COTTON FIBRE QUALITY RESEARCH NEEDS: THE INDIAN PERSPECTIVE

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Introduction

It is significant to note that in the very recent past the entire gamut of production and processing activity in textiles has slowly and steadily shifted to the Asia-Pacific region. To this revival of sorts, the contribution of the natural fibres has been very significant. The world today has suddenly turned its attention towards the natural fibres that are environment friendly and biodegradable. It is important to note here that the research and technology initiatives, safe cultivation practices and their on-farm demonstrations on a large scale have resulted in a staggering increase of about 20% in the natural fibre production in the globe as a whole.

Despite the inroads made by manmade fibres particularly the polyester, cotton continues to remain established as the most widely used textile material in the world. During 2000-05; the production of cotton world-wide has grown by a whopping 25% fuelling the growth of the natural fibre sector as a whole. It is worth mentioning here that while the annual growth rate of polyester in the 1990s to the beginning of the new millennium was 7% as against the then 1-2% growth rate of cotton, the second half of 2000-2010 decade, has witnessed a growth rate of about 10% for cotton as compared to about 5% growth for polyester. It looks as if spurt in natural fibre growth has come to stay.

The scenario in India is no different than the rest of the world. An already heavily reliant textile sector on natural fibrs particularly cotton; is served well by the surge in production in recent times. The cotton production has taken a giant leap forward to 280 lakh bales and the increased availability has fuelled consumption as well. The productivity although far lower than world average has significantly improved to stand at 470 kg/ha, in 2006-07 as against a world average of 700 kg/ha. An all-round awareness in the entire value chain, improved production and protection technologies and their large scale on-farm demonstration, genetically modified cotton and its adoption, improved processing and market infrastructure and above all a favourable governmental policy and programme initiatives by the government have all contributed to this welcome development.

Demand and Supply of Cotton

Global:

The world cotton use has been on the rise since 1998 and the consumption is likely to increase by 3-4% in the coming years. A cursory look at the supply and demand position of cotton given in Table 1, indicates that with the production remaining steady at around 25 million tonnes, the ending stocks are expected to

decline by 1 million tonnes by the end of 2006 fuelling an increase in international price. A gradually declining ending stocks to use ratio would also firm up the price.

Table 1. Global Supply and Use of Cotton

(Million Metric Tonnes)

Year	2003	2004	2005	2006 (Proj.)	2007 Proj.
Beginning stocks	9.35	8.71	11.04	10.69	9.85
Production	20.71	26.29	24.74	24.89	26.47
Imports	7.26	7.33	9.55	9.70	9.67
Total supply	**37.32**	**42.33**	**45.33**	**45.28**	**45.99**
Consumption	21.28	23.41	24.87	25.73	26.25
Exports	7.23	7.78	9.75	9.70	9.67
Total use	**28.51**	**31.19**	**34.62**	**35.43**	**35.92**
Ending stocks	8.81	11.14	10.71	9.85	10.07
Ending stocks/use	0.31	0.36	0.31	0.28	0.28
Cotlook 'A' index cents/pound	68.3	52.2	56.2	58*	63*

*Futures prices

Indian situation

In the recent past increased availability of cotton due to enhanced production coupled with improved productivity has lead a spurt in consumption as well to the extent of 10-12% annually. However, on a long run it is expected that cotton consumption in the coming years would grow at the rate of 4-5% p.a. The import of cotton has gradually reduced and exports have picked up. Now the import is restricted mainly to extra-long staple which is in short supply within the country.

Table 2. Supply and Use of Cotton in India

Year	2003	2004	2005	2006	2007
Beginning stocks	40.0	24.0	21	72	56.0
Production	136.0	177.0	243	280	310
Imports	17.67	7.21	12.17	4.0	2.0
Total supply	**193.67**	**208.21**	**276.17**	**356.0**	**368**
Consumption	168.83	173.96	195.03	217.0	257.6
Exports	0.84	13.25	9.14	47.0	49.5
Total use	**169.67**	**187.21**	**204.17**	**264.0**	**307.1**
Closing stock	24.0	21.0	72.0	92	60.9
Stock/use	0.14	0.11	0.35	0.21	0.20

From the table it is clear that the continuously climbing stocks/use ratio has been halted and reversed in the recent years. This could be the reason for some what of a stability in domestic prices despite steep rise in production and availability of cotton in the market.

