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Extra Long Staple Cotton in India: To Meet the Demand of a Long Term Goal

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Abstract : Cotton is the backbone of textile industry, which consumes 70 per cent of the country's total fibre production. All four domesticated cotton species are grown in India, where there is significant variation in all characteristics, particularly in terms of fiber quality, which includes 13–7 mm staple length, 25–3 g/tex bundle strength, 1.4–.4g boll weight, *etc.* However, the demand of the textile industry is not met by the production of cotton in the country which falls mainly in ELS category. ELS cotton is produced by only four states such as Karnataka, Tamil Nadu, Madhya Pradesh, and Rajasthan produce ELS cotton through varieties and hybrids namely Suvin, Co 18, Phule Mahi, *G. hirsutum* varieties like Surabhi and hybrids from private sectors. One significant source of ELS cotton production is interspecific hybridization between *G. hirsutum* and *G. barbadense* (HxB). Compared to upland cotton, ELS cotton is more difficult to develop in India because the common varieties require a longer growing season and give lower and more variable yields. India' domestic consumption demand for ELS cotton is met through imports. The United States, Egypt, and Israel are the major suppliers of ELS cotton. To increase extra long staple (ELS) cotton productivity and reduce dependence on imports, the Indian government is still investigating a number of strategies. This paper discusses the production and demand for ELS cotton worldwide, including India's ELS profile, difficulties encountered, and potential future prospects.

Keyword: *ELS cotton, G. barbadense, G. hirsutum, Suvin, HxB hybrids*

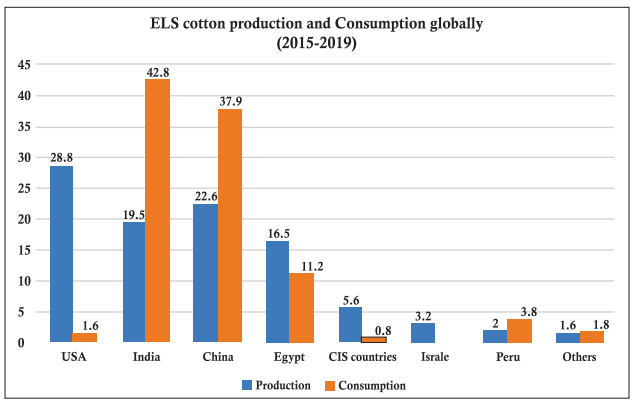
Cotton is the most important commercial crop contributing around 65 per cent of the total raw material required for the textile industry in India (https://egyankosh.ac.in/). Interestingly, India is a country where all four cotton species namely, *Gossypium arboreum, G. herbaceum* of diploid, and *G. hirsutum* and *G. barbadense* of tetraploid cotton are grown. A wide range of variability is available in all traits, especially fibre quality such as 13 to 37 mm staple length, 25-53 g/tex bundle strength, 1.4-7.4 boll weight, *etc.* However, because of the extreme diversity, the majority of the widely used cultivars worldwide lack the ideal balance of length, strength, and Micronaire. According to Mao *et al.*, (2016), the textile industry currently demands cotton types with fiber lengths of 33-35 mm, fiber breaking strengths of 33-37g/tex, and micronaire values of 3.5-4.0. Unfortunately, the majority of the available variations don't fit the requirement. Despite being the world's greatest producer, India's mills are compelled to import 15 per cent of their domestic needs from other countries like USA, Egypt, Sudan, and so on. The import is especially in the range of Extra Long Staple cotton (ELS) (>32.5 mm SL) which is required to produce the finest yarns. These ELS cotton fibres were obtained from pure *barbadense* but cultivation of this species is becoming non remunerative due to two reasons. First, the yields of *barbadense* varieties like Suvin, RHCb 011, and CO18 etc are comparatively low due to high pest attacks attracted by its luxurious foliage and secondly, its cultivation is very much location specific. Additionally, the *G. barbadense* crop has a long growing season (182-210 days), poor yields (15 q/ha), reduction of fibre quality due to moisture stress, and lower ginning output of approximately 25-33 per cent against 34-40 per cent than another cotton. Suvin, DCH 32, and MCU 5 (ultra fine) are three of the most widely used cotton types in India and fall within

