Weekly Publication of

Cotton Association of India

COTTON STATISTICS & NEWS

Edited & Published by Amar Singh

2016-17 • No. 1 • 5th April, 2016 Published every Tuesday

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Need for a Robust Desi Cotton Roadmap

EXPERT's Column

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There was turbulence in the north and mild tremors across rest of the cotton farms in the country last year. In 2015, all the Bt-cotton Bollgard-II (BG-II) hybrids in north India without exception suffered to a variable extent from whiteflies and cotton leaf curl virus disease (CLCuD). Alarmingly, all the BG-II hybrids suffered from pink bollworm infestation to a variable extent all across central and south India. Production declined. Farmers protested. Monsanto openly threatened to go back home. Irrespective of their presence or absence in India, it is a fact now that the pink bollworm will continue to vandalise cotton especially in Gujarat and other parts of central and south India. It is clear that so far cotton in the country was riding on a Bt bubble waiting to burst. After having seen how the tiny worms tore into the all powerful BG-II, we need to seriously prepare a roadmap that would help us fight the bollworms without getting into the chemical quagmire like in the yester years. India cannot afford more bubbles; what we need is sustainable solutions for high yields. If the solutions have to be sustainable, they will have to essentially come from within the home.

Ideally, the country should have harvested a record yield because of the good monsoon all across the country except in Marathwada and north Karnataka. Though monsoon was erratic initially in Telangana, it recovered to normalcy by end of the season. But yields were 18% less than predicted. Despite the prediction of a normal good monsoon for 2016-17, none of the cotton stakeholder agencies are having the courage to predict high yields. With the experiences faced last year, there is apprehension and many finger are crossed. What next? Is the question that everyone is asking.

A few technology proponents are proposing Bollgard-III as the solution to the current problems. The proposal of the three gene (Cry1Ac+Cry2Ab+VIP3A) based BG-III has actually little to offer to assure effective bollworm control. The 'BG-II resistant' pink bollworms may not even take 2-3 years to munch the new BG-III. Wide-strike (Cry1Ac+Cry1F) from Dow Agrosciences and Twinlink (Cry1Ab+Cry2Ae) from Bayer may not stand a strong chance before the pink bollworm since the worm is already resistant to the related Bt toxins Cry1Ac and the Cry2Ab. Pink bollworm is a late season pest that occurs after mid November in Central and South India. Bolls formed during November and later are likely to get into the grip of the pink bollworm and may not contribute significantly to yields. Therefore it is unlikely that any of the currently listed Bt-cotton technologies may be able to combat the BG-II resistant pink bollworm. Any other unlisted technology, even if it gets into the country this year, may take at least another five years to be commercialised, after having completed all the regulatory requirements. The closest that we can get is to the BG-III which may be a bit better than the rest of all the Bt-cotton technologies that have completed field trials in India. But, before we consider that a new technology BG-III may give us any additional benefit, we must answer the basic question. Did Bollgard-II benefit India?

Bt-era is coming to an end

Data clearly show that Bollgard may have benefitted to some extent, but BG-II may not have conferred any additional benefit to the country. The single gene Cry1Ac based Bt-cotton Bollgard (BG) was introduced into India in 2002 in Central and South India and in 2006 in North India. Bt-cotton controlled the bollworms effectively and insecticide use decreased by 33.0%. During the period 2002-2007 yields increased by 67%. But, it would be incorrect to attribute the yield increase to Bt-cotton alone. During the five year period, fertilizer usage on cotton increased by 36%; area under hybrid cotton doubled; the irrigated cotton area in Gujarat doubled; a new seed treatment chemical imidacloprid 'Gaucho' effectively protected susceptible Bt-cotton hybrids from sap-sucking insect pests; at least six new effective insecticides were introduced to control sap-sucking insects and bollworms. Yields had already increased in North India even before the introduction of Bt-cotton in 2006. Interestingly, when the yields increased to the current levels of 490 kg lint per hectare in 2004, the non-Bt area in India was about 95% and there were just about three Bt-cotton hybrids that were available in the market. Nevertheless, to be fair to the Bt-cotton technology, it must be admitted that bollworm damage was arrested and yields were certainly protected by Cry1Ac to a good measure. But yield benefits were not just because of Bt-cotton.

The introduction of Bollgard-II in 2006, ushered in a lot of uncertainty in Indian cotton. Yields were 554 kg lint per hectare in 2007 when the area under BG-II was negligible. Yields declined constantly to 504 kg/ha by 2012 as the area under BG-II increased every year from 0% in 2006 to reach a saturation point of 90% in 2012. For nine years after 2006, yields stagnated at 504-524 kg/ha with no perceptible benefit from the increase of area under BG-II. Disappointingly, the yields were stagnant despite 70% increased usage of fertilizers (Data source: Ministry of Agriculture, http://eands.dacnet.nic.in/Cost_of_Cultivation.htm). Alarmingly, the insecticide usage also increased by 92%, because of increase in sap-sucking insects on the BG-II hybrids. Insecticide use increased significantly from 0.5 kg per hectare to 0.97 kg per hectare, thereby resulting in rapid development of 'insecticide-resistance' in whiteflies and leaf hoppers. A whopping 734 Bollgard-II hybrids were approved to saturate the entire country's cotton area with Bollgard-II in just five years after its introduction. Majority of the new BG-II hybrids were highly susceptible to leaf hoppers and whiteflies. However hard one might search, there is no scientific evidence to show that BG-II may have actually conferred any additional benefit over Bollgard after 2006. If anything, yields declined and chemical usage (fertilizers and pesticides) increased significantly. Thus to sum up, there is no evidence to show that the introduction of BG-II may have actually benefitted the Indian farmer.