Future Requirements of Cotton:

Global requirements of cotton:

It is estimated that the world demand for all fibres is expected to rise in volume terms from 52.651 million tonnes in 2000 to 74 million tones in 2010 and to 95 million tonnes in 2020. Going by the current contribution of different fibres to the basket and future trends viz. cotton (45%), jute and other natural fibres (5%)(not included in the above estimate), wool (2-3%), cellulosics (5%) and synthetics (42%) the projected requirement of different fibres in volume terms would be as shown in Table 3.

Table 3. Projected Global Fibre Demand/Consumption

Million Metric Tonnes

Year	Cotton	Jute and allied fibres	Wool	Cellulosics	Synthetics	Total
2000	20.01	2.63	1.58	2.63	28.43	55.28
2005	24.74	2.94	1.76	2.94	32.78	65.16
2010	33.30	3.70	2.22	3.70	34.78	77.70
2020	42.75	4.75	2.85	4.75	44.65	99.75

The above bifurcations in terms of different fibres has been, made on the following premises:

- A revival of sort has taken place in the production of natural fibres and this tempo is likely to sustain and grow. Therefore a higher percentage contribution from natural fibres like cotton is assumed.

- The limited and non-renewable resource of crude oil and other petroleum products would put a constraint on the growth of synthetic fibre production despite continuing rise in the production and market of biodegradable polymers made of natural materials.

From the table it is clear that almost the double the amount of cotton would be required from the 2000 level during 2020. This has to be achieved essentially without any substantial increase in area of cultivation. Low productivity zones particularly in the Afro-Asian region would have to contribute substantially by improved productivity to achieve the above requirement.

Cotton Requirement in India:

The Indian Cotton Mills Federation now known as Confederation of Indian Textile Industry (CITI) being the apex body of the industry in India enjoying the consultative status with the national government and international agencies; has projected the requirement of cotton at 350 lakh bales by 2010; by which time India is expected to catch 6% share of global trade in textiles. Going by the current production

figures in different staple groups as per the industry's demand, the staple wise cotton requirements for 2006-07 and 2010 are given in Table 4.

Table 4. Staple-wise Cotton Production: Current and Future Requirements

(lakh bales)

Staple group	2003-04	2006-07	2009-10
Short (20mm and below)	18	31	34
Medium (20.5mm – 24.5mm)	61	91	121
Medium long (25.5mm – 27.0mm)	30	63	65
Long (27.5mm – 32mm)	61	82	110
Extra-long (32.5mm and above)	7	13	20
Total	177	280	350

About 35% of the cotton required would be in the medium staple category while 30% of the demand would be in the "long" group. In the ELS category, about 6% of the total demand is forecasted which works out to 13 lakh bales in 2007 and a significant quantity of 20 lakh bales by 2010. It is in this category that India has to find the right quality cotton as quickly as possible to avoid inflow of material from USA (Supima) and Egypt(Improved Giza types)

Looking beyond 2010:

As already noted the cotton consumption is growing at the rate of 10%. However, a more pragmatic approach for a long term would suggest that the use of cotton would pick up at the rate of 5%. The mill and non-mill consumption put together for 2005-06 has been 280 lakh bales. With a CARG of 5% this consumption is likely to go up to 430 lakh bales in 2020 as seen from Table 5.

Table 5. Cotton Requirement in 2020/2025(on the basis of consumption)

2005-06: Cotton Consumption (mill and non-mill) - 280 lakh bales; Export: 47 lakh bales

	Requirement*(in lakh bales)	
Year	**2020**	**2025**
Consumption	430	548
Export(@10% of consumption)	45	52
Total	475	600

*Assuming a CARG of 5%

Here again it is clear that the requirement of cotton in 2020 would be double the consumption at the current point of time. Unless productivity improvement atleast to match global average with special attention towards improvement in rain-fed production/productivity is provided, meeting the above target would be very difficult within the available time frame.