the category of ELS cottons. Varalaxmi, TCHB 213, and Phule 388 are a few more kinds that are offered in smaller amounts. Only four States namely Karnataka, Tamil Nadu, Madhya Pradesh, and Rajasthan produce ELS cotton through varieties and hybrids namely Suvin, Co 18, Phule Mahi, *G hirsutum* varieties like Surabhi and hybrids from private sectors. Interspecific hybridization between *G. hirsutum* and *G. barbadense* (HxB) is an important source of ELS cotton production. These HxB hybrids assume a special status owing to their extra long staple fibres, high yielders, and biotic and abiotic tolerance with more adaptability compared to the varieties.

Global cotton production and demand of ELS cotton

Duringthe early 1980s, around 15 million tons of cotton were produced overall, of which 950,000 tons, or 6 per cent, were extra long stapled. Gradually there was a decline in ELS production and the total extra long staple is only 1.6 per cent. This scanty amount of ELS cotton comes majorly from the four countries *viz.,* USA, China, India, and Egypt. Looking into the trends of ELS production, the US and China show an increasing trend from 1980 to 2018. The US Pima cotton production has increased from 2 to 36 per cent from 1980 to 2018 (Dhuria, 2018). Whereas the countries like Egypt and India have seen a declining phase during the last four decades. Over the period, India has contributed around the same amounts to global ELS stocks: about 17 per cent in 1981 and 18 per cent in 2018. However, in terms of volume, ELS production fell from 1.64 lakh tons to 0.78 lakh tons over that time, which means that in less than 40 years, ELS production in India reduced to half of the production. Similar trends were observed in Egypt' share which has gone down from 50 to 16 per cent for the past 40 years. For the past five years on average, the highest production of ELS is in the USA (28.8 %) followed by Egypt (16.5%), China (22.6%), and India (19.5%) (ICAC, 2019).

Fig 1. Global ELS Production and Consumption (2015-2019)



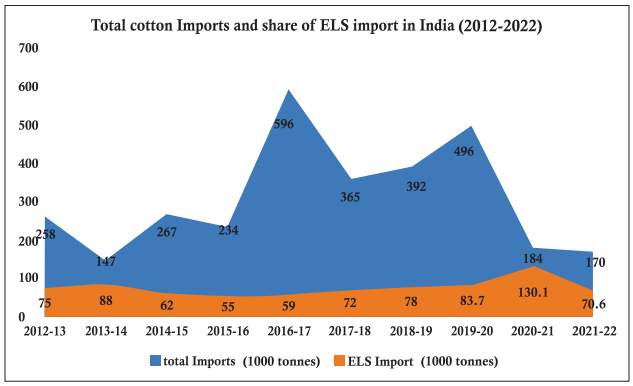
Source: ICAC, Cotton Outlook and market sources

Other countries like Israel, Peru, Sudan, and CIS put up together contribute around 12 per cent. When considering the consumption of ELS cotton, India (42.8%) and China (37.9%) are the huge consumers while the other countries' demand is around 20 per cent of the total production. The few popular ELS varieties across the world are Pima, (produced in the United States, Peru, and Israel); Egypt's Giza 45, 70, 76 and 70; India's Suvin and DCH 32; China's Xinjiang 149; Sudan's Barakat; and the USSR's Tonkovoloknistyi (Sabesh *et al.*, 2021). The countries producing and consuming ELS cotton are presented in Fig. 1.