BG-II was expected to delay resistance development of bollworms to Bt-cotton. However, the policy of deploying the Bt-technology in hybrids with cry genes in heterozygous condition, coupled with long duration of the hybrids, blew away the benefits into thin air. This policy brought the pink bollworm back as a major pest after 30 years of hiatus. The pink bollworm which was almost forgotten in India after 1980 appeared back in 2010. It is now highly resistant to Cry1Ac+Cry2Ab toxins of BG-II. This happened because of two major factors: firstly long duration (180 to 240 days) hybrids and secondly, the segregation of Bt toxins in seeds inside the bolls of Bt-cotton hybrid crop. Both these factors are unique to India. Pink bollworm is a late season pest. The main insect peaks occur when winter sets in. As long as the pink bollworms were susceptible to Bt toxins, it was easy to cultivate long duration Bt-cotton hybrids, but not any longer. In bolls of BG hybrid, about 25% of developing seeds do not contain Cry1Ac toxin and in bolls of BG-II hybrids, about 6.25% of seeds do not contain Bt toxin, while about 18.75% seeds have only Cry1Ac; 18.75% contain only Cry2Ab and the rest would have both toxins. This situation provides an ideal condition for an insect species that can survive only on developing seeds or floral parts. The pink bollworm is one such species which used these ideal conditions to develop resistance to Bt-cotton rapidly.

Clearly the pink bollworm will continue to damage Bt-cotton in the ensuing seasons. The damage will only increase with every progressing year. Pink bollworm will continue to be a major threat as long as late duration hybrids are cultivated. Another impending problem is the dreaded American bollworm. Indications are that it is likely to resurface any time in the next few seasons. With just the pink bollworm in action, cotton cultivation becomes uncertain. With the two major bollworms back in form, cotton cultivation would become miserable again with every possibility of the return of the chemical juggernauts.

What next after Bt-cotton?

With bollworm resistance to Bt-cotton, will Indian cotton survive? What next after Bt-cotton? This is one question that many have been asking, but few have answers. With bollworm resistance to Bt-cotton surfacing as a reality, the common concerns are: How will we be able to control bollworms? How can we get good yields? How can we get good quality cotton? Are we heading back to the era of chemical farming which was so uncertain?

As of now there are no solutions that are robust enough to immediately replace Bt-cotton hybrids.

However with careful planning, effective strategies can be developed.

For the ensuing 2016 season, some simple solutions that the Bt-cotton seed industry may consider to escape pink bollworm infestation are as follows:

1. Avoid Bt-hybrids of more than 180 day duration
2. Recommend Bt-hybrids that are tolerant to leaf hoppers in Central and South India and to leaf curl virus in North India
3. Develop Bt-cotton hybrids with homozygous condition of the cry genes

These strategies work in a better manner if sowing is done in time and with strict avoidance of excessive use of chemicals such as urea, neonicotinoids and insecticides such as monocrotophos, especially during pre-flowering period which results in prolonged vegetative phase, delayed maturity and prolonged crop duration.

Hybrid cotton has its own advantages of hybrid vigour with more bolls per plant, big boll size, superior length and strength. Hybrid plants are designed to produce more number of bolls at about 80-150 bolls per plant which invariably make them run into a longer duration. Application of excessive urea and a few insecticides of the neonicotinoid and the organophosphate group would extend the crop duration and severely disrupt natural enemy complexes in ecosystems thereby making it easy for the bollworms to attack and prosper. Moreover, long duration cotton results in a long flowering and fruiting window. Because of the hybrid vigour of foliage the crop exhausts the available nutrients in the vegetative stage itself, with very less left for the critical flowering and fruiting phase. The long duration pushes the 'flowering and fruiting' window into moisture and nutrient stress in rainfed regions which results in low yields. Literature shows that 80% of moisture and nutrients are needed by cotton plants at the flowering and fruiting phase, with 60% of this requirement for flowering. Under irrigated conditions water and nutrients can be provided during the late window of flowering and fruiting. But, the pink bollworm becomes an issue for long duration cotton, because it is a late season pest. So far, the long duration hybrids survived the pink bollworm due to the presence of Bt. It will be difficult now because of the pink bollworm resistance to BG-II.

Short duration varieties escape the pink bollworm. If sown early, in Central and South India, short duration early maturing varieties complete the narrow flowering window in August itself, even before the American bollworm starts its first peak infestation in early September. Thus it is possible to escape both the major bollworms with short duration varieties or hybrids. But, with the low density of plants, short duration Bt-hybrids cannot give high yields and long duration hybrids come under pink bollworm attack. High density is not a viable option with hybrids because of high seed cost and also because of hybrid vigour which needs to be suppressed with chemicals.

