming a major cotton importer could be a call to action. The impact of new seed technology implemented correctly on yields can be emphasized. The recent crisis was void of any discussion of the advantages which new seed technology can bring and failed to mention responsibilities of the untrained growers.
7. Establish a firm legal framework to protect seed technology and an improved distribution method for the seed that prevents alterations.

In closing 2018/19 Indian Yields are poised to equal only 50% of the US or one third that of Brazil. This inequality is unsustainable and no amount of subsidy can provide the solution an improvement in yields can accomplish.



THANK YOU TO ALL WHO CONTRIBUTED TO THIS RESEARCH ACROSS INDIA

JOIN US IN MOVING THIS DISCUSSION FURTHER:

In order to move this discussion forward we are establishing the

JG India 2025 Cotton Initiative & Council

If you would like to be part of this Initiative please contact either our Indian
or US Office:

USA: Ed Jernigan ed.j@jernigancg.com

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