ELS profile of India

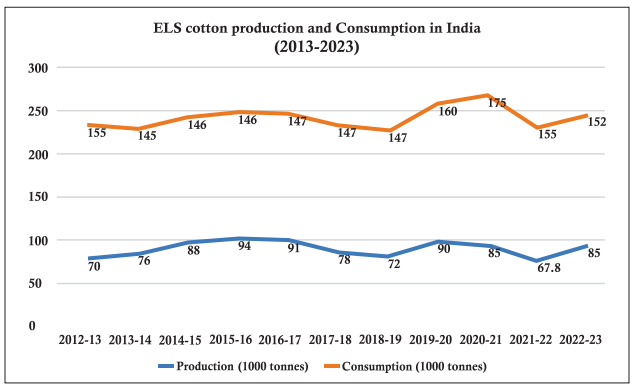
In India, G. *hirsutum* is widely cultivated, about 90 per cent of the area is under upland cotton cultivation due to its higher yield potential than *G. barbadense*. The specialty of ELS fibre is due to its unique character of staple length 33mm combined with fineness making it potentially suitable for various fields of textiles especially fine shirting (200/2 count) (Ministry of Textiles, 2017). Currently, only a few places in the world *viz.*, Egypt, United States, India, China, Peru, Sudan, and Israel etc., are able to produce ELS cotton. Recently ELS production has become just 1 per cent of the total Indian cotton crop, as against the demand of 5 –15 lakh bales. This demand is bridged by Supima cotton from USA, Improved Gizas from Egypt and

Fig. 2. Share of ELS imports in total cotton imports in India from 2012 to 2021



Source: ICAC, Cotton Outlook and market sources

Fig. 3. ELS cotton production and consumption in India



Source: ICAC, Cotton Outlook, and market sources

Bakarat from Sudan. The maximum import of ELS cotton was 130.10 thousand tons during 2020-2021 and the minimum was 55 thousand tons during 2015-2016 (ww.icac.org) (Fig 2).

India already consumes between 40 and 45 per cent of the world's ELS cotton supplies, making it the largest consumer. However, given that many international fashion firms are eager to increase their purchases of garments, home textiles, and textile made ups from the nation, the consumption of ELS cotton is projected to rise in India starting in 2022 or 2023.India gets its ELS from *barbadense* (Suvin, CICR B Cotton 45), HxB hybrids (DCH 32, TCH 213, SIMA HB 3, Sara 2, Puli, MRC 7918, RCHB 708), and even hirsutum varieties (Suraksha, Subiksha, Surabhi and Suraj) (Prakash *et al.*, 2022). India from the above listed ELS cotton varieties and hybrids with no increase in area under cultivation the production of ELS cotton in the country has remained between 104 to 171 thousand bales for the past decade (www.usda.gov). There lies a huge gap between the production and consumption trends of ELS cotton (Fig 3). The consumption of ELS cotton is on an average of about 150,000 tons and the consumption was much higher during 2020-2021 (170,000 tons). India already ranks first among countries that import Pima and Giza cotton, and it is highly likely that it will continue to rise in the next years. The government has also set a number of initiatives, including the introduction of new extra long staple (ELS) cotton varieties/hybrids, scaling up macro irrigation, and providing incentives for ELS cotton varieties to increase cotton production.

In India, in 1949 there were only two categories of fibre produced *i.e.*, short staple (33 %) and medium staple (67%). Slowly during the 1980's with the release of Suvin, ELS hybrids, and other varieties from public sectors there were five categories of fibre starting short staple (7%), medium staple (39%), superior medium (28%), long staple (19%) and extra long (7%) (DCD, GOI, Nagpur, 2017). This was the period where India's share in the world average production of ELS was raised upto 17 per cent. When the *Bt* hybrids from the private sector came to the market there was a huge shift in the long staple cotton category. The production of this category shifted from 19 to 68 per cent in 2012 which now has touched 90 per cent. Hence during the 1990s we had surplus production of ELS and the import was negligible for this cotton. Slowly the demand started increasing and the production (2%, Fig 4) and area under ELS were decreasing thus the deficit zone has put the Indian mills to meet their 15 per cent of domestic requirement from the imports from other countries.