Alternatively, a sustainable option is to rely on pure-line straight varieties. Though seemingly simple, a very robust solution is "Sucking pest tolerant, early maturing, compact varieties with good fibre quality short duration (<150 days) for rainfed and medium duration (<180 days) for irrigated".

Plant breeders may consider developing cotton varieties with the following attributes:

1. Short duration (140-150 days) cotton varieties for rainfed conditions
2. Medium duration (150-180 days) cotton varieties for irrigated conditions
3. Early maturing and synchronous flowering habit
4. Mandatory resistance/tolerance to leaf hoppers in Central and South India
5. Mandatory resistance/tolerance to leaf curl virus in North India

With just about the need for 8-10 bolls per plant in the high density planting systems, the attributes of big boll size, superior fibre quality, can be easily obtained with the pure line, short duration, early maturing varieties, which fit into high density planting. Why high density? Under high density of 1.1 to 2.5 lakh plants per hectare, high yields can be obtained with few bolls (8-10) per plant. This requires a narrow window of flowering and boll formation. Under rainfed conditions, the crop gets access to soil moisture and nutrients easily for the narrow window. With early sowing of early maturing short duration varieties, flowering of 8-10 flowers is completed by mid-August and the crop escapes American bollworm which start generally by end of August and peak in September and October. With short duration crop, harvest is completed before the end of November and pink bollworm appears after that time.

Strange as it may sound to many, Desi cotton will be the best bet as an alternative to Bt-cotton. All roads lead to home. Why then was the Desi cotton species Gossypium arboreum replaced completely with American cotton species Gossypium hirsutum? Because the Desi cotton bolls were small and the fibre was short, weak and coarse. The fibre was not suitable for machine spinning. The bolls of American cotton varieties were bigger and the fibre was relatively longer, stronger and finer. The fibre quality was suitable for machine spinning. The American cotton varieties responded to chemical fertilizers and were highly susceptible to insects and diseases.

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S. No	Name	Year	Institution	Duration days	Ginning percent	Fibre length (mm)	Bundle Strength	Mic value	Counts
1	G. Cot. Hy DH 9	1990	GAU, Surat	180-200	34	31	23	4.7	20
2	PHA 46	1996	MAU, Parbhani	180	34	29	22	5	40
3	Parbani Turab	2004	MAU, Parbhani	150-160	38.1	28	22	4.5	40s
4	DLSa 17	2009	UAS, Dharwad	145-150	38	27.5	22	4.5	30
5	PA 183 (Sawata)	1996	MAU, Parbhani	150-160	38.3	27	20.5	4.6	30
6	Pawan ADB 332	1981	ANGRAU	170	38	27	23	4.4	30
7	PA 402 (Vinayak)	2005	MAU, Parbhani	160-170	38.4	27	21.5	4.6	40
8	Rohini (NA 48)	1985	MAU, Nanded	175	38	26-27	46	4	30

Insecticides were essential for good yields. The American cotton hybrids respond more to fertilizers and need more pesticides for protection against a range of insect pests and diseases, because of the high levels of susceptibility. Of course, the American cotton varieties can also be tailored for sustainability, but Desi varieties provide the necessary resilience and robustness that are needed for long term sustainability of high yields with low production costs and least chemical inputs. Unfortunately, historically, there was very less effort on breeding good quality Desi varieties. Many of the varieties were of long duration bearing coarse fibre. It is only now that some excellent short duration varieties with outstanding fibre qualities have been developed. A combination of short staple and long staple short duration Desi varieties can certainly make a huge difference to cotton farming in the country.

India's future is in DESI cotton: The Desi cotton species Gossypium arboreum is resistant to drought, climate extremes, insects and diseases. It has the resilience to grow without chemical fertilizers and pesticides. The Desi Gossypium arboreum species has all the necessary answers for Indian cotton. We now have Desi varieties with long, medium and short staple fibres. Phule Dhanwantary is an excellent short staple short duration variety, which has been doing wonderfully well in Vidarbha for high yields under high density planting almost without any chemical inputs. Efforts are being made to develop long staple Desi varieties with architecture and duration similar to that of Phule Dhanwantary. Indian plant breeders have done a brilliant job in developing Desi varieties with excellent quality fibre as can be seen from the above table.

Additonally, there are four varieties developed by MAU Parbhani. PA 812, 785, PA 778 and PA 740 which have outstanding fibre qualities of 30-32 mm fibre length, 30 g/tex (HVI mode) with fine micronaire and other fibre attributes equivalent or better than the fibre of any best American cotton variety or hybrid developed in India thus far.