Quality Issues:

Cotton Vs Polyester Fibres:

Cotton has to confront the stiff competition posed by synthetic fibres particularly polyester. It is well known that cotton, being a natural fibre endowed with high moisture absorption , provides the right amount of warmth and wear comfort allowing friendly contact between human skin and textile (see Table). However, polyester and more prominently polyester-blended textiles have received tremendous customer support due to their enhanced durability and aesthetic appeal particularly for their elergant look and drape.

Cotton Vs Polyester Fibre

Cotton	Polyester
Advantages: Fine, soft, high moisture absorption, skin-body friendly, eco-friendly, renewable, hygienic, biodegradable, easy dyeability, good air permeability.	Strong, high elongation, uniform fibres. No trash, dust and foreign matter, tailor-made fibre properties, high easy-care value, vigorous promotional efforts and good marketing strategy.
Disadvantages: high trash and dust, weak and immature, less elongation, high variability in fibre length, fineness and strength, poor easy-care property, very poor productivity, poor promotional efforts, lack of coordination among different segments in the industry.	Poor moisture absorption, not so friendly fabric-skin interactions, non bio-degradable, static electricity generation, petroleum-reserve dependent.

Indian Cotton Vs Imported:

As things stand, two distinctly different quality cottons one in length range of 15-20 mm and other 23-27 mm are grown in the north in designated areas. If this situation continues, quality deficiencies due to mixing can be avoided. In the central region one finds irrespective of sub zone, high variability in span length of cottons grown. Right from 22.0 mm to 37.0 mm in length, wide variability in micronaire value from 2.0 to 6.5 and that in tenacity from 15 g/tex to 30 g/tex are encountered in this region making it rather difficult to preserve the quality of the produce. Sub zonal identification and regulation in seed in terms of quality is highly essential. The situation in the south zone is also not different than that existing in the central region. Varietal zoning is urgently called for to ensure quality in cotton cultivated in this region.

Tables 6-8 provide summarized data on the fibre attributes of some of the Indian cottons in different staple groups (a) 20mm – 25mm, (b) 26.0mm – 30mm and (c) 31mm to 36mm in comparison to some of the foreign growths of the same staple grade. One factor stands out as far as Indian cottons are concerned is that, irrespective of the class, they are rather poorly developed often due to immaturity. Indian cottons in the length range 20 to 25 mm are coarser and weaker presumably due to lack of

maturity. The high value of micronaire found in some of the cottons in this category may be due to intrinsically larger perimeter but devoid of adequate packing of cellulose resulting in weaker fibres as compared to foreign growths having more optimum strength and micronaire values. Indian cottons in this category are weaker due to poor cell wall development.

Table 6. Fibre attributes of Cottons in the Staple group 20 mm – 25.0 mm

Origin	2.5% S.L.(mm)	Mic. Value	Tenacity (g/t)
Foreign			
Iran	20	6.1	21
Myanamar	22-25	5.5-6.0	19-20
	19-22	5.5-6.0	19-20
Thailand	25	5	18
Indian			
Jayadhar	22.7-23.7	5.1-5.4	14.7-17.5
CD.327	18.5-21.8	5.5-7.8	13.7-16.4
LD.491	18.4-21.4	6.8-7.7	15.1-16.6
NHH.44	22.5-28.2	2.7-5.3	16.3-22.7
RS.2013	23.7	4.7	20.4-21.9
RST.9	23.5-27.1	3.5-5.6	18.0-22.7
V.797	22.6-25.4	4.1-5.5	15.5-15.7
Y.1	23.2-25.8	3.9-5.4	19.8-23.6