Indian cotton has similar properties to that of imported ELS cotton (Table 1). The SL is notably high in Suvin when compared to other world cotton. The major drawback in Indian

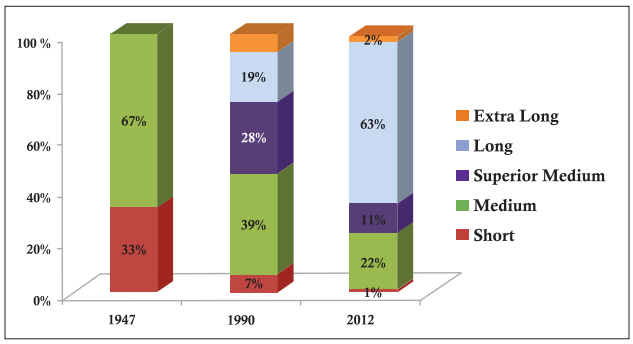


Fig. 4. The trend in the production of cotton based on staple length for the past 60 years

ELS is in the range of micronaire, where the world average is around 3.8-4.5 but it's only around 2.9 to 3 in Indian varieties (Basu and Chellamani, 2006).

Pros and cons: Overcoming the issues to reach the goal Extra Long Staple cotton is losing ground in India in terms of both area and productivity because it produces lower returns than upland cotton especially *G. hirsutum*. The vast majority of India's "heritage" cotton types are in a terrible condition of neglect despite the country's long history in cultivating cotton. DCH32 (released in 1981) is currently the predominant ELS variety farmed in various regions of the states of Madhya Pradesh, Karnataka, Tamil Nadu, and Maharashtra, accounting for just 168,000 hectares (or around 1% of the total area under cotton in the country) that are cultivated with ELS types. Varalaxmi, an ELS type, introduced in 1972, and Suvin, an important ELS variety, released in 1978 almost faded away except for a few pockets of Tamil Nadu. The crop size of Suvin, a valued Indian ELS variety with the longest and finest fibre in the world, which at its peak in the 1980s saw output of almost 7,500 tons, is now down to about 2,000 running bales, or 340 tons or even less. This was due to seed management and manufacturing practices that have caused the initial benchmark quality standards. It is grown in Tamil Nadu on a very tiny area of land-less than 1,500 hectares. The amount of ELS cotton produced during the 2021-2022 season was a meager 1.3 per cent of India's total cotton crop or roughly 67,800 thousand tones.

ELS cotton is more challenging to farm in India than upland cotton because the common varieties require a longer growing season and give lower and more variable yields. For instance, Suvin has a cultivation cost that is three times greater than any other ELS type, grows in 220 days, yields only 300–500 kg/ha, and has a ginning outturn of 28–29 per cent. Indian ELS types require a lot of resources (constant irrigation and other inputs) and are vulnerable to pest infestations. They are extremely susceptible to climate change, and even little changes in the weather can further lower the already meager yields.

Variety/hybrid development: The breeding programmes should be strengthened with targets substantially above the worldwide base standards in order to fulfill the need of the constantly increasing ELS requirement. Traditional terminology for upland cotton has been short or medium staple cotton, and it made up roughly 90 per cent of Indian production, with ELS making up less than 2 per cent. Due to its potential yield advantage over *barbadense* and the fact that its fibre has been sufficient for the majority of end uses, upland cotton is cultivated on the bulk of cotton-growing acreage. But cotton breeders have long worked to create upland cotton with Suvin's superior fibre quality, greater fibre length, greater fibre bundle strength, and decreased fibre diameter are the main fibre characteristics desired without compromising fibre maturity. ELS upland strains were to be created utilizing G. *barbadense* as a recognized donor for fibre quality genes in order to compete at this greater UHM length expectation. Since the earliest efforts were documented in the 1960s, the majority of attempts to achieve these better fibre qualities have been made through the hybridization of G. *hirsutum* with G. *barbadense* with little to no success. The minimum Suvin UHM length is 37.5 mm, and upto this point, no upland cultivar or germplasm line has been

made public that displays UHM lengths longer than that. In recent days public research organizations are working on meeting the standards of international quality, which is the main reason for improved varieties/hybrids like Suraksha, CICR B cotton 45 (www.cicr.org.in).