In my article "Long Live Swadesi Cotton" in CAI Cotton Statistics & News Vol. No. 20, August 2013, I had concluded that 'It is for sure that, if India has to move towards sustainable cotton cultivation, Desi cotton provides the answers not just for sustainability but for a vision towards India's global leadership that can happen through focused efforts and sound planning.' There were mixed responses, with most on them on the two extremes. However, last month I was pleasantly surprised when a senior colleague who in August 2013 had scoffed at the idea of Desi cotton returning back, called me to ask if 'at this point of time, can we explore the option of Desi cotton?'. He was worried at the crumbling of all the American cotton hybrids to the 'Cotton Leaf Curl Virus Disease' in many parts of North India in 2015. However much we may look at the possible sustainable alternatives after Bt-cotton, for high yields with low production cost and least chemical inputs, all roads seems to lead to Desi cotton varieties.

"All that is gold does not glitter,
Not all those who wander are lost;
The old that is strong does not wither,
Deep roots are not reached by the frost.

From the ashes a fire shall be woken,
A light from the shadows shall spring;
Renewed shall be blade that was broken,
The crownless again shall be king."

— J.R.R. Tolkien, The Fellowship of the Ring

It may be that I am obsessed with Desi cotton to the extent that, when I first read this beautiful poem, each line reminded me only of Desi cotton. The last line 'The crownless again shall be king' is the most apt for it. I firmly believe that the unheralded crownless 'Desi cotton' shall soon be the King to lead India towards durable economic profitability and ecological prosperity.

(The views expressed in this column are of the author and not that of Cotton Association of India)

Production & Stock of Spun Yarn (SSI & Non-SSI)

(In Mn. Kgs.)

MONTH / YEAR	PRODUCTION				STOCK			
	COTTON	BLENDED	100% N.C.	G. TOTAL	COTTON	BLENDED	100% N.C.	G. TOTAL
2007-08	2948.36	677.11	377.75	4003.22	104.81	43.57	20.59	168.97
2008-09	2896.15	654.89	360.95	3911.99	89.04	33.54	15.03	137.61
2009-10	3078.97	707.31	407.15	4193.43	85.56	25.68	11.41	122.65
2010-11	3489.77	796.47	426.38	4712.62	186.43	48.79	18.00	253.22
2011-12	3126.34	789.29	457.08	4372.72	110.87	42.20	20.44	173.51
2012-13	3582.68	828.19	456.75	4867.61	107.92	40.37	21.38	169.67
2013-14	3928.26	896.19	484.99	5309.45	133.80	51.33	23.40	208.53
2014-15 (P)	4054.51	920.20	512.92	5487.64	140.60	48.30	22.48	211.38
2015-16 (Apr-Jan) (P)	3450.06	806.08	464.67	4720.81	158.10	57.90	25.18	241.18
2013-14 (P)								
April-13	316.61	65.91	39.68	422.2	121.99	41.07	21.94	185.00
May-13	314.97	71.46	38.94	425.37	123.79	39.59	19.08	182.46
June-13	317.69	71.18	38.95	427.82	117.62	36.75	17.84	172.21
July-13	332.12	74.84	41.31	448.27	116.52	38.01	20.68	175.22
Aug.13	336.29	78.66	42.21	457.17	120.07	37.18	18.27	175.52
Sept.13	326.09	79.42	43.47	448.98	132.87	43.34	22.51	198.72
Oct.13	328.80	78.03	43.05	449.88	132.74	49.76	25.43	207.93
Nov.13	312.13	72.21	39.01	423.35	136.35	51.53	26.52	214.40
Dec.13	341.67	80.55	40.41	462.63	132.43	53.00	24.27	209.69
Jan.-14	340.38	77.71	39.33	457.41	117.38	51.11	23.60	192.09
Feb.-14	321.31	71.27	37.21	429.80	128.59	54.60	25.79	208.99
Mar.-14	340.20	74.95	41.42	456.57	133.80	51.33	23.40	208.53
2014-15 (P)								
April-14	328.68	73.84	41.41	443.93	142.80	50.06	21.20	214.06
May-14	332.92	74.77	42.71	450.40	139.60	46.20	20.80	206.61
June-14	330.69	74.03	42.95	447.67	151.05	47.99	22.56	221.60
July-14	340.00	78.51	44.85	463.36	160.20	51.30	24.18	235.67
Aug.-14	338.09	76.66	44.23	458.98	166.64	53.21	24.87	244.72
Sept-14	334.03	77.91	42.55	454.49	167.53	51.73	24.02	243.28
Oct.14	323.53	74.51	40.96	439.00	178.62	56.85	25.89	261.36
Nov.14	335.66	71.42	41.50	448.58	171.13	55.01	25.21	251.36
Dec.14	353.96	76.54	42.01	472.51	160.58	56.06	26.47	243.11
Jan.-15	349.83	80.16	43.25	473.23	161.61	55.80	24.17	241.57
Feb.-15	330.35	81.26	41.88	453.49	149.92	50.83	22.47	223.22
Mar.-15	356.79	80.59	44.62	481.99	140.60	48.30	22.48	211.38
2015-16 (P)								
April-15	351.32	77.11	44.07	472.5	140.82	50.55	21.07	212.43
May-15	348.14	80.02	44.74	472.9	153.07	52.34	23.79	229.21
Jun-15	346.72	79.68	45.27	471.67	158.57	55.72	23.93	238.22
Jul-15	356.36	82.15	47.48	485.99	160.33	61.25	26.62	248.20
Aug-15	354.67	82.24	49.97	486.88	166.34	63.73	27.88	257.95
Sept.-15	338.53	79.51	45.41	463.45	165.96	62.33	26.16	254.46
Oct.-15	340.57	83.43	47.28	471.28	169.03	63.61	25.55	258.19
Nov.-15	319.58	78.01	43.29	440.88	174.07	61.73	24.17	259.97
Dec.-15	350.76	81.15	49.95	481.86	159.81	58.33	25.23	243.37
Jan.-16	343.41	82.78	47.21	473.40	158.10	57.90	25.18	241.18