Table 7. Fibre attributes of Cotton in Staple group 26.0mm – 30mm

Origin	2.5% S.L.(mm)	Mic. value	Tenacity (g/t)
Foreign			
Australian	26.0-27.6	3.8-3.9	19.9-22.2
Benin	26.0-28.7	3.8-4.5	19.0-23.5
Burkino Faso	26.7-28.8	3.7-4.5	19.3-22.8
Brazilian	29.3	4	23.9
Cameroon	29	4.2	23.3
Kazhakistan	27.9-28.0	5	21.5-22.2
Tanzanian	26.7-27.5	3.4-3.8	20.9-22.2
Mozambique	27.5	4.2	21.7
Uzbekistan	28.8-30.0	4.4-4.7	21.2-22.2
Indian			
AKH.468	27.8-29.1	3.5-3.7	22.1-23.5
Ankur 651	25.9-30.8	3.4-5.1	19.5-23.5
DHH.11	26.4-28.9	3.7-4.2	19.2-24.3
LHH.144	26.3-29.8	3.4-4.7	20.6-25.6
LK.861	26.5-29.4	3.7-4.8	19.1-22.6
MCU.5	27.6-33.1	3.0-4.1	20.2-26.4
MECH.1	26.4-32.5	3.0-4.5	19.5-25.5
RCH.2	25.9-30.8	2.5-4.3	19.6-22.9
S.6	24.5-31.2	3.0-4.4	19.0-25.0
J.34	26.0-28.0	3.4-4.9	17.0-24.6

Table 8. Fibre attributes of cottons in Staple group 31 – 36 mm

Origin	2.5% S.L.(mm)	Mic. Value	Tenacity(g/t)
Foreign			
Giza-70	30.2 -32.9	3.9-4.0	29.3 -34.0
Male	33.8-35.6	3.8-4.0	31.1-35.2
Gala	34.2-35.5	3.8-4.1	31.5-35.4
Plori	34.5-35.0	4.0-4.1	33.0-33.9
CIS-ELS	32.5-35.3	3.7-4.5	24.6-29.4
Tajakistan	33.0 -34.3	3.8-4.1	28.0-29.4
Turkmenistan	32.0 -33.8	4.0 – 4.4	28.2 -30.3
Indian			
Bunny	27.2-35.7	3.0-4.7	20.2—28.1
DCH.32	30.1-37.9	2.6-3.9	23.4-29.6
Surabhi	31.3-34.2	3.3-4.6	21.5-27.1
Navbharat Kranti	34 .0 -36.2	3.7 -4.1	23.5 -27.2
Suvin	38.8-39.4	3.5-3.6	32.7-35.4

In the 26.0 – 30.0 mm category; Indian cottons possess lower micronaire values by about 0.5 units on an average. Here again, hybrids prone to immaturity and rapid degradation during subsequent pickings have brought about this state of affairs. Indian cottons in staple group 31-36 mm have been found to have lower micronaire value not exceeding 3.5 units in majority of the cases as compared to an average value of 4.0 in imported growths. The lower micronaire value has been found to be not due to intrinsic finer nature of the cotton but has more to do with immaturity arising from lack of adequate cell wall development. The tenacity values of Indian cottons in this category have been noted to be on the lower side by about 4-10 g/tex.

Modern Spinner's demand for quality:

Due to the Sweeping changes in Textile Machinery and modern processing systems with automatic controls, and increase in speed of spindles (RPM),demand cottons with the following attributes:

- Highly clean, contaminant-free cotton
- Stronger and mature fibres for a given length
- Low variability in fibre attributes from bale to bale
- Lower short fibre content
- Higher fibre elongation
- Lower fibre neps and seed coat fragments
- Lower organic trash and microdust
- Higher amenability to cleaning

R&D Efforts on Cotton:

In the multifibre free-trade regime, the base of cotton as a natural fibre could be strengthened by projecting its positive attributes, adding value to the fibre as well as textiles made therefrom by carrying out appropriate researches to overcome its deficiencies by employing mechanical, chemical /biochemical routes, promoting the use of "cotton crop" as a whole by adopting a holistic approach to the utilization of its byproduce and also the processing wastes. CIRCOT has been channelising its research towards empowering cotton and strengthening its base realizing the stiff competition from man-made fibres.