Package of practices: Agronomic advancement is equally important for a healthy crop, high output, and producer profitability. Long term endeavors include plant protection, weed control, irrigation, and nutrition management research and development. At the core of our development efforts are the proactive search for and use of cutting edge agrotechnology, intelligent agricultural practices, and precision management. Modern agricultural systems adopt and continuously use additional soil conservation techniques, such as minimum tillage or no till farming, crop rotation to maintain high yields, and other traditional concepts. Studies show that drip irrigation and foliar spray for canopy management in ELS genotypes especially Suvin produced the highest seed cotton of 2182 kg/ha which was significantly higher than that of farmer's practice (1413 kg/ha) (CICR Annual Report, 2021) Contamination free harvest: From the perspective of the farmer huge increase in labour wages for picking cotton year after year makes the cultivation of ELS unprofitable. Changes in seed types, ginning procedures, and harvesting techniques are all part of the methodical process of moving from handpicking to machine harvesting, which could reduce the cost of cultivation to a certain extent. The mechanization of the upland cotton industry in India has been ongoing for a while and is now quite advanced, although the shift for extra long staple growers in the area is slower and more challenging. Trials using machine picking of extra- long staple cotton last year at public research institutes revealed high levels of contamination and poor hygiene. The defoliant's insensitivity and the machine prototype's requirement for numerous tests and modifications were among the factors put out as explanations for these results. Early application of defoliants also had other impacts, such as a high litter component, undersized cotton bolls, and weak, short fibres. Therefore, all of these components must be revised for a harvest that is free of contaminants. However, machine picking will undoubtedly grow more popular in the future due to its increased harvest prices, labour shortages, and generally inefficient operation. Nevertheless, such a significant decrease in planted area is expected to cause issues and dangers with the purchase of long staples in the upcoming year, and the interests of spinning mills with high quality cotton requirements could be jeopardized.

Numerous initiatives have been made to reduce the disparity between the local supply and demand for ELS cotton. These include contract farming systems, campaigns to persuade farmers to grow more ELS cotton, the incorporation of a canalizing agency in 1970 for the import of cotton and particularly extra long staple varieties, an important step in the development of Suvin as an Indian ELS type, and currently CITI-CDRA project. The "Grow More ELS Cotton" campaign launched by the Southern India Mills Association, the Cotton Association of India, and the Cotton Development and Research Association (CDRA) is one of the initiatives aimed at enhancing ELS production in the nation. Other initiatives include contract farming agreements made between growers and a few south Indian mills with the aim of expanding the cultivation of significant ELS types; and other initiatives.

CONCLUSION

Overall, the demand for domestic ELS is trending up progressively. From the perspective of the spinner, it is impossible to avoid comparing the price changes of US Pima and extra long staples, the two main sources of supply. There

was always an advantage in the price of ELS cotton from the past. For the cotton season 2023–2024, the MSP for cotton with medium and long staple lengths has been set at Rs. 6620/q and Rs. 7020/q, respectively, whereas the price for ELS is above Rs. 10000 /q. The MSP for short staple and medium staple has seen an increase of roughly 50 per cent (SS-Rs 4020, LS-Rs 4320) from 2017 to 2023. During 2017 the rates of ELS cotton especially Suvin were about Rs. 5360/q of cotton (https://www.texmin.gov.in/). The difference was around Rs. 1000/q between LS and ELS. With such a price difference, the existence of foreign fibres is the only thing that restricts the use of extra long staples and keeps prices from rising. The charge of the private sector, which clearly favors shorter duration, insect resistant, and high yielding *Bt* cotton, is having an impact on the entire diversity of the cotton landscape and expanding its reach into the region where ELS kinds are produced in the nation and there is a need to aim higher now. Targeted studies on how to develop superior cultivars, conserve and improve the basic seed stocks of these irreplaceable cotton types, and develop powerful branding tactics are needed, as well as increased industry-research collaboration. Additionally, we must strengthen supply chain integration and incorporate the concepts of sustainability and circularity as key elements of value creation. In order to accomplish the goal of doubling farmers "incomes" and creating an '*Aatma Nirbhar Bharat*' (self sufficient India), the country urgently needs to improve ELS cotton production.

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