P - Provisional

Source : Office of the Textile Commissioner

The Social, Environmental and Economic Performance of Cotton

This article is based on the report 'Measuring Sustainability in Cotton Farming Systems: Towards a Guidance Framework' published by the ICAC's Expert Panel on Social, Environmental and Economic Performance of Cotton

(Contd. From Issue No.52 dtd. 29th March 2016)

Methodology for Rating

According to the SEEP, the indicators are designed to serve the purpose of monitoring or impact assessment. The priority for monitoring indicators is the feasibility issue, i.e., cost, accessibility and accuracy. The development process for impact assessment indicators will emphasize the relevance of the indicators to the broader (sustainability) outcomes sought by key stakeholders in the process and their usefulness (comparability, significance and conceptual logic) as tools for detecting a causal relationship between a series of interventions and the desired outcomes. While monitoring indicators are usually more assessable and data collection less expensive, it is impact indicators that provide evidence that sustainability goals have been achieved. A comprehensive and feasible sustainability assessment framework should include a mix of monitoring and impact indicators. Three criteria -- relevance, feasibility and usefulness -- were used to score and rank indicators in the Cotton Report.

ICAC

Sustainability Indicators for Cotton

No. Indicator

ENVIRONMENTAL INDICATORS

1. Pest and Pesticide Management

1.1 Quantity of active ingredients of pesticides used (Kg/ha)
1.2 Quantity of active ingredients of highly hazardous pesticides used (Kg/ha)
1.3 Number of pesticide applications per season
1.4 % of treatments that involve specific measures to minimize non target application and damage
1.5 Existence of a time-bound IPM plan
1.6 % area under IPM
1.7 % of farmers that use only pesticides that are nationally registered for use on cotton
1.8 % of farmers that use pesticides labeled according to national standards, in at least one national language
1.9 % of farmers that use proper disposal methods for pesticide containers and contaminated materials including discarded pesticide application equipment
1.10 % of farmers following recommended practices for pesticide mixing, application and cleaning of application equipment
1.11 % of farmers with dedicated storage facilities that keep pesticides safely and out of reach by children
1.12 Total number and % of cotton area involving vulnerable persons applying pesticides
1.13 % of workers applying pesticides that have received training in handling and use
1.14 % of farmers having access to and using adequate protective equipment (by type)

2. Water Management

2.1 Quantity of water used for irrigation (m3/ha)
2.1 Irrigation use efficiency (%)
2.3 Crop Water Use Productivity (m3 of water per ton of cotton lint)
2.4 % of area under water conservation practices
2.5 Groundwater table level (m from the surface)
2.6 Salinity of soil and irrigation water (deciSiemens (dS) per meter, EC)
2.7 Quality of discharge water (various)

3. Soil Management

3.1 Soil characteristics: organic matter content, pH, N, P and K
3.2 Use of soil sampling for N, P and K (% of farmers)
3.3 Fertilizer used by type (Kg/ha)
3.4 % of area under soil erosion control and minimum/conservation tillage practices

4. Land Use and Biodiversity

4.1 Average yield (ton of cotton lint/ha)
4.2 Total area (ha) and % of natural vegetation converted for cotton production (in ha)

4.3 % of total farm area that is non-cropped
4.4 Average number of cotton and other crops per 5-year period

5. Climate Change

5.1 Greenhouse Gas emissions and carbon sequestration per metric tons of cotton lint and/or ha (in CO2-equivalent)
5.2 On-farm energy use per metric ton of cotton lint and/or ha (GJ-gigajoule)

ECONOMIC INDICATORS

6. Economic Viability, Poverty Reduction and Food Security

6.1 Average annual net income from cotton production
6.2 Price received per ton of cotton lint at farm gate
6.3 Returns above variable costs per hectare and ton of cotton lint
6.4 Return on investment
6.5 Debt to asset ratio
6.6 Number and % of household members living below the national poverty line
6.7 % of farmers/workers with access to productive resources
6.8 Average value of assets per producer household
6.9 % of producing households with a specific asset
6.10 Perception of change in economic situation over last five years (% of farmers)
6.11 Total number and % of cotton farming household members with kilojoule intake below the international norm
6.12 Number of days with food deficiency per annum in cotton producing households

7. Economic Risk Management

7.1 Cotton yield volatility
7.2 Farm gate cotton price volatility
7.3 % of farmers with measures in place to manage price risks by type
7.4 % of total household income that the largest income source represents
7.5 Average number of days after sale that farmers receive payment
7.6 % of farmers with access to equitable credit
7.7 % of farmers showing understanding of the factors involved in price formation or have daily access to international and domestic prices