Researches on Energy Efficient High Productive Ginning and Cleaning:

Increasing Productivity of DR Gins

India's inherent advantage continues to be its "gentle ginning" using rollers particularly for the long and extra long cotton providing a smooth feeling. However, the low productivity of DR Gins has been one of its deficiencies. CIRCOT's researches have been over the years directed to devise technologies for energy efficient, high productive gentle ginning using double roller gins. The DR Gin has been ,modified to independently control the speeds of the roller and beater accurately. This enables choice of appropriate speeds for both the roller and beater depending upon the staple length of the cotton. Large scale ginning trials using variable speed gin have shown that lint output increased by 70% to 140% over the conventional machine that normally gives an output of 45 kg/ha without any additional demand on power. Even short staple cottons which are otherwise difficult to gin using conventional DR machine could be successfully ginned using VS Gin realizing optimum productivity.

CIRCOT has also brought in significant modifications in the mechanisms to apply pressure on the rollers; the gear mechanisms and improved roller material etc. As a result productivity has been almost doubled with significant reduction in energy consumption, maintenance etc.

Development of Efficient Cleaning Machines:

An inclined cylinder type precleaner designed by CIRCOT can efficiently clean even "kawdi" grade kapas. This "import substitute" precleaner produces more open and cleaned kapas enough to feed 20 DR Gins and also improves the productivity of the gin reducing the cost of ginning with concomitant saving on power consumption.

Researches to Preserve/Project/Monitor pristine qualities of cotton:

There can be no two opinions regarding the crucial role played by the lint quality in deciding the mechanical processing efficiency and properties of yarns spun from cotton. About 60% of the yarn manufacturing cost is traceable to the cost of the raw material. This makes all the more important to evaluate and use the raw material

optimally to derive maximum benefit. Hence, parameters crucial to hassle-free processing become very important while assessing cotton quality.

Equally well known is the fact that cotton, the agriculturally produced raw material shows considerable variation in fibre properties year after year and also from region to region. Therefore, it is necessary to monitor and take corrective measures, if need be to preserve the quality of cotton fibre.

Monitoring the quality of Indian cottons and enhancing knowledge base of foreign cottons

Assessment of the quality of commercially released varieties to see whether they maintain their genetic purity is a mandated activity of CIRCOT. For this cottons raised under standard conditions employing the recommended cultivation practices referred to as "standard varieties/hybrids" are subjected to quality evaluation to see whether any deterioration in fibre quality has occurred over the time and space. In addition to the above CIRCOT also carries out fibre quality analysis on several "trade varieties" and thousands of "commercial samples" as they are marketed in order to help the industry to choose the best cottons possessing the right blend of fibre attributes for yarn manufacture.

As is well known about 15% of the cotton consumed by the Indian mills comes from outside the country mainly from Australia, USA, China, CIS and others. Apart from economic considerations certain quality deficiencies have been stated to be the cause for mills' preference to foreign cottons. CIRCOT carries out fibre quality evaluation of several foreign samples submitted by the trade and industry. Based on CIRCOT's experience, the following points emerge while one compares Indian and foreign cottons.

1. The contaminants are found to be totally absent in foreign cottons
2. The trash content and microdust are also very low in cottons originating from outside the country
3. Foreign cottons pose problems due to stickiness while mechanical processing
4. Bale to bale and lot to lot variability in fibre length, micronaire and fibre tenacity have been found to be much lower in imported cottons than those found in Indian varieties
5. For cottons belonging to long and extra long category, the micronaire value in foreign cottons is rather high indicating good maturity.
6. Both the short fibre content and immature fibre content are found to be lower in cottons originating from Australia, USA, China and Egypt etc.
7. The Degree of Polymerisation particularly for the long and extra long staple cottons coming from outside was found to be higher than those found in similar Indian cottons.

CIRCOT's HVI Round Test

CIRCOT conducts regularly round robbin tests involving all HVI users in the country by sending well blended cotton samples for testing. The results are analysed

and those participants whose test results fall below or above the acceptable tolerance limits are informed so that appropriate action could be initiated for setting right the instrument or test procedure. These round tests have become very popular and the participation has been showing continuous rise. CIRCOT's round tests have helped the industry to effectively utilize this equipment and derive maximum benefits.