SOCIAL INDICATORS

8. Labor Rights and Standards

8.1 % of children attending and completing appropriate level of school (by gender)
8.2 % of farmers/workers with effective access to health care facilities
8.3 % of farmers/workers with access to potable water
8.4 % of farmers/workers with access to sanitation facilities
8.5 Number of child laborers (by age and gender)
8.6 % of workers with an enforceable employment contract (by age and gender)
8.7 % of workers who are paid a minimum or living wage and who always receive their full wage in time (by age and gender)
8.8 Total number and % of workers being subordinated by forced labor
8.9 % of active cotton farmers and workers contributing to a pension scheme and / or eligible to receive a pension
8.10 % of cotton farming households benefitting from income support in case of officially recognized extreme income shocks
8.11 % of employed women that have the right to maternity leave and receive payments

9. Worker Health and Safety

9.1 Annual nonfatal incidences on cotton farms (total, % of workforce by age, gender)
9.2 Total number of fatalities on cotton farms per year

10. Equity and Gender

10.1 % of leadership roles held by women in a producers' or workers' group
10.2 Gender and age wage differentials for the same quantity of produce or same type of work
10.3 % of women whose income from independent sources has increased/ decreased

11. Farmers' Organization

11.1 Numbers of farmers, workers who have attended training (by training type, age and sex)
11.2 Number of farmers and workers participating in democratic organizations (by age, gender)

Relevance refers to the meaningfulness of the indicator to the broader community of stakeholders. The usefulness aspect refers to comparability across regions and production systems, significance and conceptual logic based on the activity and the outcome measured. Feasibility refers to the practicality of collecting data, which will depend on cost, access to data and accuracy of the data collected.

Table 8: Example of Scoring Matrix of Indicators

Sustainability indicator	Indicator score							Selection Criteria			Indicator Selected?
	Relevance	Usefulness			Feasibility			Total Scores	Balance	Expert ex- /Inclusion	
	Cotton	Comparability	Significance	Logic	Cost	Accessibility	Accuracy				
1.Insectidie a.i.	2	2	3	3	2	2	2	16	0.38		YES
2.											
3.˙											
4.											
5											

Scoring/rating is based on seven variables – relevance to cotton, comparability, significance, conceptual logic, cost, accessibility and accuracy. A scale of 1 to 3 was used, in which a 1 for relevance would indicate low relevance and a 1 for cost would mean high cost. The maximum possible score is 21 and this particular indicator scored 16 (table 8). The balance figure of 0.38 is the standard deviation so that extreme values do NOT affect the average and lead to incorrect decisions. The standard deviation among the three scoring dimensions (relevance, usefulness and feasibility) has to be lower than 0.59. Based on the scoring and standard deviation values, the indicator can be selected or rejected.

Acknowledgement

The SEEP report 'Measuring Sustainability in Cotton Farming Systems: Towards a Guidance Framework' is a joint report endorsed by all members of the Expert Panel. The ICAC appreciates the individual contributions of all members of the SEEP, and collectively acknowledges the support of member governments, as well as the Food and Agriculture Organization of the United Nations and CIRAD (French Agricultural Research Centre for International Development). Support from all private and public sector organizations that provided information/data and participated in the preparation of the report is very highly appreciated.

Source: The ICAC Recorder
Vol. XXXIII No.3 – September 2015.

World Cotton Prices

Monthly Average Cotlook A Index (FE) from 2011-12 onwards
(Cotlook Index in US Cents per lb.)

	2011-12	2012-13	2013-14	2014-15	2015-16
August	114.10	84.40	92.71	74.00	71.82
September	116.86	84.15	90.09	73.38	68.74
October	110.61	82.00	89.35	70.34	69.03
November	104.68	80.87	84.65	67.53	69.22
December	95.45	83.37	87.49	68.30	70.39
January	101.11	85.51	90.96	67.35	68.75
February	100.75	89.71	94.05	69.84	
March	99.50	94.45	96.95	69.35	
April	99.94	92.68	94.20	71.70	
May	88.53	92.70	92.71	72.89	
June	82.18	93.08	90.90	72.35	
July	83.97	92.62	83.84	72.35	

Source: Cotton Outlook

UPCOUNTRY SPOT RATES

(₹\Quintal)

March 2016

2015-16 Crop

Growth	P/H/R	P/H/R	GUJ	KAR	M/M	P/H/R	M/M/A	M/M/A	P/H/R	M/M/A	M/M/A	P/H/R	M/M/A	GUJ	M/M/A/K	GUJ	M/M/A/K	M/M/A/K/T/O	A/K/T/O	M(P)/K/T
G. Standard	ICS-101	ICS-201	ICS-102	ICS-103	ICS-104	ICS-202	ICS-105	ICS-105	ICS-105	ICS-105	ICS-105	ICS-105	ICS-105	ICS-105	ICS-105	ICS-105	ICS-105	ICS-105	ICS-106	ICS-107
Grade	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine
Staple	22 mm	22 mm	22 mm	23 mm	24 mm	26 mm	26 mm	26 mm	27 mm	27 mm	27 mm	28 mm	28 mm	28 mm	29 mm	29 mm	30 mm	31 mm	32 mm	34 mm
Micronaire	5.0-7.0	5.0-7.0	4.0-6.0	4.0-5.5	4.0-5.5	3.5-4.9	3.0-3.4	3.5-4.9	3.5-4.9	3.0-3.4	3.5-4.9	3.5-4.9	3.5-4.9	3.5-4.9	3.5-4.9	3.5-4.9	3.5-4.9	3.5-4.9	3.5-4.9	3.0-3.8
Strength/GPT	15	15	20	21	23	26	25	25	26	26	26	27	27	27	28	28	29	30	31	33
1	8380	8520	5849	7311	8408	9139	8352	8661	9420	8520	8858	9533	8998	9083	9195	9336	9420	9701	10264	13779
2	8323	8464	5765	7227	8380	9083	8323	8633	9364	8492	8830	9476	8970	9055	9167	9308	9392	9673	10236	13694
3	8295	8436	5708	7171	8352	9055	8295	8605	9336	8464	8802	9448	8942	9026	9139	9280	9364	9645	10179	13638
4	8267	8408	5708	7171	8323	9026	8267	8577	9308	8436	8773	9420	8914	8998	9111	9251	9336	9617	10151	13610
5	8267	8408	5708	7171	8323	9026	8267	8577	9308	8436	8773	9420	8914	8998	9111	9251	9336	9617	10151	13610
7		...		...			...		HOLIDAY				...			...		...		
8	8127	8267	5680	7171	8323	9026	8239	8577	9308	8408	8773	9420	8914	8998	9139	9280	9364	9673	10151	13610
9	8127	8267	5624	7171	8323	9026	8239	8577	9308	8408	8773	9420	8914	8970	9139	9251	9364	9673	10151	13610
10	8239	8380	5624	7171	8323	9055	8099	8520	9336	8267	8717	9448	8914	8970	9139	9251	9364	9673	10151	13610
11	8239	8380	5568	7114	8267	9026	8042	8520	9308	8211	8717	9420	8858	8970	9083	9251	9336	9673	10151	13610
12	8239	8380	5568	7114	8267	9026	8042	8520	9308	8211	8717	9420	8858	8970	9083	9251	9336	9673	10151	13610
14	8183	8323	5568	7114	8267	8998	8042	8436	9280	8211	8661	9392	8858	8942	9083	9223	9336	9673	10151	13610
15	8183	8323	5568	7114	8267	8970	8042	8436	9251	8211	8661	9364	8858	8942	9083	9223	9336	9673	10151	13610
16	8183	8323	5455	7058	8211	8914	7986	8380	9195	8155	8605	9308	8802	8886	9055	9167	9308	9645	10123	13610
17	8155	8295	5371	7002	8155	8886	7902	8295	9167	8070	8520	9280	8773	8858	9026	9111	9308	9645	10123	13582
18	8155	8295	5315	7002	8155	8886	7902	8295	9167	8070	8520	9280	8773	8858	9026	9111	9336	9645	10123	13582
19	8155	8295	5315	7002	8155	8858	7902	8295	9139	8070	8520	9251	8773	8858	9026	9111	9336	9589	10067	13582
21	8155	8295	5315	7002	8155	8830	7845	8239	9111	8042	8492	9223	8773	8858	8998	9055	9280	9561	10067	13582
22	8155	8295	5315	7002	8155	8886	7789	8211	9167	8042	8492	9280	8773	8858	8998	9055	9280	9561	10067	13582
23	8211	8352	5315	7002	8155	8914	7761	8183	9195	8014	8464	9308	8745	8830	8970	9026	9251	9533	10039	13582
24		...		...		...			HOLIDAY				...			...		...		
25	8183	8323	5343	7030	8183	8886	7761	8211	9167	8014	8492	9280	8773	8858	8998	9055	9251	9533	10039	13582
26	8183	8323	5343	7030	8183	8914	7761	8239	9195	8014	8520	9308	8802	8886	9026	9083	9251	9533	10039	13582
28	8183	8323	5343	7030	8211	8970	7789	8267	9251	8042	8577	9364	8858	8942	9083	9139	9308	9589	10039	13582
29	8183	8323	5343	7030	8211	8970	7789	8323	9251	8042	8633	9364	8914	8998	9139	9195	9336	9617	10067	13582
30	8183	8323	5343	7030	8211	8970	7789	8323	9251	8042	8633	9364	8942	9026	9167	9223	9336	9617	10067	13582
31	8183	8323	5343	7030	8211	8970	7789	8323	9251	8042	8633	9364	8942	9026	9167	9223	9336	9617	10067	13582
H	**8380**	**8520**	**5849**	**7311**	**8408**	**9139**	**8352**	**8661**	**9420**	**8520**	**8858**	**9533**	**8998**	**9083**	**9195**	**9336**	**9420**	**9701**	**10264**	**13779**
L	**8127**	**8267**	**5315**	**7002**	**8155**	**8830**	**7761**	**8183**	**9111**	**8014**	**8464**	**9223**	**8745**	**8830**	**8970**	**9026**	**9251**	**9533**	**10039**	**13582**
A	**8205**	**8346**	**5496**	**7091**	**8247**	**8972**	**8001**	**8409**	**9254**	**8197**	**8646**	**9366**	**8862**	**8947**	**9086**	**9188**	**9328**	**9626**	**10119**	**13608**