CIRCOT's Calibration Cotton: A standard Reference Material

Being an accredited Institute by the Department of Science and Technology, Government of India for producing Standard Reference Material for cotton; CIRCOT on regular basis makes it available on commercial lines the Calibration Cotton for Indian industry for operating the HVI both in ICC as well as HVI modes. This import substitute has been well received and the patronage by the Indian industry is on the rise. CIRCOT standards are as good as if not better than those of USDA.

Adding value to Cotton (and textiles) by technologies employing Mechanical routes:
Development and Standardisation of Spinning Tests and Miniature Spinning Machines*:*

The potential of cotton variety and its processing capacity need to be evaluated for its best use and production of value added yarns. The cotton should meet the specifications as demanded by the end use. For the purpose, CIRCOT has developed a standard used spinning test methods as well as miniature spinning machines.. A small cotton sample is subjected to actual spinning operation, and the potential of the cotton to produce quality yarn is assessed with reasonable accuracy. From these results it is possible to predict the performance in bulk trials. The miniature spinning system consists of various table model machines designed with state of the art technology. The machine can be operated via an easy operator's interface. The cost of the system is about one fourth of the imported one.

Blending of cotton with other fibres as a means of value addition:

Blending is an accepted method of combining the desirable properties of component fibres with a view to derive optimum benefit by mechanically mixing them. CIRCOT has undertaken from time to time studies on development and production of blended textiles with cotton as a component for value addition. Speciality fibres such as hollow polyester fibres, trilobal fibres, micro-denier fibres etc. were blended with cotton to produce textiles with different functional properiies.

CIRCOT has also developed methods for blending cotton with short wool as well as speciality animal fibres such as Angora rabbit hair. Also a processing technology in the cotton system for blending cotton with ramie fibres has also been developed. Tropical rich feel suiting and jackets from cotton/wool blends and knitted garments from cotton/ramie blends were produced.

Adding Value to Cotton by Technologies employing Chemical/Biochemical routes

Cotton, though is a most sought after textle fibre on account of its superior comfort properties, faces stiff challenge from the new breed of man-made fibres possessing superior physical properties. At this juncture , the chemical and physical modifications of structure of cotton is the best alternative to widen its scope of application to produce a range of textile materials catering to the ever-growing demands of the trade and industry.

In this direction CIRCOT has undertaken several research projects in the past and date. The broad areas of research undertaken to enhance the utility of cotton are indicated as under.

- Process and input modifications to improve Durable-Press properties of cotton fabrics using Formaldehyde-free chemicals.
- Development of functional finishes like antisoiling, flame retardancy and anti-bacterial finishes for cotton.
- Value addition through dyeing particularly natural dyes.
- Development of low energy and less polluting biochemical scouring of cotton
- Antimicrobial finishing through employment of Nanoparticles produced through non-conventional biological routes

Value Added Products from Processing Wastes

Considerable amount of waste is generated during processing operations like pre-cleaning, post-cleaning, ginning, etc. The waste generated contains about 2% -5% of good quality cotton fibres. This causes loss to farmers as well as to the ginners. CIRCOT has developed technologies to convert the trash left after recovery of good fibres from ginning waste into good quality compost. The technology of compost preparation from trash has already been transferred to an industry in Surat district of Gujarat. The quality of the compost was found to be very good as indicated in the field trials. CIRCOT has thus standardized techniques to improve the soil health by application of compost prepared from cotton wastes thereby completing the “cotton cycle”.

Looking Ahead:

Customers are looking for certainty and want to know how best the fibre will spin in their system and the quality of yarn produced from it. Although the need for fibre specification is not new, it is currently greater than it has ever been. Cotton growers face considerable challenges from synthetic fibre manufacturers, whose product is more consistent and cheaper compared with cotton and other natural fibres. Research projects “cotton value chain” under NAIP have the aim of supporting cotton growers in their long-term aim to position Indian cotton as preferred fibre in the world textile market.