H = Highest   L = Lowest   A = Average

UPCOUNTRY SPOT RATES

(Rs./Qtl)

Standard Descriptions with Basic Grade & Staple in Millimetres based on Upper Half Mean Length [By law 66 (A) (a) (4)]							Spot Rate (Upcountry) 2015-16 Crop MARCH - APRIL 2016					
Sr. No.	Growth	Grade Standard	Grade	Staple	Micronaire	Strength /GPT	28th	29th	30th	31st	1st	2nd
1	P/H/R	ICS-101	Fine	Below 22mm	5.0-7.0	15	8183 (29100)	8183 (29100)	8183 (29100)	8183 (29100)	8183 (29100)	8183 (29100)
2	P/H/R	ICS-201	Fine	Below 22mm	5.0-7.0	15	8323 (29600)	8323 (29600)	8323 (29600)	8323 (29600)	8323 (29600)	8323 (29600)
3	GUJ	ICS-102	Fine	22mm	4.0-6.0	20	5343 (19000)	5343 (19000)	5343 (19000)	5343 (19000)	5287 (18800)	5287 (18800)
4	KAR	ICS-103	Fine	23mm	4.0-5.5	21	7030 (25000)	7030 (25000)	7030 (25000)	7030 (25000)	6974 (24800)	6974 (24800)
5	M/M	ICS-104	Fine	24mm	4.0-5.0	23	8211 (29200)	8211 (29200)	8211 (29200)	8211 (29200)	8211 (29200)	8211 (29200)
6	P/H/R	ICS-202	Fine	26mm	3.5-4.9	26	8970 (31900)	8970 (31900)	8970 (31900)	8970 (31900)	8970 (31900)	8970 (31900)
7	M/M/A	ICS-105	Fine	26mm	3.0-3.4	25	7789 (27700)	7789 (27700)	7789 (27700)	7789 (27700)	7733 (27500)	7733 (27500)
8	M/M/A	ICS-105	Fine	26mm	3.5-4.9	25	8267 (29400)	8323 (29600)	8323 (29600)	8323 (29600)	8323 (29600)	8352 (29700)
9	P/H/R	ICS-105	Fine	27mm	3.5.4.9	26	9251 (32900)	9251 (32900)	9251 (32900)	9251 (32900)	9251 (32900)	9251 (32900)
10	M/M/A	ICS-105	Fine	27mm	3.0-3.4	26	8042 (28600)	8042 (28600)	8042 (28600)	8042 (28600)	8042 (28600)	8042 (28600)
11	M/M/A	ICS-105	Fine	27mm	3.5-4.9	26	8577 (30500)	8633 (30700)	8633 (30700)	8633 (30700)	8633 (30700)	8661 (30800)
12	P/H/R	ICS-105	Fine	28mm	3.5-4.9	27	9364 (33300)	9364 (33300)	9364 (33300)	9364 (33300)	9364 (33300)	9364 (33300)
13	M/M/A	ICS-105	Fine	28mm	3.5-4.9	27	8858 (31500)	8914 (31700)	8942 (31800)	8942 (31800)	8942 (31800)	8998 (32000)
14	GUJ	ICS-105	Fine	28mm	3.5-4.9	27	8942 (31800)	8998 (32000)	9026 (32100)	9026 (32100)	9026 (32100)	9083 (32300)
15	M/M/A/K	ICS-105	Fine	29mm	3.5-4.9	28	9083 (32300)	9139 (32500)	9167 (32600)	9167 (32600)	9167 (32600)	9223 (32800)
16	GUJ	ICS-105	Fine	29mm	3.5-4.9	28	9139 (32500)	9195 (32700)	9223 (32800)	9223 (32800)	9223 (32800)	9280 (33000)
17	M/M/A/K	ICS-105	Fine	30mm	3.5-4.9	29	9308 (33100)	9336 (33200)	9336 (33200)	9336 (33200)	9336 (33200)	9392 (33400)
18	M/M/A/K/T/O	ICS-105	Fine	31mm	3.5-4.9	30	9589 (34100)	9617 (34200)	9617 (34200)	9617 (34200)	9617 (34200)	9673 (34400)
19	A/K/T/O	ICS-106	Fine	32mm	3.5-4.9	31	10039 (35700)	10067 (35800)	10067 (35800)	10067 (35800)	10067 (35800)	10123 (36000)
20	M(P)/K/T	ICS-107	Fine	34mm	3.0-3.8	33	13582 (48300)	13582 (48300)	13582 (48300)	13582 (48300)	13582 (48300)	13582 (48300)

(Note: Figures in bracket indicate prices in Rs./Candy)